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(54) Rotary flow distributor for internal combustion engines.

(57) The invention is concerned with a rotary flow distributor for internal combustion engines. The flow distributor comprises a hollow cylinder (17) whose interior is divided into plural chambers, the engine intake mixture and exhaust gases being flown through said chambers. The distributor cylinder (17) is located above and communicates with the engine combustion chambers (22) through ports (23) and hollow sealing elements (31) interposed between the distributor cylinder (17) and combustion chambers to provide a seal during the rotation of the cylinder (17). The distributor cylinder is driven rotatively by the engine crankshaft.

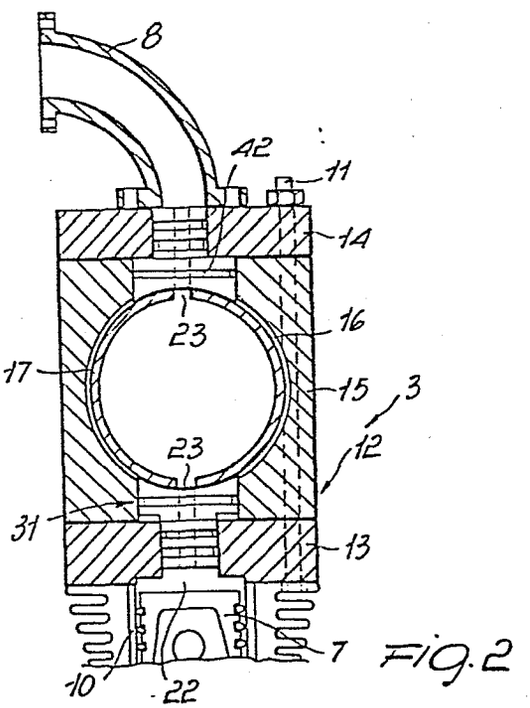

FIG.2

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"ROTARY FLOW DISTRIBUTOR FOR INTERNAL COMBUSTION ENGINES"

This invention relates to a rotary flow distributor for internal combustion engines.

It is a well-known fact that internal combustion engines have been designed heretofore to include intake passageways and exhaust passageways controlled by valves which are parts of a flow distribution system also including camshafts mounted in the engine cylinder head and arranged to actuate, either directly or through rocker arms, the valve stems, or alternatively, cams accommodated in the engine lower portion and actuating the valves with the intermediary of pushrods and rocker arms.

Such prior arrangements have several disadvantages, and in particular a problem originating from reciprocation of the valves. Where the valves are provided, as is the case with many embodiments, with return springs, it is impossible to achieve valve closing and opening rates exceeding the elastic characteristics of the springs themselves. This means that the engine rpm range has limitations due to both the reciprocating motion and presence of the springs.

Where the so-called bilateral or positive distribution system is used, there are still encountered problems connected with the reciprocating motion and difficulty of achieving proper adjustment. All this, moreover, increases the engine noise emission and requires an accurate adjustment of the timing system which has to be checked periodically.

Furthermore, the engines equipped with spring

loaded valves have the additional problem of power being expended in the spring work, which problem is more markedly felt in starting an engine, when the resisting load may be considerable.

Valves, which are known to comprise a stem and a head positioned inside the combustion chamber, in the event of failure of the return arrangement or device driving the camshafts, may remain in open position projecting within the combustion chamber and hit by the raising piston, causing serious engine damage.

It is a primary object of this invention to provide a rotary flow distributor for internal combustion engines which can obviate the problems connected with conventional valve timing systems.

Another object of the invention is to eliminate the reciprocating motion which enables closing and opening of the intake and exhaust passageways in current engines.

It is a further object of this invention to provide a flow distributor which, by doing away with any reciprocating motions, suffers no limitations from the elastic or mechanical characteristics of its component parts, thus imposing no limitations on the engine rpm range.

Still another object is to provide a flow distributor which is inherently quiet and originates no vibration or noise from the assembly.

An added important object of the invention is to provide a flow distributor which has very low power

requirements for the driving thereof, and in particular offers no resistance during the engine starting stage.

A not unimportant object of this invention is to provide a flow distributor which has no adjustment requirements, and comprises simple parts which are easy to manufacture and virtually maintenance-free.

Another important object of the invention is to render at least some component parts of the distributor automatically adaptable to deformations to which component parts cooperating therewith may be subjected.

