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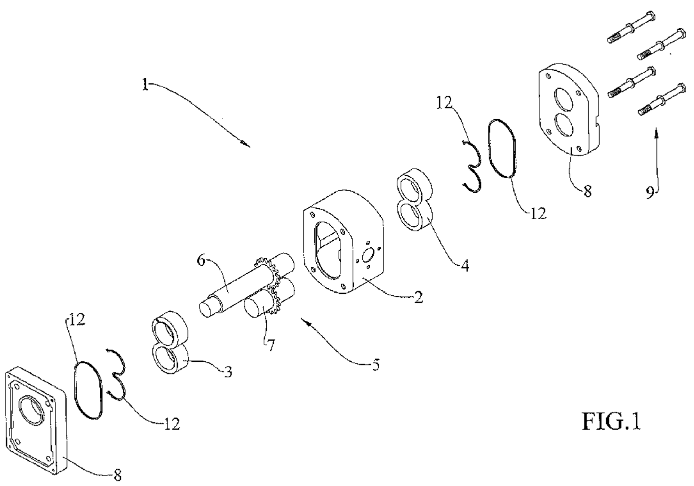

FIG.1

(57) Abstract: There is disclosed a working process for obtaining the pack clearance in hydraulic rotary volumetric machines (1, 20) including means (5, 16-17) to transmit the hydraulic fluid from an inlet mouth (10) to an outlet mouth (11) housed between two side sealing elements (3-4, 18-19) in a body (2, 15) closed by at least one lid (8). Said process includes the steps of semi-finishing the side sealing elements (3-4, 18-19) and the body (2, 15) with a machining allowance on the height values of the body (2, 15) and of the side sealing elements (3-4, 18-19), of obtaining a service thickness (14) with a height corresponding at least to the pack clearance of the design to be implemented, of obtaining a preassembled unit (13) including the body (2, 15), the thickness (14) and the two side sealing elements (3-4, 18-19), of finishing the external surfaces of the preassembled unit (13) to obtain the design pack clearance with a minimum tolerance, and finally of functionally assembling with the use of means (5, 16-17) to transmit a hydraulic fluid and eliminating the thickness.

WO 2009/019185 A1

"A working process for obtaining a pack clearance in pumps and hydraulic rotary volumetric motors".

* * * *

The present invention relates to a working process for obtaining a pack clearance in pumps and hydraulic rotary volumetric motors.

Such pumps and motors use rotary pumping elements (for pumps) or actuator elements (for motors) to transmit the hydraulic fluid and produce a flow by converting mechanical energy to fluid pressure energy (for pumps) or vice versa (for motors).

The hydraulic energy produced by the pumps is used to operate, for instance, actuators driven by control systems, for the most varied uses.

A pump is, for instance, the capacity source of the circuit, whereas the pressure is generated only with a resistance to be counteracted. If, for instance, the resistance is represented by a load on a piston, a pressure only sufficient to operate the load will be generated.

The volumetric machine with fluid transmission elements consisting of "External gears" is disclosed hereinafter as it is the most widespread, although the conclusions may be extended also to volumetric machines with "Internal gears", "Gerotor", "Orbital", "Lobe" and "Blade" machines.

An external gear pump generally consists of

- a fluid inlet opening (suction), to which the feeding line from the tank is connected
- an outlet opening (delivery) which is placed in communication with the pressure line
- a pumping chamber which is the volume in which the fluid is isolated when passing from suction to delivery (between the spaces of the teeth, body and side elements without connections with suction or delivery)
- a body made of ferrous material (e.g. cast iron) or non-ferrous material (e.g. aluminium)

- a front lid (e.g. aluminium or cast iron)
- bushings (e.g. aluminium or bronze)
- a back lid (e.g. aluminium or cast iron)
- driving and driven gears (e.g. steel)
- body-lid gaskets (e.g. rubber or special plastic materials).

A motor mainly has the purpose to provide mechanical energy to operate a load, by converting fluid pressure energy generated by the pump. An external gear motor has a structure similar to the pump and differs because of the inner drainage as it is built to operate in both rotation directions; as opposed to the pump, the suction mouth receives fluid from the pressure line and the delivery mouth results at a lower pressure and is connected to the tank.

The bushings are also referred to as glasses due to the typical number 8 shape and may also be divided into two halves so as to become two half-glasses.

The main function is the mechanical sealing of the pressurised liquids on the contact surface with the side of the gear or on the opposite contact surface with the lid or with the blind bottom of the pump body, whereby they will be referred to as “side sealing elements” with general reference to such elements for all of the rotary volumetric hydraulic machines.

The bushings may also be supporting elements for the shanks of the gears and have a boring that becomes the seat of a plain bearing to reduce mechanical frictions and improve performance and life.

More frequently for pumps/motors with a cast iron body, the seat of the plain bearings is obtained on the closing lids or on the blind bottom of the pump body and in this case the bearings are thinner as they do not serve the function of supporting the shafts of the gears.

The success of external gear pumps and motors is due to a set of features such as considerable lightness, simple mechanics, adaptability to any position in narrow compartments, tolerability to the viscosity variations, very good suction, wide range of available flow rates and last but certainly not least, the cost that qualifies these hydraulic machines as among the most cost-effective machines available on the market.

The high demand for these hydraulic generators has spurred manufacturers to a continuous research of desirable implementations with special materials, accurate thermal treatments, minimum coupling tolerances and super-finishing of the surfaces with the purpose of achieving pressures which are increasingly higher (e.g. up to 300 bars), reducing noise, and improving performance.

From this perspective, the optimal embodiment of a feature referred to as “axial clearance of the pack” or “pack clearance” disclosed hereinafter has gained increasingly greater importance.

“Pack” refers to the components inserted within the body (fluid transmission elements and side sealing elements) coupled together and to the corresponding overall height, and “axial clearance of the pack ” indicates the difference between this height of the “pack” and that of the body containing it.

In practice, such a measure represents the space available for the pack components to float within the body.

The smaller this component clearance is within the body, the less will leakages be, the space being reduced for the seepings themselves.

The hydraulic machines may have a fixed or balanced axial clearance.

In the case of “fixed axial clearance” the side sealing elements (bushings), if present, do not serve a balancing function and the design value of the clearance is minimum and limited to a few hundredths of a millimetre, which may not be further reduced without the risk of seizures, both for the component machining tolerances and because deformations induced on the components by pressure must be in any case allowed.

