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(54) Rotary valves for internal combustion engines

(57) A rotary valve member 8 for a rotary valve controlling supply and exhaust of gas to and from an internal combustion engine has two circumferential grooves 17 joined by two grooves 30. Each groove 17 contains sealing rings 25, 26A and 26B pressed outwardly against a cylinder wall 13 by a spring 20. Each groove 30 contains blocks 32 engaging the ends of a sealing bar 33. A spring 31 presses the bar 33, via the blocks 32, against the cylinder wall 13.

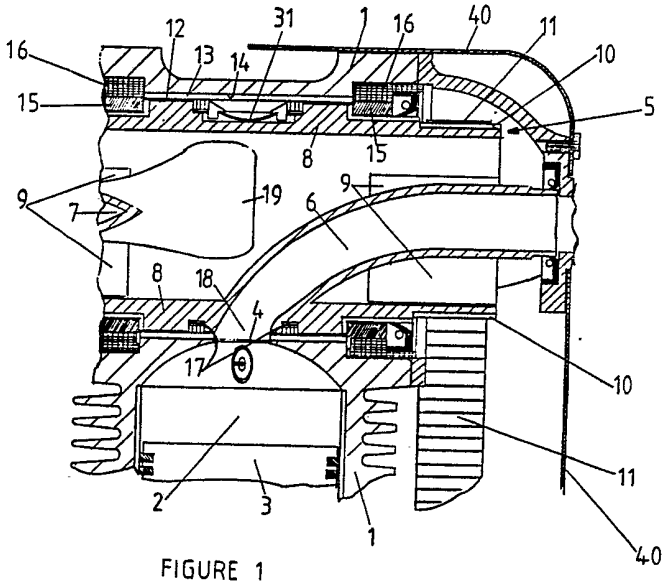

FIGURE 1

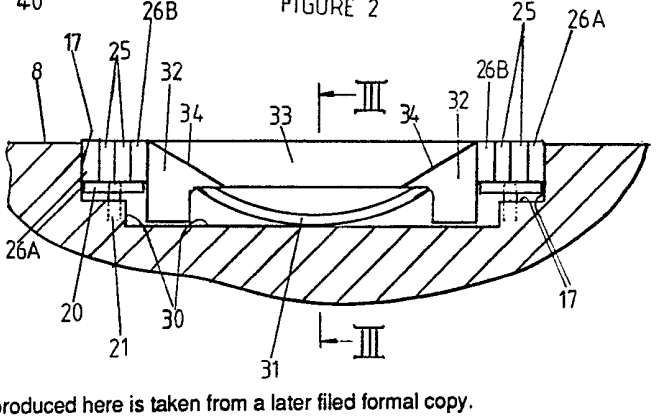

FIGURE 2

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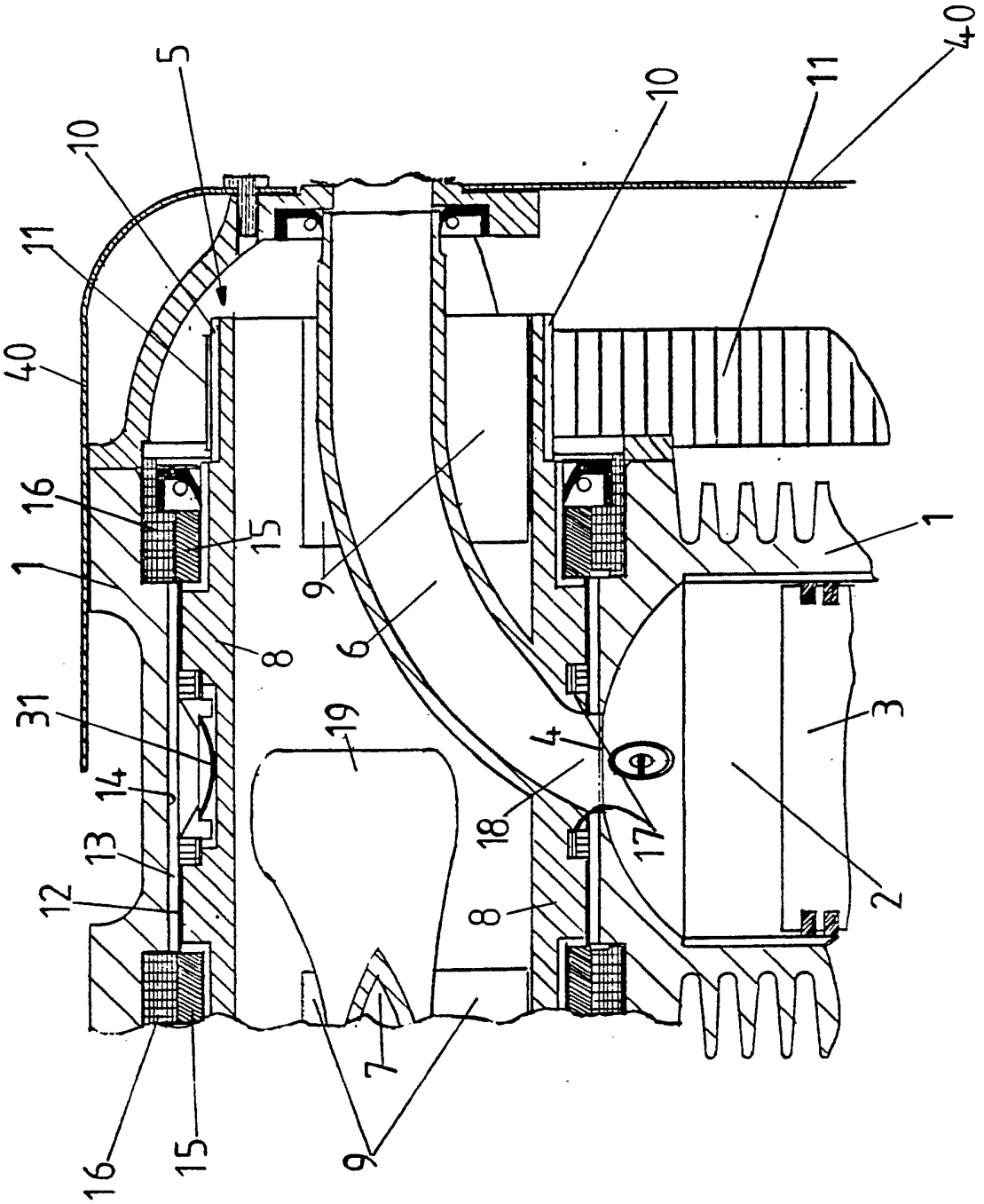