With regard to the last mentioned object, it will be understood that an important component part of the device according to this invention is a hollow distributor cylinder provided with suitably arranged ports on its periphery and arranged in a cylindrical bore of a body member. This cylinder will be more fully described later on. At this point it is of interest to note that it has been found that in operation the distributor cylinder undergoes thermal and mechanical deformations owing to which in certain portions and moments the cross-section of the cylinder is not perfectly circular, but assumes an oval shape. The cylinder is also subjected to bending stresses with respect to its longitudinal axis. Owing to these deformations interferences easily occur between the walls of the bore where the cylinder is located and the periphery of the cylinder.

The task of this invention is to solve also the above mentioned interference problem.

These and other objects, such as will be apparent

hereinafter, are achieved by a rotary flow distributor for internal combustion engines, characterized in comprising a hollow distributor cylinder rotatably supported within a bore of a housing body arranged adjacent the engine cylinders, said distributor cylinder having at least two selectively located ports and mouth elements facing the circular paths of said ports, said mouth elements facing said housing body and providing in selected positions of the distributor cylinder communication between the operative chamber of the engine cylinder and alternatively with the intake and exhaust manifolds of the engine cylinder, said distributor cylinder being rotated in timing relationship with the operational cycles of the engine cylinders to attain said selected positions thereof.

Further features and advantages of the invention will be more clearly understood by making reference to the following detailed description of a preferred embodiment, given herein by way of example and not of limitation and being illustrated in the accompanying drawings, where:

Figure 1 shows a general layout diagram of an engine incorporating this rotary flow distributor mounted in the engine cylinder head, partly in section;

Figure 2 is a sectional view taken through the rotary flow distributor along one of the engine cylinders;

Figure 3 is a sectional detail view of the

intermediate sealing element;

Figure 4 illustrates this flow distributor cylinder; and

Figure 5 is a perspective view of the intermediate sealing element.

Making reference to the drawing views, there is shown an internal combustion engine of the air-cooled type, although the invention may also be applied on any other internal combustion engines, whether of the gasoline or diesel types.

In the partly sectional view of the engine shown in Figure 1, there are depicted schematically the engine block 1, oil pan 2, cylinder head 3, and intake and exhaust manifolds 4. More particularly the engine crankshaft is indicated at 5, one piston connecting rod at 6, a piston at 7, and individual intake and exhaust manifolds at 8 and 9.

Secured above the engine cylinder 10 by means of throughgoing studs 11 is an assembly forming the engine distribution system 3 and comprising a main intermediate body 12 which is completed by a first plate 13 facing the engine block 1 and a second plate 14 facing the manifolds 4.

The main intermediate body 12 comprises essentially a parallelepipedal element 15 having a centrally located cylindrical through bore 16 (See Figures 2,3) accommodating a distributor cylinder 17 therein which is divided internally into a number of compartments, of which only three are shown in Figure 4 and designated

with the numerals 18, 19 and 20, said compartments being formed by inserting disc-like partition members 21 into the cylinder 17.

According to one embodiment of the invention above and in cooperation with each combustion chamber, such as 22 in Figure 2, of the in-line cylinders of the engine, two compartments are arranged.

The outer wall of the distributor cylinder 17 has ports 23 formed therein. At least two of such ports are provided for each compartment. Said ports 23, in the illustrative drawings, are arranged diametrically opposite to each other. In actual practice, however, more than two ports may be provided and arranged other than diametrically opposite to one another, depending on the angular position of the manifolds.

It is important, however, that they are provided in a number equal to or greater than two for each compartment.

The distributor cylinder 17 includes in a head 24 a guide and support pin 25 mounted for rotation in bearing means 25' provided on said intermediate main body 12.

At the other end, the second head 26 has another guide and support pin, indicated at 27, rotatably supported in bearings 27' on body 12. The pin 27 has a sprocket wheel 28 keyed thereto and receiving its motion from a sprocket 30 keyed to the engine shaft 5 through a drive chain 29 or a cogget belt.

The drive ratio of the sprocket 28 to the sprocket 30 will depend on the number of ports provided in each

compartment of the distributor cylinder 17.

In practice, as the number of ports 23 increases, the rotational speed of the distributor cylinder 17 should be decreased, and hence, the sprocket drive ratio appropriately selected.

Arranged at the path of rotation of each of the ports 23, and provided in number of at least two per cylinder, are intermediate sealing mouth elements generally indicated at 31 which will be called hereinafter sealing mouth elements.