In the case of “balanced or compensated axial clearance of the pack” the delivery pressure is sent through inner channels behind the bushings and acts on surfaces appropriately delimited by the gaskets (so-called balancing gaskets) housed in seats obtained on the bushings themselves or on the lids.

This system generates forces which draw the bushings together at the sides of the toothed wheels, eliminating the clearance and therefore the seepings in the coupling between the bushing-gear side surfaces, even without inhibiting the presence of a lubricating film that increases the resistance to wear and therefore life.

The axial clearance in this case may have values which are a little higher than the fixed clearance, for instance about one tenth of a millimetre, to avoid that the thrust on the gasket "packs" with excessive frictions the toothed wheels and causes problems with the start-up.

In more recent years, performance has continued to be carried to excess both on pumps and on hydraulic motors with increasingly high pressures and sudden variations of loads.

From here the need to ever increasingly restrain the "axial clearance of the pack" within limited tolerance values (a few hundredths of a millimetre) and near the minimum required for the correct operation of the gasket with the balancing backpressure.

Most of the more widespread industrial applications may refer to two configurations: with a (through) perforated body and with a blind body. In both cases the value G of the "axial clearance of the pack" is determined by the difference between the measure of the height of the body and the sum of the thicknesses of the inner elements (bushings and gears).

As previously defined, the value of the height of the perforated body or depth of the blind body will have to be greater than the value corresponding to the sum of the heights of the components mounted inside the body having a clearance value G and, the more this clearance is near to the set theoretical value, the better the performance of the pump will be, with the most restrained tolerance possible.

The components of the "pack" (body, gears, bushings) are nowadays made by procedures (e.g. machining and grinding centres for the gear shoulders) which induce a variability of the value of the “clearance” which may not be tolerated for a high percentage of applications that nowadays require high performances.

Even by using final "super-finishings" on the single components, such as the grinding/lapping of the opposite surfaces on the body and on the bushings, as well as having higher costs, a quality which is still not optimal would be obtained in relation to the reciprocal geometries of the components (perpendicularity and parallelisms) which are not corrected by the grinding/lapping.

It is the object of the present invention to provide a working process to obtain pumps and hydraulic motors allowing to better restrain the “axial clearance of the pack” with respect to the known processes within restricted values of tolerance near the design value.

In accordance with the invention, such an object is achieved by a working procedure for obtaining the pack clearance in hydraulic rotary volumetric machines including means for the transmission of hydraulic fluid from an inlet mouth to an outlet mouth housed between two side sealing elements in a body closed by at least one lid, characterized in that it includes the steps of:

- semi-finishing the side sealing elements and the body, with machining allowance on the values of height of the body and of the side sealing elements,
- obtaining a service thickness with a height corresponding at least to the value of the pack clearance of the design to be implemented,
- obtaining a preassembled unit including the body, the thickness and the two side sealing elements,
- finishing the external surfaces of the preassembled unit to obtain the design pack clearance with a minimum tolerance,
- functionally assembling with the use of means for the transmission of

hydraulic fluid and eliminating the service thickness.

Advantageously, the above disclosed process may provide a preassembled unit with a service thickness with a height corresponding to that of the hydraulic fluid transmission means plus the value of the pack clearance of the design to be implemented. In this case the functional assembly will provide for the replacement of the service thickness with the fluid transmission means.

Again advantageously, the process may provide for a service thickness having a height equivalent to the value of the pack clearance of the design to be implemented, the fluid transmission means being present in the preassembled unit. The functional assembly will simply consist in the removal of the service thickness.

These and other features of the present invention will become more apparent from the following detailed description of a practical embodiment thereof, shown by no way of limitation in the accompanying drawings, in which:

Figure 1 shows an exploded perspective view of a gear pump with a perforated body according to the present invention;

Figure 2 shows a cross-sectional view of the assembled pump during operation;

Figure 3 shows a diagrammatic vertical section view of the preassembled pump;

Figure 4 shows a diagrammatic sectional view similar to that in Figure 3 of the assembled pump;

Figure 5 shows a diagrammatic vertical section view of a preassembled pump with a blind body;

Figure 6 shows a diagrammatic sectional view similar to that in Figure 5 of the assembled pump with a blind body;

Figure 7 shows a front view of a gerotor according to the present invention;

Figure 8 shows a front view of a first side sealing disc of the gerotor;

Figure 9 shows a front view of a second side sealing disc of the gerotor.

An external gear hydraulic pump 1 includes a body 2, in which bushings or glasses 3-4 while supporting gears 5 (driving shaft 6 and driven shaft 7) are housed (figure 1).

Lids 8 close the pump by means of fastening screws 9.

The pump 1 further includes a fluid inlet or suction mouth 10 and a fluid outlet or delivery mouth 11 (Figure 2).

Gaskets 12 with seats obtained on the bodies, on the bushings or at the same level on the lids (the oval ones being external to the bushings) complete the pump 1 (the so-called balancing gaskets on the bushings may or may not be provided with an anti-extruder housed in a profiling in the section of the gaskets themselves).

The working process according to the present invention, disclosed hereinafter, employs a machining among the oldest and best known grinding/lapping ones, although it is characterised by the process itself of machining the preassembled details in relation to the feature of axial clearance of the pack to be obtained.

This grinding/lapping occurs, for instance, by means of parallel surfaces and with the supply of abrasive material which provides for the removal of material from the piece (lapping) or with proper flat and parallel grinding wheels which form the removal tool (grinding), although with similar results for the purposes of the process set forth.

The grinding/lapping allows to obtain particularly precise surfaces as far as planarity, roughness and reciprocal parallelism are concerned, by using for instance the so-called (horizontal or vertical) parallel surface machines or one or two single-surface grinding/lapping machines with sequential finishing of the two surfaces, or machines in which the pieces pass under a single grinding wheel which is appropriately profiled and angled for obtaining a flat surface parallel to the opposite surface, or machines in which the pieces pass under two opposed and independent grinding wheels which are appropriately profiled and angled for obtaining flat and parallel surfaces or similar grinding machines which have been developed in the course of time.

An appropriate machining allowance (e.g. about 0.2 mm) should be left on the height values of the body 2 and of the bushings 3-4 and an additional final grinding/lapping of the preassembled components (preassembled unit 13) is suggested.