FIGURE 1

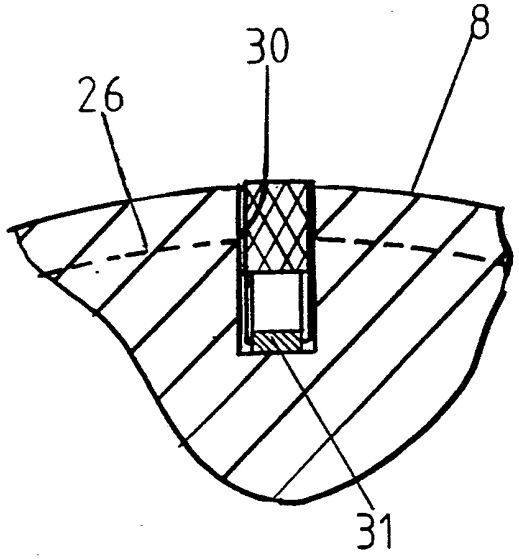

FIGURE 3

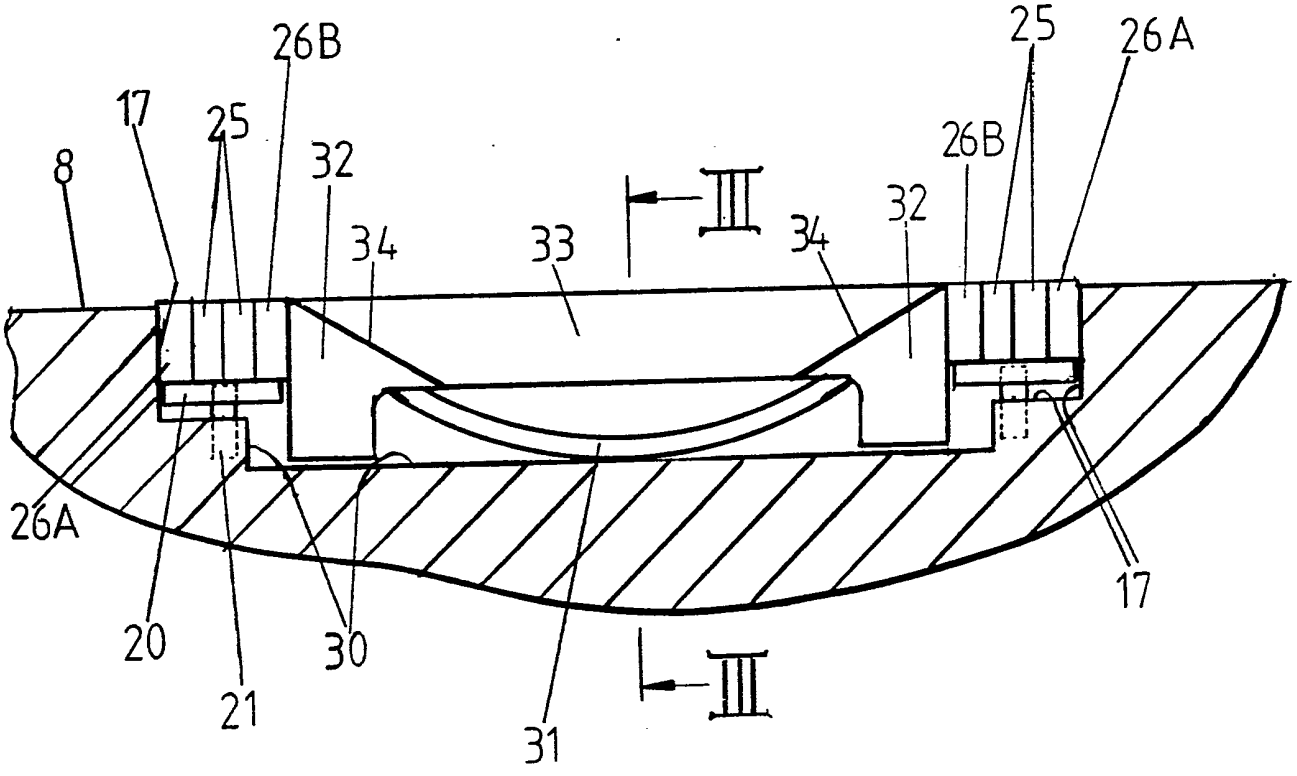

FIGURE 2

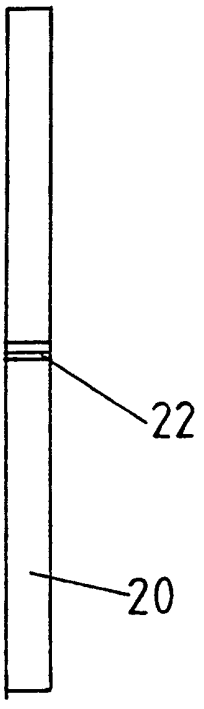

FIG 5

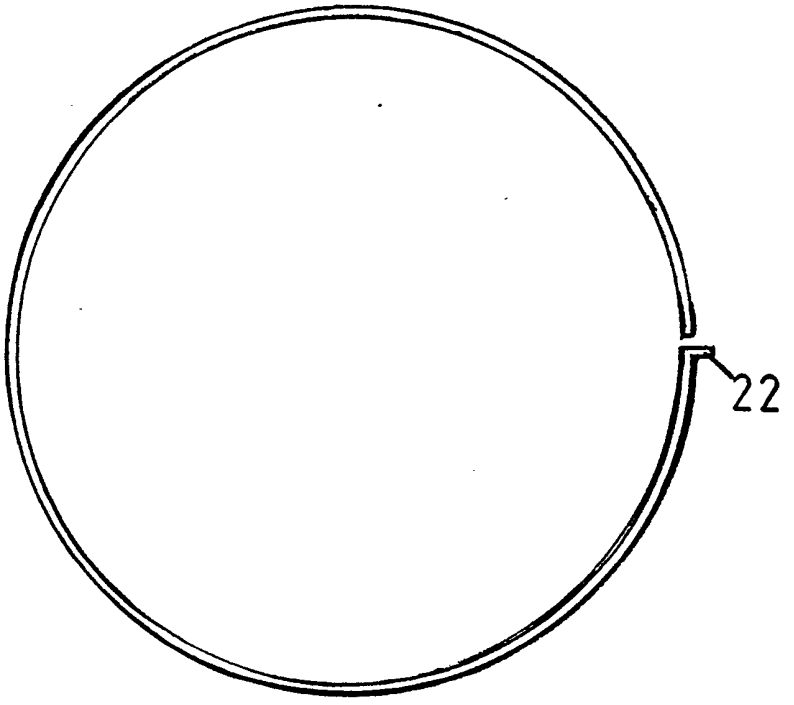

FIG 4

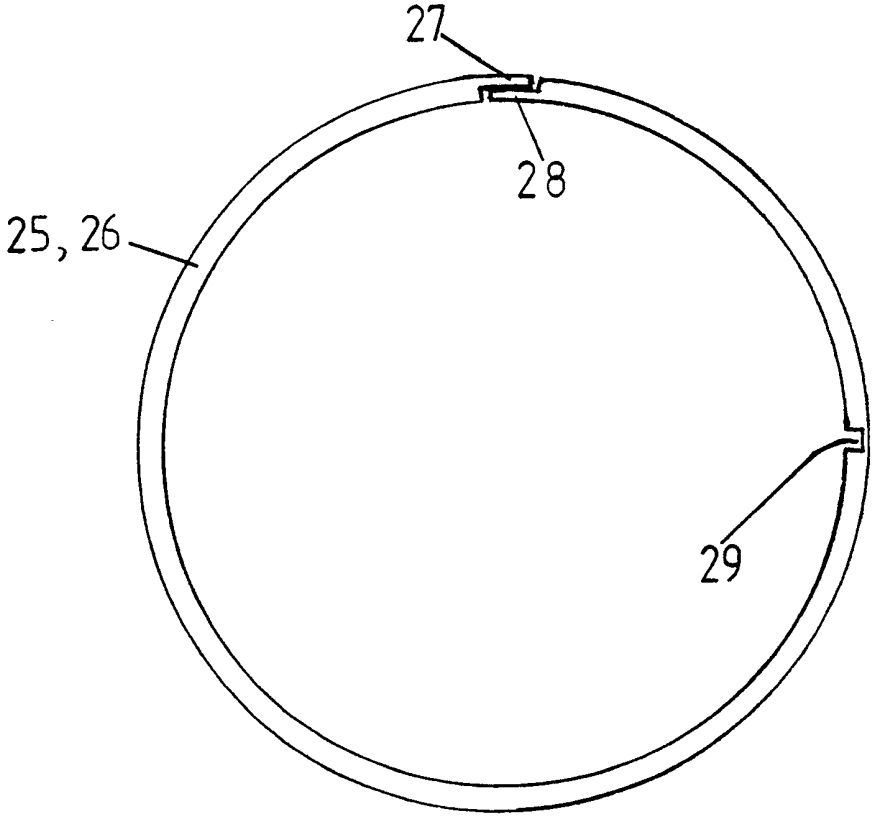

FIGURE 6

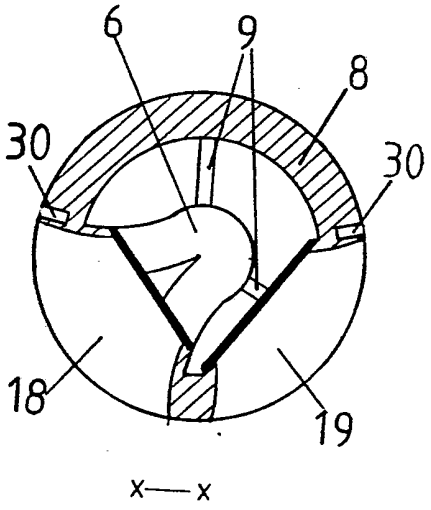

FIG 7

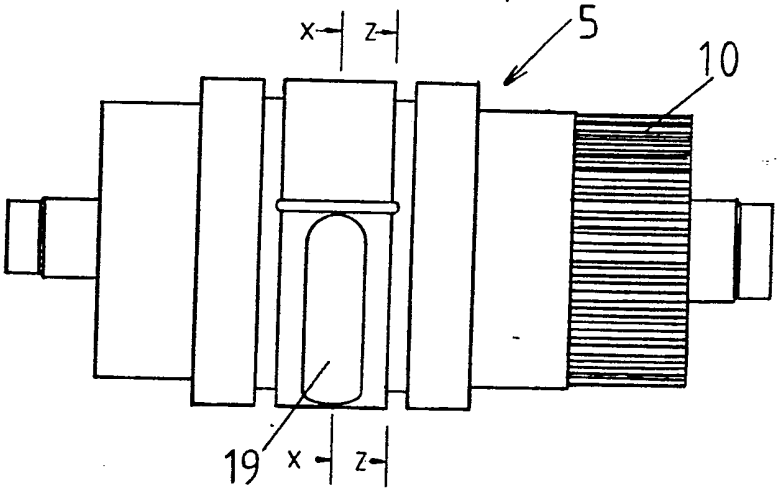

FIG 8

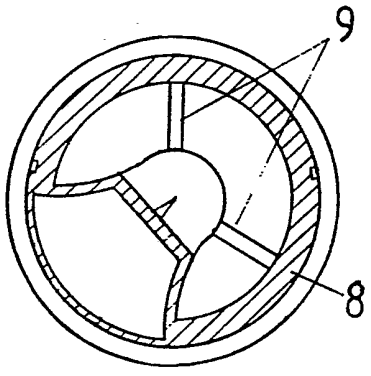

FIG 9

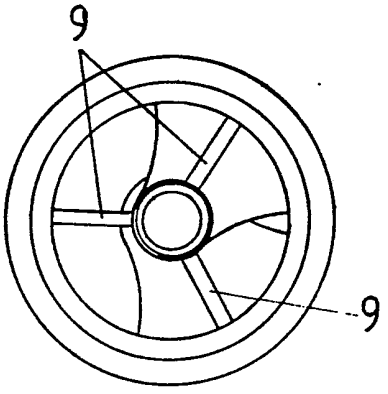

FIG 10

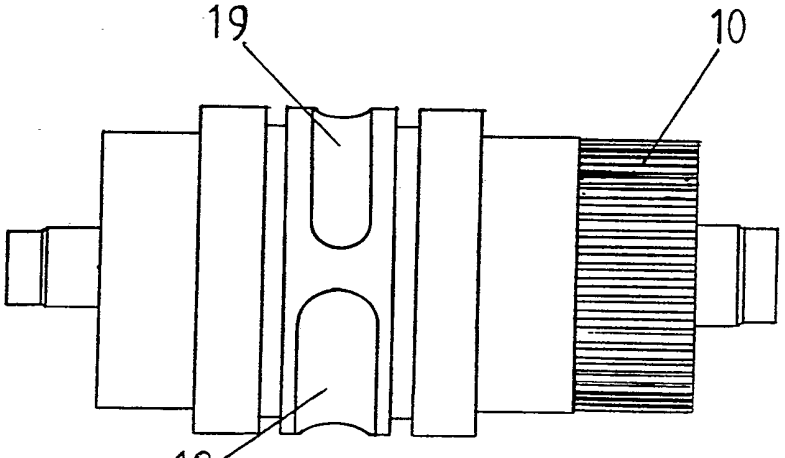

FIG 11

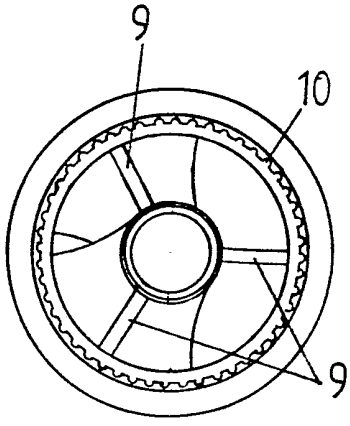

FIG 12

ROTARY VALVES FOR INTERNAL COMBUSTION ENGINES

According to the invention, there is provided a rotary valve member as defined by claim 1. Claims 2 to 9 define features which appear to be important but not essential features of an embodiment of the invention.