Such intermediate sealing elements have a mushroom-like shape and (see in particular Figure 5) essentially comprise a widened head 32 having a substantially cylindrical cross-section and its top face 33 shaped to match the surface of the cylinder 17 which it contacts slidingly.

Said widened head 32 is extended into a cylindrical body 34 (Fig. 5) which is inserted through a hole 35 formed in said plate 13 on the combustion chamber side.

Said cylindrical body 34 has, in the illustrated embodiment, two circumferential sliding seal grooves 36' implemented with elastic rings 36 providing a seal between the body and the hole 35 while allowing an optional translatory movement of the former.

The outer cylindrical surface of the widened head 32 is also provided with a sliding seal, indicated at 37, which makes a seal on the inside wall of a circular cross-section bore 38 formed in said parallelepipedal element 15.

A cylindrical spring 39, or other elastic bias

element, acts between a shoulder 40 resulting from the reduced cross-section between the bore 38 and bore 35 and said widened head 32.

The spring 39 has the function of holding the intermediate sealing element 31 constantly urged toward the wall of the cylinder 17.

The intermediate sealing element 31 has an axial bore 41 of preferably rectangular cross-section, which is located to align with the port 23 as the latter instantaneously aligns itself with the axis of said intermediate element 31, thus establishing an instantaneous communication between the combustion chamber 22 and one of the internal compartments of the distributor cylinder 17.

A second intermediate sealing element, indicated at 42, is positioned in Figure 2 at a diametrically opposite location to the first element, indicated at 31, and forms a sealing element on the cylinder 17 communicating one of the compartments of the distributor cylinder 17 to one of the manifolds, e.g. the intake or exhaust manifold indicated at 4.

The shape of said second sealing element 42 is quite identical to that previously discussed and indicated at 31.

Even though each cylinder of the engine could be associated on the combustion chamber side with one sealing mouth element 41 and on the manifold side with one or two opposite sealing mouth elements 42, it is preferred in certain applications to associate each engine cylinder with four such sealing mouth

elements, two of them on the combustion chamber side and the other two on the opposite manifold side. In this latter case the two sealing mouth elements on either side are arranged in side by side relationship in the direction of the longitudinal axis of the distributor cylinder and between the juxtaposed sealing mouth elements a partition member 21 is arranged, so that each engine cylinder is associated with two compartments of the distributor cylinder, one compartment cooperating with one pair of opposite sealing mouth elements 41,42 and the other compartment cooperating with the other pair of opposite sealing mouth elements 41,42. It will be understood that in such case through one of said compartments called exhaust compartment only exhaust gases flow and through the other of said compartments called intake compartment only the intake mixture of fuel and air flows, so that the concerned component parts may be designed and dimensioned accordingly.

The operation of the flow distributor is as follows:

The distributor cylinder 17 is rotated by the engine shaft 5 in timing relationship with the operational cycles of the engine. During the feeding phase of the operational cycle of the concerned cylinder of the engine, the intake compartment of the distributor cylinder is operative, which is associated with the intake manifold of the concerned engine cylinder. Moreover during the feeding stage a port 23 faces the opening of the sealing mouth element 41 which is in alignment with the intake compartment of the distributor cylinder and another opposite port 23 faces the opening of the opposite

sealing mouth element 42 in communication with the intake manifold. At the same time the distributor cylinder exhaust compartment associated with the concerned cylinder is shut off, since the concerned ports 23 are so arranged that no port 23 of the distributor cylinder exhaust compartment is in alignment with the two opposite sealing mouth elements 41 and 42 associated with the exhaust compartment so that the concerned sealing mouth elements 41 and 42 are closed by the solid wall parts of the distributor cylinder, in a way similar to a slide valve. As is known to those skilled in the art the timing of the closing and opening of the passages through the intake and exhaust compartments may be adjusted in conventional manner. The concerned engine cylinder operates "mutatis mutandis" in a similar manner during the exhaust phase of the operative cycle of the engine cylinder, so that a detailed description of such operation is omitted.

In practice, the distributor cylinder is provided with a plurality of suitably located ports to move into alignment with the intermediate sealing mouth elements which put the distributor cylinder compartments into communication with the engine combustion chambers, according to the engine cycle phases.

Seal is provided by the sealing mouth elements and the ports are uncovered as the latter move into alignment with the individual sealing mouth elements.

With this configuration, it may be seen that the distributor element is only driven of rotary motion, thereby removing all problems connected with the

reciprocating movements in conventional poppet valve systems.