In both cases, whether the body 2 is perforated or blind (respectively Figures 3-4 and 5-6), a thickness 14 is obtained, the height of which will have a value corresponding to that of the toothed band of the gears 5 (it replaces in this step, see Figures 3 and 5), i.e. calibrated on the average value of the tolerance allowed by the machining process of the gears themselves 5, plus the value of the axial clearance of the design pack to be implemented.

The thickness 14 will be obtained with particular precision as far as height and parallelism of the opposite faces are concerned and may be in a single piece, or in two half-thicknesses machined from a bar etc.

Such a thickness 14, used as machining tool for grinding/lapping, will be inserted with the bushings 3-4 within the body 2.

The external surfaces of the body 2 and of the bushings 3-4, which are preassembled, will therefore be grinded/lapped.

The process is based on the observation that the axial clearance of the pack thus obtained, as it is a difference in heights, will no longer be modified as the grinding/lapping leads the heights of the body 2 and of the pack formed by the bushings 3-4 plus the thickness 14 to be equivalent.

Indeed, if G is the “pack clearance”, X and Z are the heights of the bushings 3-4, and Y is the height of the thickness 14:

$G = W - (X + Y + Z)$ where the height W of the body 2 is the minuend and the height $(X + Y + Z)$ of the pack is the subtrahend.

If the minuend and the subtrahend vary by the same amount, the result of the subtraction does not vary.

It should be noted that the feasibility of this final operation of grinding/lapping the preassembled components results much simpler with respect to the same operation carried out on the single components, as it is not required to comply with the limited tolerance on the overall height of the body 2 and of the pack, whereas it must be complied with when machining the single components.

It should be considered that the grinding/lapping does not correct the geometries of the machined surfaces in relation to the non-machined surfaces.

Because of the above mentioned limit of the grinding/lapping, the only important constraint that remains unaltered in the comparison between the suggested process and the current processes is to take particular care with the bushings 3-4 for the geometry of the perpendicularity between the gear side and the peripheral external surface of the bushings 3-4 themselves, which will have to coincide with the corresponding geometries on the gears 5 (which remain unaltered as they are not processed again by the suggested machining) in order to guarantee the sealing of the seepings of oil from the high pressure area to the lower pressure area.

The especially restrictive constraints featured by the processes, which are to date most widely used in the industry, are considerably reduced, the constraints being related to the geometries of the body 2 (roughness, planarity, surface parallelism and perpendicularity to the perforation axis) and to the similar geometries of the glasses 3-4 only on the side of the gasket, as well as to the height of the components.

Hereinafter, some application details of the process will be disclosed in relation to the preferred embodiments, nowadays recurring in industrial applications, i.e. to provide the balancing gasket 12 seat on the lids 8 (an optimal alternative for the process set forth) and also vice versa to provide it on the bushings 3-4 (a less appropriate alternative).

a) Balancing gasket 12 on the lids. If the body 2 is perforated (figures 3-4), the bushings 3-4 are, for instance, inserted within the body 2 as in the functional assembly, i.e. with the gasket sides facing outwards and with a thickness 14 calibrated at the centre and a super-finishing is carried out with grinding/lapping the external sides of the preassembled units.

If the body 2 is blind (figures 5-6), the process is similar except for the bushing 4, placed on the blind bottom which, not involved in the super-finishing, will have the possible balancing gasket seat and precisions similar to those that may be obtained with the current processes as far as the parallelism and perpendicularity geometries of the surfaces are concerned, even allowing a lower precision on the height value.

b) Gasket 12 on the bushings 3-4. The application of the suggested process may also occur with the constructive variant that provides for the balancing gasket seat on the bushings 3-4, even though it results being the less advantageous solution. Indeed, the presence of the gasket seat on these sealing elements limits the machining if carried out on this side to the depth of the groove itself and to the geometries of the previous precise and critical machinings such as in current processes. It will be in any case possible to carry out the process in this manner, leaving small machining allowances to be removed by grinding/lapping and therefore reducing to minimum the errors caused on the depth of the gasket groove. If the super-finishing by grinding/lapping is carried out on the opposite side (gear side) with inverted bushings, the advantage will be maintained of being freed from the constriction of the precision on the height of the body 2 components and of the bushings 3-4, although the geometries of parallelism and perpendicularity of both will have to be maintained, the latter not being corrected by the grinding/lapping and determining as a result of the machining that will maintain on the bushings 3-4 a perpendicularity between gear side and profile only as a function of the pre-existing perpendicularity on the body 2 between the surfaces and the central boring (pack seat). In the case of a perforated body 2, the bushings 3-4 are inserted within the body 2 inverted with respect to the functional assembly, i.e. with the gear sides outwards and with the thickness 14 calibrated at the centre. A super-finishing machining is carried out for instance with grinding/lapping of both surfaces at the same time or sequentially. In the case of a blind body 2 the bushings 3-4 are inserted within the body 2, the external bushing having the gear side facing outwards and a grinding/lapping will be carried out on only one surface.

For both reference cases, the subsequent functional assembly will have to occur by replacing the thickness with the definitive gears, and correctly positioning the bushings with the gear side inwards and the gasket side outwards. In the case of the perforated body 2, if the gear side of the bushings has been machined, the position of the bushings may also be reciprocally exchanged in order to maintain the same geometric error on the perpendicularity between the surfaces and the axis of the pack seat in the coupling with the body 2. In this case, it should be recalled that such an error will have to be in any case very small, the reference geometry of the gears 5 (grinded on the outside and on the sides of the toothing) representing a constraint with respect to the boring of the body 2 and accordingly the error will have to also be small on the bushings 3-4 between the gear side and the profile.

As an alternative, the thickness 14 may also be positioned outwards the body, for instance in the case of a perforated body 2 and in the case of the use of grinding machines on only one surface, so that the magnetic surface plate underlying a belt for conveying the pieces, may lock the (metal) thickness 14, and the belt accordingly draws the advancing preassembled unit under the grinding wheel.

The machining of the remaining surface of the body and of the corresponding bushing will occur by repositioning the thickness 14 towards the outer side which has been previously machined and by grinding the opposite side as disclosed above.

The achievement of the value G of the pack clearance will result precise short of the difference between the calibrated thickness 14 obtained on the average value between the grinding value of the gear 5 and the actual value of the gear itself 5, so that, for instance, if such a value varies up to 0.01 mm with respect to the nominal value, the maximum error will be half, i.e. 0.005 mm.