Flow is distributed by the hollow distributor cylinder, and tight seals are provided by interposing sealing elements which fit constantly but yieldingly to the cylinder surface across sufficiently narrow areas to prevent the sliding motion from causing overheating of the distributor cylinder, which would pose cooling problems and problems from any heat-induced deformations.

By increasing the number of the ports, one can conveniently lower the rotational speed of the distributor cylinder itself, thus further attenuating the problems brought about by the required sliding motion to ensure an adequate seal.

The thrust applied by the explosions within the combustion chambers on the sealing mouth element, which is not rigid with the heads but rather fitted with sealing rings allowing its sliding translation movement, further contributes to provide a perfect seal during the fuel combustion phase.

Expediently, the ports will have a rectangular cross-sectional configuration with their major sides extending parallel to the distributor cylinder axis of rotation, so as to provide short port uncovering and covering times.

It should be further noted that the presence and special shapes of the intermediate sealing mouth elements afford seals which can take up any play developed by either deformation or wear.

It may be appreciated from the description and illustrations that all the invention objects have been achieved, and that a flow distributor has been provided in practice which eliminates the need for reciprocating valves and may be utilized with any types of internal combustion engines.

There no longer exist spring problems, and the rpm may be as high as desired without any problems of valve floating being encountered.

The absence of reciprocating valves and the fact that the port size and location may be selected as desired enables, on the one side, an improved feeding of the cylinder, and on the other side, a faster and easier ejection of the burned gases owing to no obstacles hindering their outflow.

Timing adjustment is also facilitated, and performed by acting on a single element instead of on each valve as required by conventional engines.

In the event of a break occurring in the drive from the engine shaft to the distributor cylinder, no damage would be caused by the pistons hitting the valves or by objects penetrating the combustion chambers.

An added advantage comes from the quiet operation of this distributor, which generates no vibrations on account of its undergoing no reciprocating movements.

Maintenance is also quite simple to perform, because the members are not many nor are the adjustments.

Of course, based on this same inventive idea, the

flow distributor may be implemented differently without departing from the protection scope of the instant patent.

As mentioned previously, the port and chamber number may be selected as required in accordance with the desired rpm for the distributor, as may the dimensions and materials contingently on individual requirements.

The position of the distributor relatively to the shape of the engine cylinder head may be any selected one.

It is hereby enhanced that the materials and dimensions may be any selected ones to meet individual requirements.

CLAIMS

1. A rotary flow distributor for internal combustion engines, characterized in comprising a hollow distributor cylinder (17) rotatably supported within a bore (16) of a housing body (15) arranged adjacent the engine cylinders, said distributor cylinder (17) having at least two selectively located ports (23) and mouth elements (41,42) facing the circular paths of said ports, said mouth elements (41,42) facing said housing body (15) and providing in selected positions of the distributor cylinder (17) communication between the operative chamber (22) of the engine cylinder and alternatively with the intake and exhaust manifolds (8,9) of the engine cylinder, said distributor cylinder (17) being rotated in timing relationship with the operational cycles of the engine cylinders to attain said selected positions thereof.

2. A flow distributor according to Claim 1, wherein said distributor cylinder comprises pairs of intake flow and exhaust flow compartments (19,20) associated with each engine cylinder and for each of said compartments pairs of opposite sealing mouth elements (41,42) for the passage of fluid flow therethrough in selected angular positions of said distributor cylinder.

3. A flow distributor according to Claims 1 and 2, wherein at least a portion of said sealing mouth elements (41,42) is yieldable.

4. A flow distributor according to Claims 1 and 2, wherein said sealing mouth elements (41,42) are spring biased against said distributor cylinder.

5. A rotary flow distributor for internal combustion engines, characterized in that it comprises a rotating hollow distributor cylinder (17) divided internally into at least two chambers (18-20) each provided with at least two ports (23), and intermediate sealing mouth elements (31) arranged at the rotation path of said ports (23) and having one face thereof mating with said distributor cylinder (17), said intermediate sealing mouth elements (31) having an axial bore (41) therein for communicating at least one of them the distributor cylinder ports (23) to the engine combustion chamber (22), and at least another of them to the engine manifolds.

6.A flow distributor according to Claim 5, characterized in that said distributor cylinder (17) is rotated by an engine shaft (5) synchronously therewith.

7. A flow distributor according to Claim 5, characterized in that said hollow distributor cylinder (17) comprises a cylindrical body with two heads (24,26), a first head (24) having a sliding axis (25) mounted on a support rigid with a body (15) accommodating the distributor cylinder (17), and a second head (26) having a sliding and guiding axis (27) with a sprocket wheel (28) keyed thereto mechanically connected to and driven by an engine shaft (5) through transmission means (29), said distributor cylinder (17) being enclosed within a substantially parallelepipedal body (15) associated on one side (13) thereof with an engine block (1), and on another side (14) thereof

with the engine intake and exhaust manifolds (7,8), said distributor cylinder (17) being divided into compartments (18,20) by means of disc-like septa (21) extending on normal planes to the axis of said cylinder.

8. A flow distributor according to one or more of the preceding claims, characterized in that the outer surface of the distributor cylinder (17) presents a plurality of ports (23), said ports being at least two in number for each chamber (18,20) and arranged diametrically opposed to each other.

9. A flow distributor according to one or more of the preceding claims, characterized in that it comprises intermediate sealing mouth elements (31,42) at the area of rotation of said ports (23) both toward combustion chambers (22) and toward the intake and exhaust manifolds (7,8), the number of said intermediate sealing elements being at least twice the number of the compartments (18,20) into which the cylindrical body is divided and comprising each a cylindrical cross-section widened head (32) connected to a cylindrical body (34), with reduced dimension in cross-section than said head, said widened head having a face (33) mating with the cylindrical surface of the cylindrical distributor (17) on which it slides, said intermediate sealing mouth elements (31) being accommodated in holes (35) formed in an engine cylinder head (13) and in the body (15) enclosing said distributor cylinder (17), between the widened head (32) of said intermediate sealing mouth elements

(31) and a seat formed in the cylinder head (13) there being provided an elastic element (39) biasing said sealing element (31) toward the distributor cylinder (17) and wherein said intermediate sealing elements (31) have on their outer surfaces rings (36,37) forming sliding seals providing a gas tight and compression seal while allowing sliding of said element such that the latter is constantly pressed against the distributor cylinder.

10. A flow distributor according to Claims 5 - 9, characterized in that each intermediate sealing mouth element (31) has an axial bore (41) aligned on the corresponding port (23) of the distributor cylinder, thereby communicating the corresponding compartment (18,20) of the distributor cylinder (17) to the combustion chamber (22), on the one side, whereas an equivalent similar intermediate sealing mouth element (42), simultaneously communicates the inside chamber (18,20) with one of the intake or exhaust manifolds (7,8) and wherein the cross-section area of said axial bore (41) in said intermediate sealing mouth element (31) is smaller than the cross-section of said sealing element (31) thereby the thrust applied by an explosion contributes to biasing the sealing element (31) toward the distributor cylinder (17) so as to prevent gas leakage past contact regions.