The value of this tolerance will result totally acceptable and compatible with the design value of the pack clearance and it will allow to avoid malfunctioning in the conditions of high performance previously disclosed.

Specifically, the problems connected to poor efficiency or high starting torque when pumps and motors start, which nowadays are detected by the manufacturing companies on test benches or by the final clients themselves, will be solved.

Therefore, the performance of the products, which directly depends on the precision of the axial clearance of the pack, may be further developed.

The production costs will also be reduced by an amount considerably higher than that introduced with the suggested additional machining on the preassembled unit, thus simplifying the previous machinings, where a particularly high precision is no longer required on the single components:

- Body 2: lower precision on the height value, on geometries and on the roughness of the flat lid coupling surfaces.
- Bushings 3-4: lower precision on the height value, on the geometry and on the roughness of the flat surface at the outer side of the pump

(towards the lids).

Lower precisions will allow a better reliability of the mechanical machinings of the components and therefore special machines may be manufactured for the production of bodies and bushings, with high productivity and therefore lower costs.

As an example, it is sufficient to note that the cutting step of aluminium extruded profiles, from which a semi-finished product for subsequent machining of the bodies is obtained, may be carried out by a cutting machine with a sufficient precision on the flat faces coupling with the lids, without needing further machinings up to the final machining step of the preassembled unit by the suggested process.

Although with great approximation, a reduction of a few percentage points (2-3%) in the internal and external scraps may be supposed with the application of the suggested process. The economical value may refer to the full cost of the product for every scrap eliminated, (over 50 euros/each for poorer products, with an accepted approximation as the total costs for low quality must be included) and explains the interest that this process could find in industrial applications on the reference market.

The application of the process may be identified by simple controls carried out with a three-dimensional machine (CMM_Computer Measuring Machine), by measuring the degree of precision of the pack clearance itself and/or of the parallelism of the surfaces of the body and of the bushings and/or of the perpendicularity between the surfaces of the body and the inner boring of the pack seat, for instance, in the following manners.

The body 2 with the pack elements inserted will be rested on a control equipment surface allowing the passage of possible shafts of the fluid transmission elements. The surface will be detected on the body 2 in many positions and the surface of the bushing will be detected in the same manner and the distance between surfaces (axial clearance of the pack) will be computed by the CMM. The measurement will be repeated on several similar tested products and if the suggested process has been applied, the result will be a uniformity of the measurements of the different products with a few micron variations, vice versa if the components have been separately machined, the result will be centesimal differences and especially differences varying among different tested products.

The measurement of the parallelism between the surface of the body 2 and the surface of the bushings 3-4 may also be carried out with the same positioning as before on the control equipment, the surface of the body 2 will be detected in many positions and the surface of the bushing 3-4 will be detected in the same manner. If the two surfaces have been grinded/lapped at the same time because they were preassembled as in the suggested method, the result will be a negligible parallelism error with the same geometrical orientation and with a few micron difference among the measured products. Vice versa, if the components are separately machined, the error will not be negligible and it will especially vary by centesimal differences among the different measured products.

A further control on the measurement of the perpendicularity between the surfaces of the body 2 and the inner boring may also be carried out. It will be measured by the CMM, simply by feeling a sufficient number of positions to identify the surface and the boring cylinder. If such a perpendicularity, although imprecise, has an error coinciding in value, direction and orientation of the geometry with that between the surface and the profile of the bushings, there is a high probability that the components have been machined by the suggested process and this would be confirmed if this condition occurs for different components.

Hereinafter, an application of the process to a pump/rotary volumetric motor with internal gears of the “Gerotor” type 20 is briefly set forth, in order to exemplify the possibility of extending the process to all hydraulic rotary volumetric machines, where there are: a body containing the fluid transmission elements and side sealing element, which form the pack when coupled.

Figure 7 depicts a front section of such a pump with a body 15, a male central gear or pinion 17 with external teeth and a female peripheral gear or crown 16 with inner teeth, which display the same height (thickness) and which will generally be called “fluid transmission elements”.

The crown 16 displaying a cylindrical outer shape is inserted in a similar seat obtained in the body 15 and is free to rotate about its axis driven by the rotation of the pinion 17, which is led to be integral with the driving shaft.

The rotation centres of the pinion 17 and of the crown 16 are fixed and do not coincide, furthermore the pinion 17 has one tooth less than the crown, so that in the coupling between teeth there is a complete contact area on the whole profile without any empty space to contain the fluid and an area where the free volume increases generating a depression exploited for the suction of the fluid, and an area where the volume decreases generating a compression towards the delivery conduit.

Two plates or discs 18-19 arranged laterally to the gears (Figures 8-9) form the elements serving to convey the fluid towards the suction and delivery conduits, obtained in a closing lid, or in the blind bottom, and also to contain the side seepings and, in case, to perform the axial balancing, by means of appropriate gaskets which limit, in the outer area (opposite to the gears), the area of pressure from the delivery area through appropriate drainages, exactly as seen for the bushings in the pump with external gears.

There is a variant of the process previously disclosed.

The preassembled unit will be formed by inserting the fluid transmission elements (gears) 5 and a thickness 14 displaying a height corresponding to the pack clearance to be achieved between the sealing elements 3 and 4. In this case, the preassembled unit (13) will be of the type in Figures 4 and 6 with another infinitesimal and negligible thickness (14) in a diagrammatic representation with the correct proportions. The following steps of functionally assembling simply consist in eliminating the service thickness. This variant may be applied as an alternative to the previously disclosed process for the external gear machines, by proceeding to the step of grinding the preassembled unit 13 or 20, even in the case of the shaft protruding from the body, the latter being mounted on an appropriate tool included in the grinding machine between tailstocks on reference marks obtained by the previous machining. In this case, the grinding will occur with 2 flat and parallel grinding wheels with a circular crown profile displaying a width a little shorter than the maximum radius of the profile of the body with respect to the rotation axis (tailstocks) to allow the uniform wear of the grinding wheels.

In this manner, the error corresponding to the difference between the thickness 14 and the actual height of the fluid transmission elements is also eliminated.

Another possible variant is to use a thickness 14 having a height corresponding to the fluid transmission elements plus the pack clearance to be achieves, although such a thickness is inserted between the sealing elements together with the fluid transmission elements in the empty compartments which cross such elements.