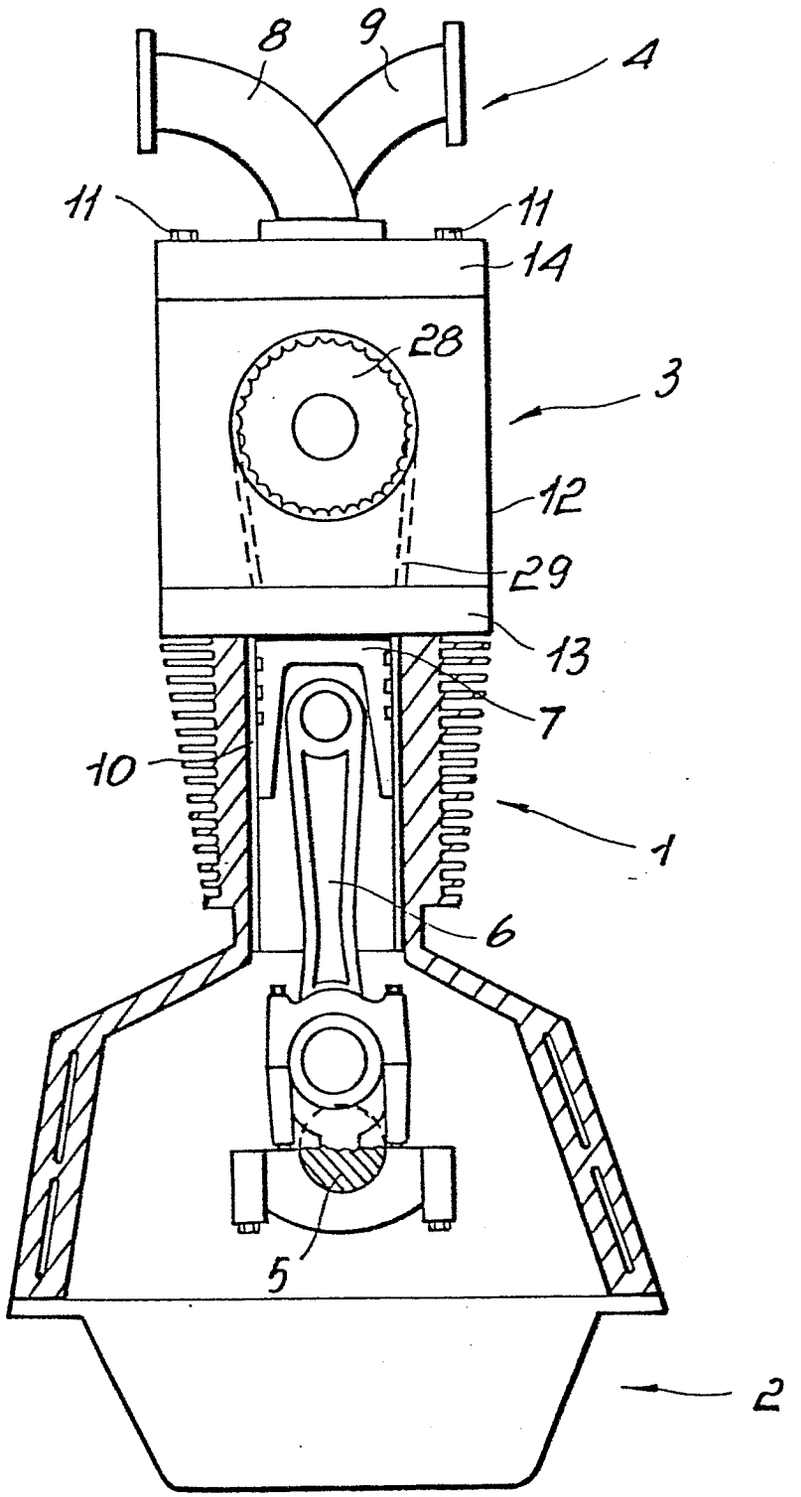

FIG.1

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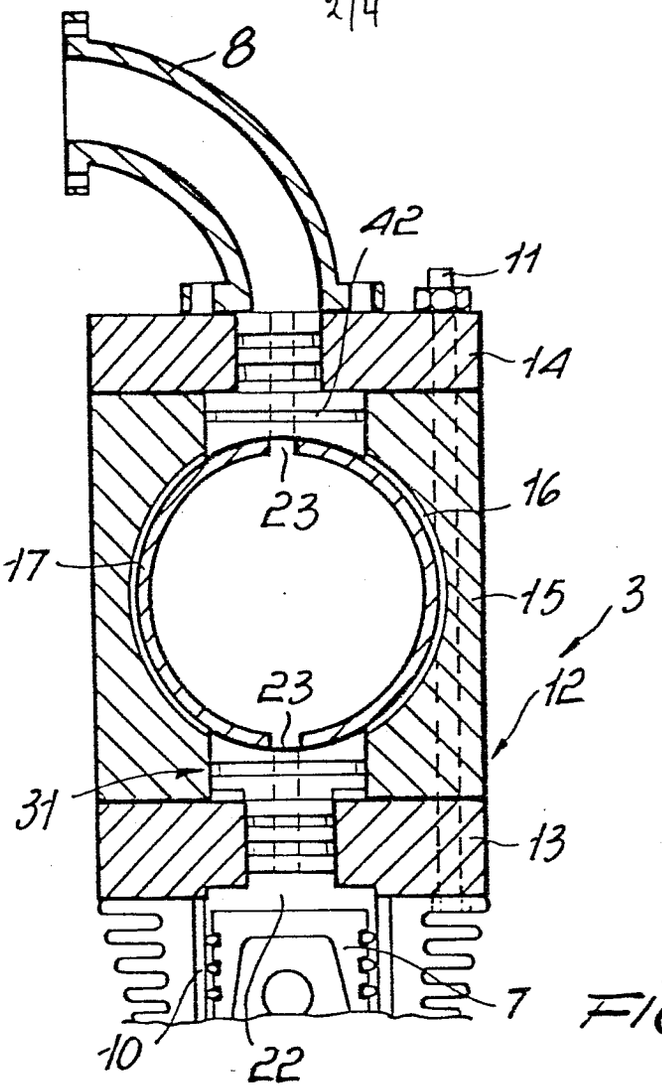

FIG. 2

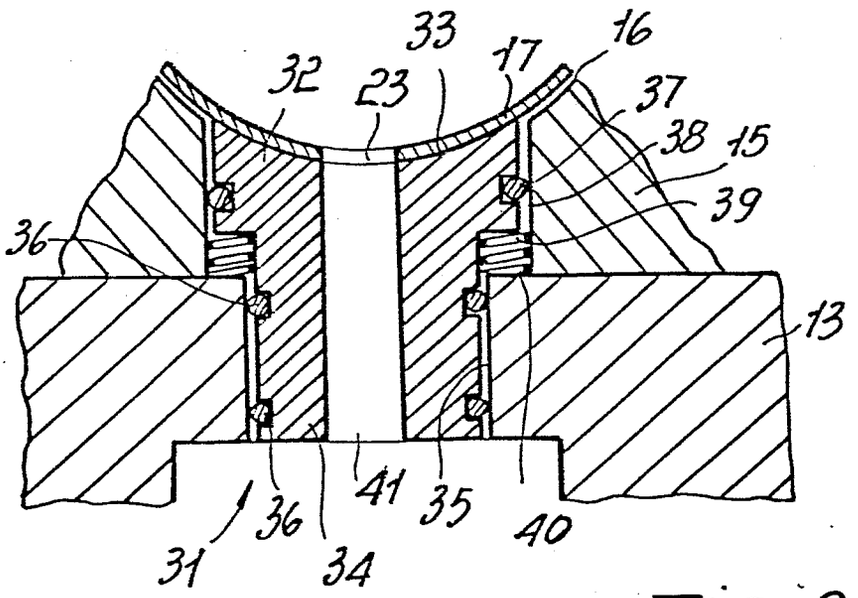

FIG. 3