For instance, some cylinder-shaped thicknesses may be inserted in the external gear compartments, the cylinder-shaped thicknesses resting on the bases on the sealing elements (bushings).

CLAIMS

1. A working process for obtaining a pack clearance in hydraulic rotary volumetric machines (1, 20) including means (5, 16-17) to transmit the hydraulic fluid from an inlet mouth (10) to an outlet mouth (11) housed between two side sealing elements (3-4, 18-19) in a body (2, 15) closed by at least one lid (8).

characterised in that it includes the steps of:

semi-finishing the side sealing elements (3-4, 18-19) and the body (2, 15), with a machining allowance on the values of height of the body (2, 15) and of the side sealing elements (3-4, 18-19),

obtaining a service thickness (14) with a height corresponding at least to the value of the pack clearance of the design to be implemented,

obtaining a preassembled unit (13) including the body (2, 15), the thickness (14) and the two side sealing elements (3-4, 18-19),

finishing the external surfaces of the preassembled unit (13) to obtain the design pack clearance with a minimum tolerance,

functionally assembling with the use of means (5, 16-17) for the transmission of hydraulic fluid and eliminating the thickness (14).

2. A process according to claim 1, characterised in that said thickness (14) has a height corresponding to that of the value of the pack clearance of the design to be implemented, the preassembled unit (13) includes the means (5, 16-17) for the transmission of hydraulic fluid, the functional assembly providing for the elimination of the thickness (14).

3. A process according to claim 1, characterised in that the preassembled unit (13) includes the means (5, 16-17) for the transmission of hydraulic fluid.

4. A process according to any one of the preceding claims, characterised in that said means for the transmission of hydraulic fluid includes gears (5, 16-17).

5. A process according to claim 4, characterised in that said gears (5)

include a driving shaft (6) and a driven shaft (7) with external meshing toothed wheels.

6. A process according to claim 4, characterised in that said gears include a crown (16) and a pinion (17) with internal meshing toothed wheels.

7. A process according to any one of the preceding claims, characterised in that said side sealing elements have the shape of glasses (3-4), consisting of a single piece or two half-bushings, or of plates/discs (18-19).

8. A process according to any one of the preceding claims, characterised in that said side sealing elements also serve the function of supporting the fluid transmission means.

9. A process according to any one of the preceding claims, characterised in that said side sealing elements also serve the function of balancing and compensating the pressure.

10. A process according to any one of the preceding claims, characterised in that said semi-finishing, finishing or super-finishing includes grinding.

11. A process according to any one of the preceding claims, characterised in that said semi-finishing, finishing or super-finishing includes lapping.

12. A process according to any one of the claims 10-11, characterised in that the grinding or lapping occurs by means of parallel surface machines.

13. A process according to any one of the claims 10-11, characterised in that the grinding or lapping occurs by means of one or two single surface machines with subsequent finishing of the two surfaces.

14. A process according to any one of the claims 10-11, characterised in that the grinding occurs by means of machines in which the pieces pass under a single grinding wheel which is appropriately profiled and angled for manufacturing a flat surface parallel to the opposite surface.

15. A process according to claim 13 or 14, characterised in that the thickness (14) is placed outside the perforated body and the opposite side is grinded.

16. A process according to any one of the claims 10-11, characterised in that the grinding occurs by means of machines in which the pieces pass under two opposed and independent grinding wheels which are appropriately profiled and angled for manufacturing flat and parallel surfaces.

17. A process according to any one of the preceding claims, characterised in that the grinding of the preassembled unit (13, 20), formed by assembling both the fluid transmission elements (5, 16, 17) and the thickness (14) between the side sealing elements (3, 4, 18, 19), occurs by assembling the latter on a specific tool included in the grinding machine, which allows the rotation thereof about an axis and by means of flat and parallel grinding wheels with a circular crown profile having a width a little smaller than the maximum radius of the external profile of the body with respect to the rotation axis, to allow the uniform wear of the grinding wheels.

18. A process according to any one of the preceding claims, characterised in that the thickness (14) of the height corresponding to that of the fluid transmission elements (5, 16, 17) plus the value of the design clearance is inserted in the compartments of the transmission elements and that together with the side sealing elements (3, 4, 18, 19) it forms the preassembled unit (13).

19. A process according to any one of the preceding claims, characterised in that it is suitable for pumps and hydraulic motors with balancing gaskets (12) housed in seats obtained on the lids (8).

20. A process according to any one of the preceding claims, characterised in that it is suitable for pumps and hydraulic motors with balancing gaskets (12) housed in seats obtained on the side sealing elements

(3-4, 18-19).

21. A process according to any one of the preceding claims, characterised in that it includes the inversion of the sealing elements (3-4, 18-19) in the functionally assembling step.

22. A process according to any one of the preceding claims, characterised in that it is suitable for pumps and hydraulic motors with a perforated body (2, 15).

23. A process according to any one of the claims 1-22, characterised in that it is suitable for pumps and hydraulic motors with a body (2, 15) with a blind hole.

24. A process according to any one of the preceding claims, characterised in that the body (2, 15) and the side sealing elements (3-4, 18-19) are obtained with traditional tool machines, flexible machining centres or special machines intended for single machinings to reduce the overall cycle time.

25. A process according to claim 24, characterised in that the semi-finishing of the height of the body and/or of side sealing elements is directly obtained in the step of cutting the extruded profile from which they are obtained.