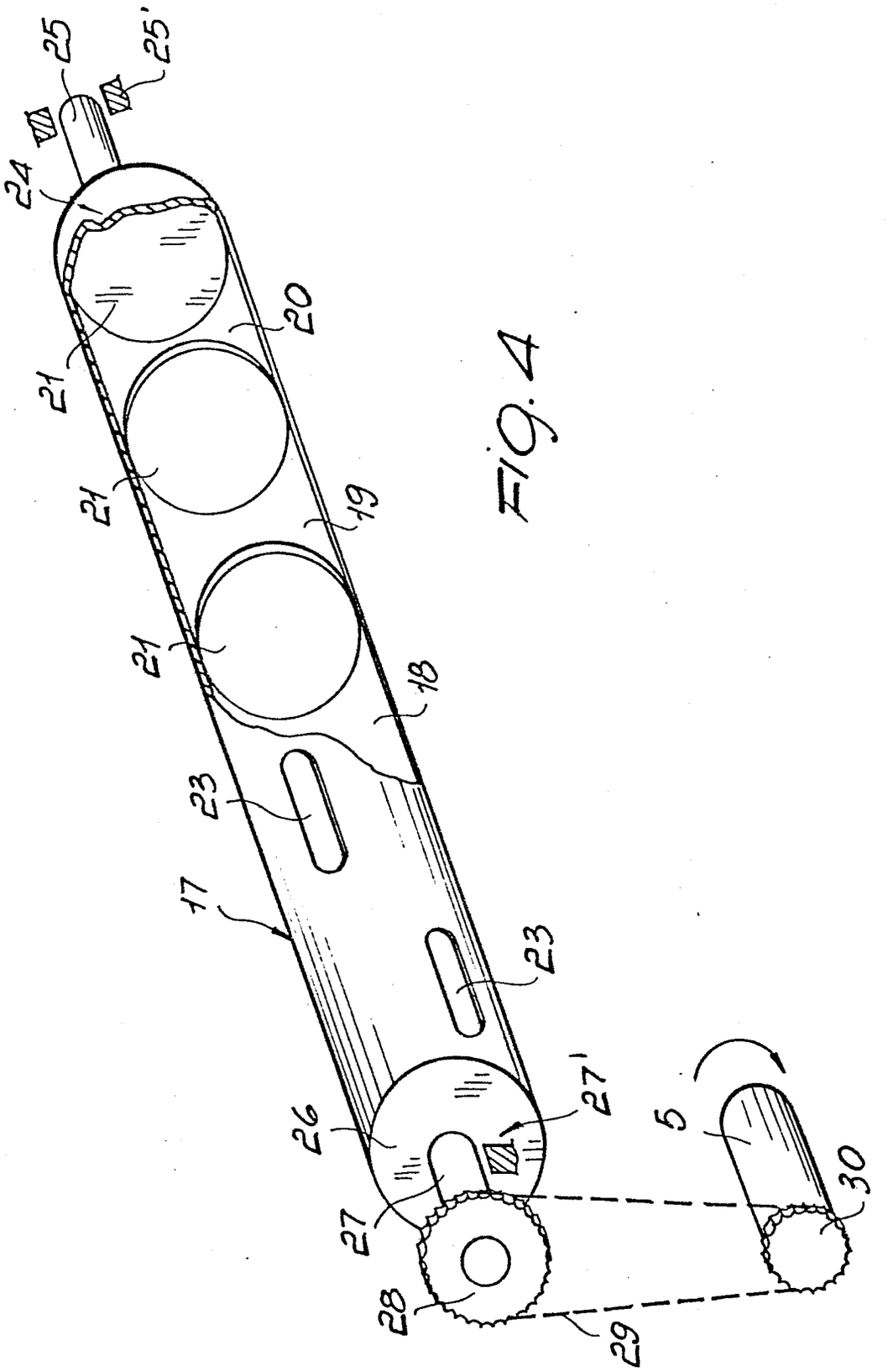

FIG. 4

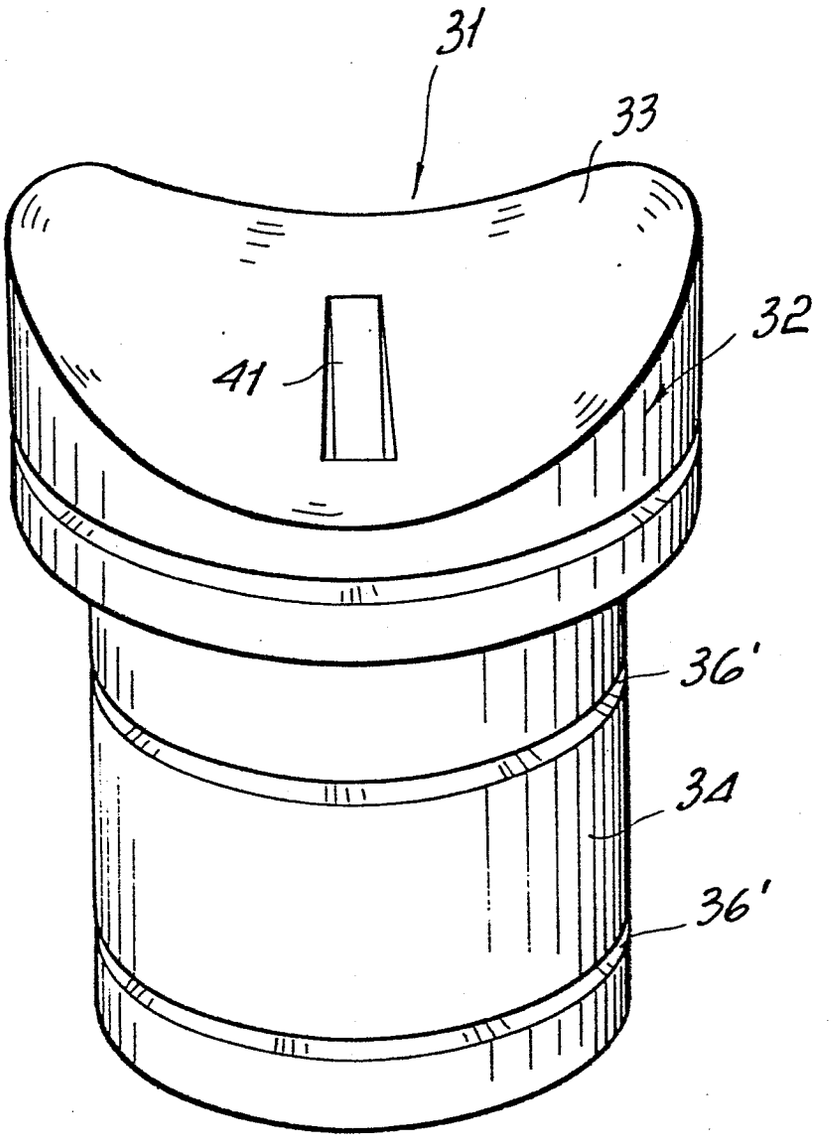

Fig.5