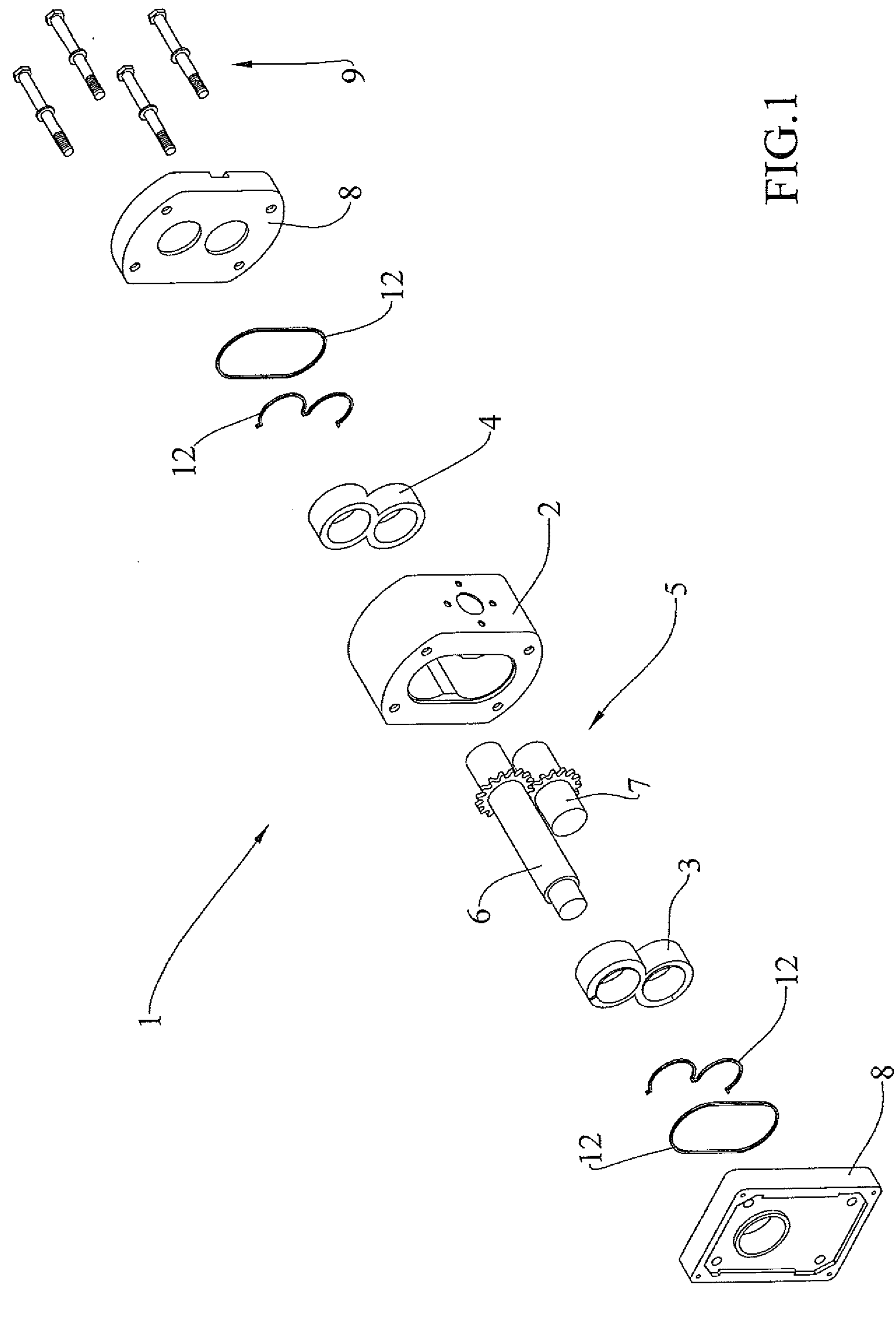

FIG.1

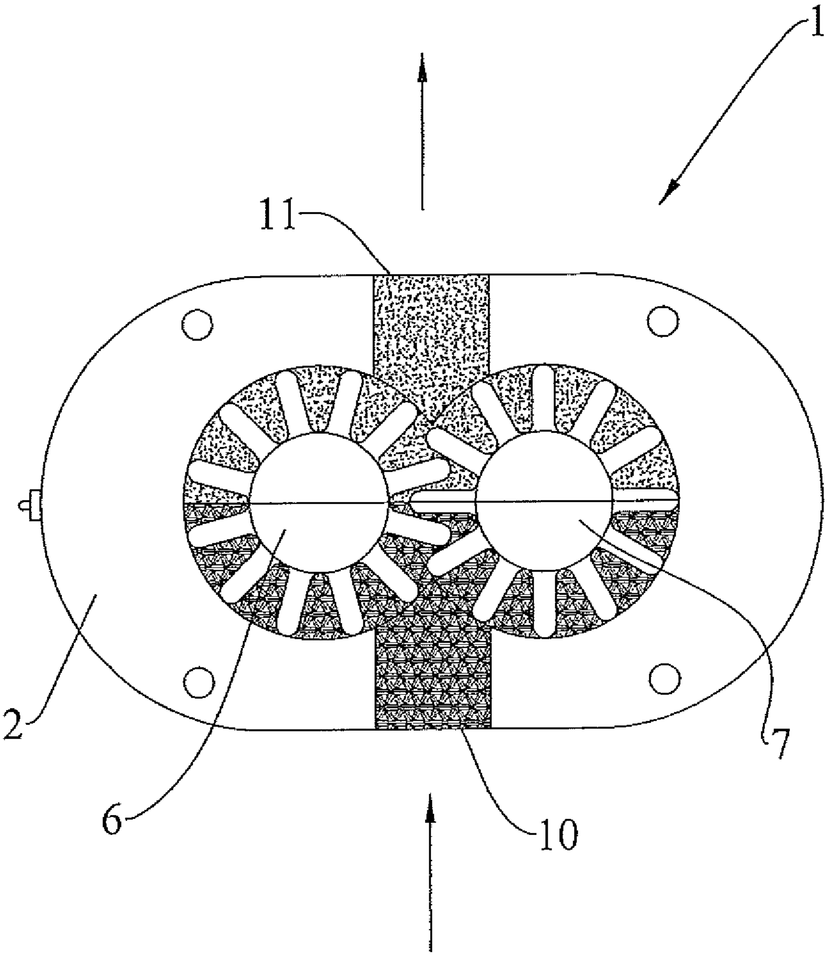

FIG.2

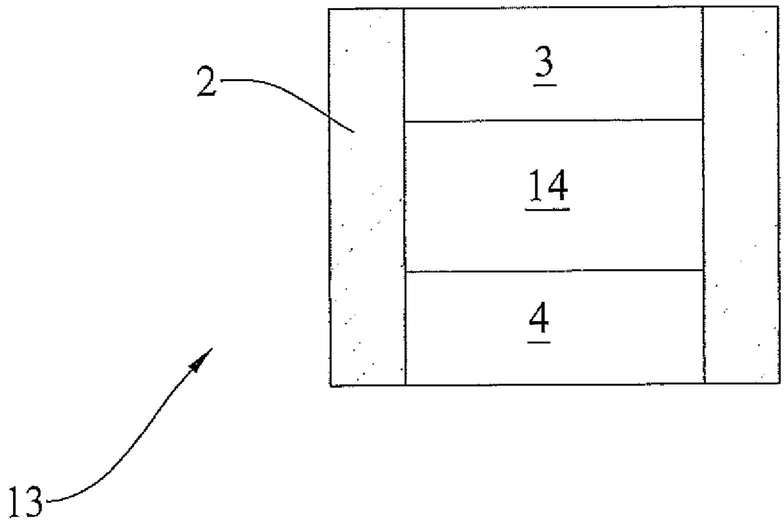

FIG.3

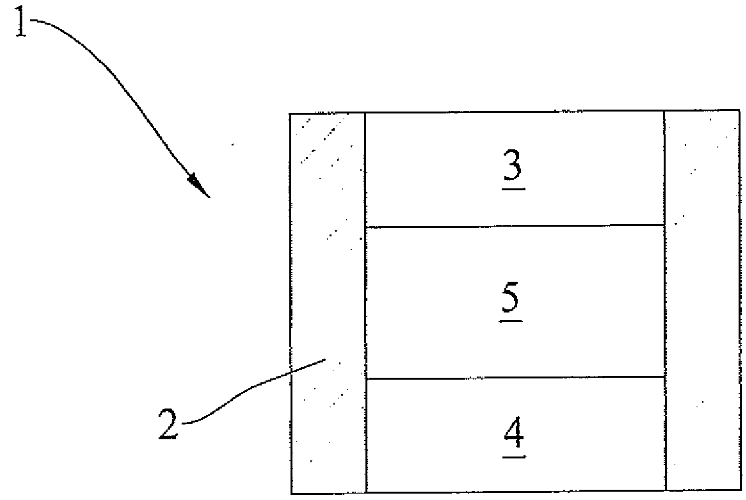

FIG.4

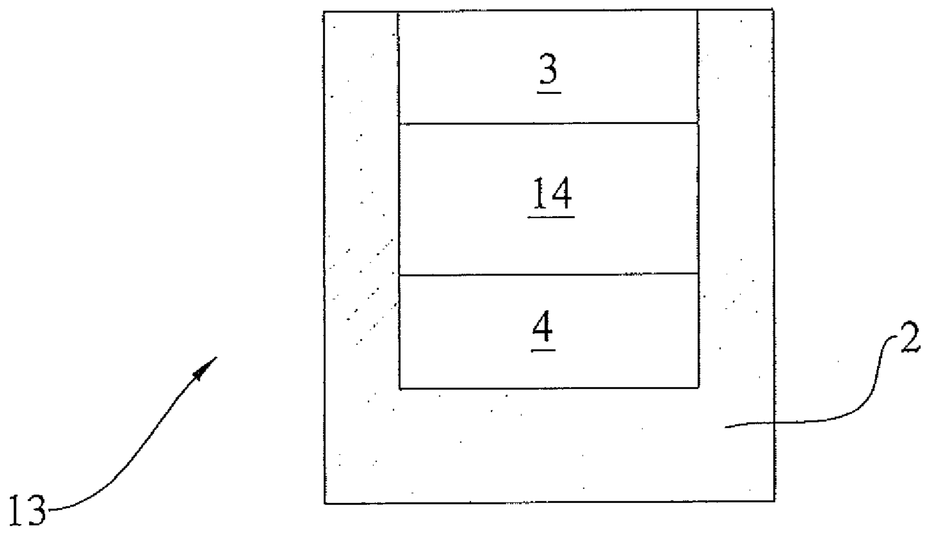

FIG.5

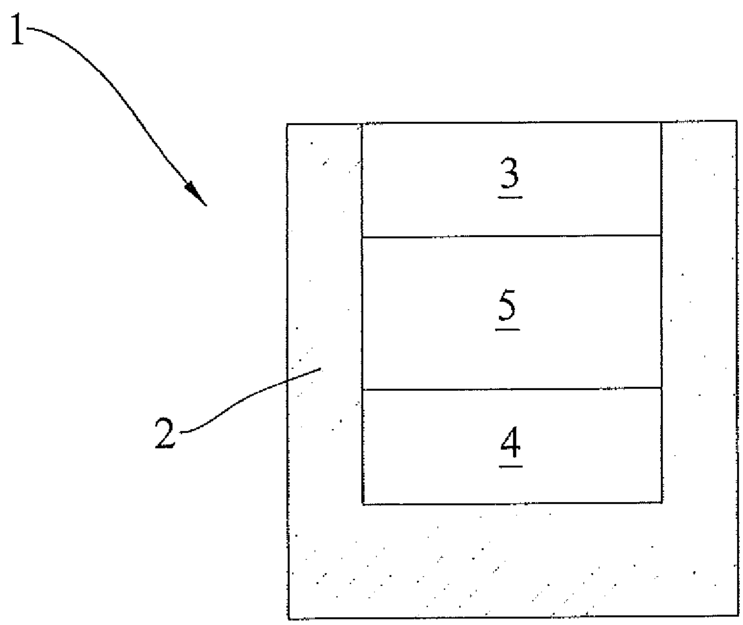

FIG.6

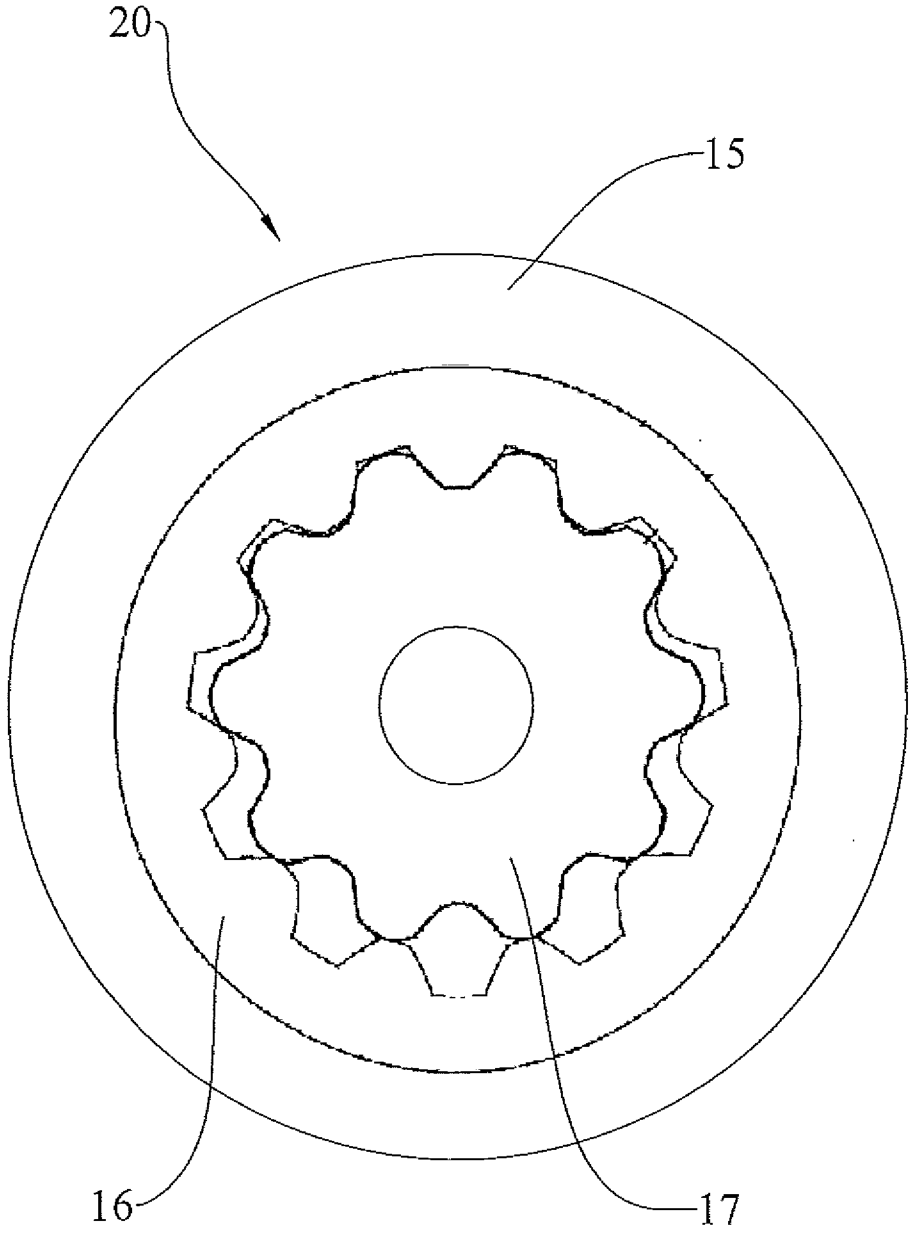

FIG.7

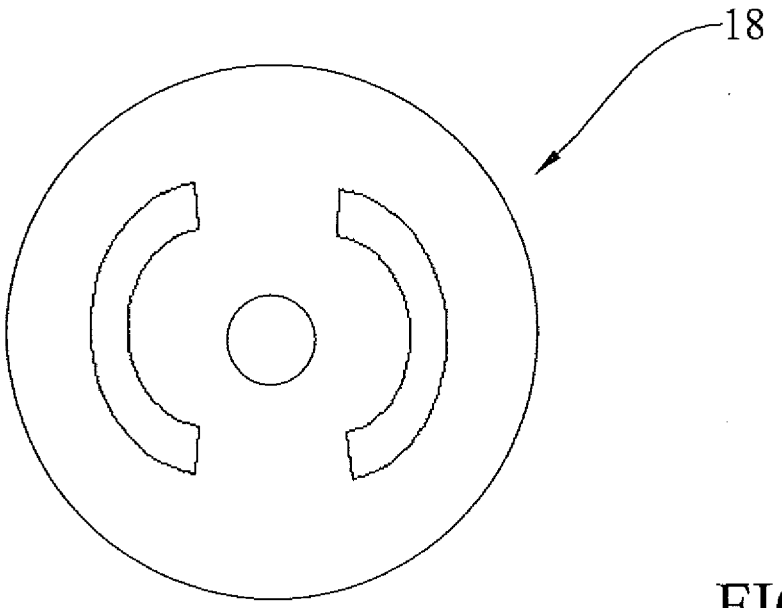

FIG.8

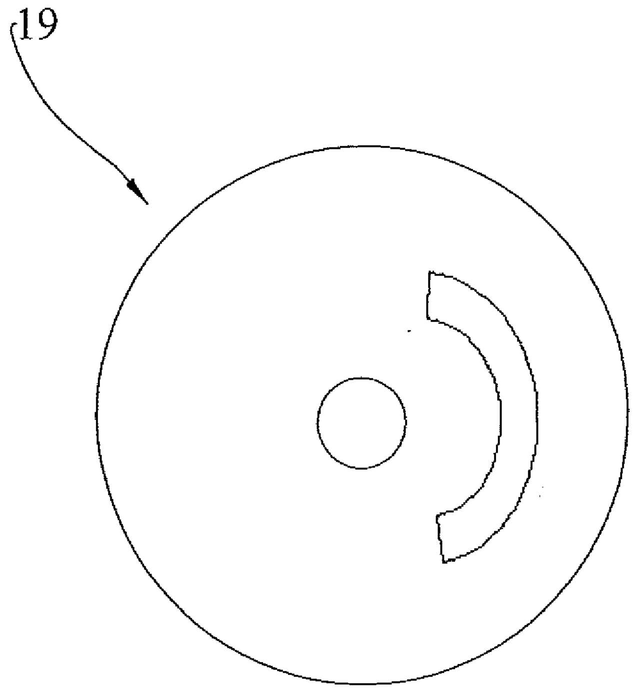

FIG.9

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2008/060017

A. CLASSIFICATION OF SUBJECT MATTER
INV. F04C2/08 F04C2/10 F04C2/18 F04C15/00 B24B41/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F04C B24B F01C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 2 620 553 A (SCHULTZ HAROLD B) 9 December 1952 (1952-12-09) figures 1-4 column 2, line 29 - column 3, line 38 claims 1-4 -----	1-20, 22-25 21
Y	US 1 626 115 A (FRITZ EGERSDORFER) 26 April 1927 (1927-04-26) figures 3,4 page 2, line 53 - line 83 -----	1-20, 22-25
Y	JP 57 091392 A (SHOWA MFG) 7 June 1982 (1982-06-07) figures 1-5 abstract ----- -/--	1-20, 22-25

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
26 November 2008	08/12/2008

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT

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International application No
PCT/EP2008/060017

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