An example in accordance with the invention is described below with reference to the accompanying drawings, in which:

Figure 1 shows a sectional side view of a rotary valve in an internal combustion engine,

Figure 2 shows an enlarged view of a sealing arrangement shown in Figure 1,

Figure 3 shows a sectional view, taken as indicated by the arrows III in Figure 2, of the sealing arrangement,

Figures 4 and 5 show two side views of a spring,

Figure 6 shows a side view of a sealing ring, and

Figures 7 to 12 show various views of a valve member of the rotary valve, with the sealing arrangement not fitted to it.

Figure 1 shows a cast cylinder block 1 of an air-cooled internal combustion engine, the block containing a cylinder 2 in which a piston 3 slides vertically. Gas enters and leaves the cylinder 2 through a port 4 under the control of a rotary valve. The valve includes a rotary valve member 5 which rotates about a horizontal axis and includes a duct 6, through which gas enters the cylinder 2 when the valve member 5 is in the illustrated position, and a duct 7, through which gas leaves the cylinder 2 when the valve member has rotated to another position. These duct members are held suspended in space within a hollow cylindrical part 8 of the valve member by webs 9. The arrangement is such that far less than half of the space within the part 8 is occupied by solid material. Air which is passed through the part 8 can, therefore, cool the

valve member substantially. Cowls 40 are fixed to the block 1 to guide air in a ducted air cooling system.

At one end the valve member 5 has a ring of teeth 10 which co-operate with a toothed belt 11 to rotate the valve member 5 within a cylinder 12 formed within a lining 13 of a bore 14 in the cylinder block 1. Oil film lubricated plain bearings 15 held by bearing carriers 16 support both ends of the valve member 5.

Two circumferential grooves 17, 5 mm. deep, are formed in the part 8 of the valve member on the opposite sides of a port 18, through which gas leaves the duct 6 to flow through the port 4, and also on opposite sides of a port 19, through which gas enters the duct 7 after flowing through the port 4. In each groove 17 there is a spring 20 in the form of a band of rectangular cross-section bent into the shape of an almost complete circle with a narrow gap between the two ends. A peg 21 locates the spring 20 by projecting into recesses in the spring and in the part 8 of the valve member, as shown in Figure 2, and the spring has an outwardly-turned lug 22 at one end, as shown in Figure 4. Each spring 20 presses outwardly, against the lining 13, two sealing rings 25 which are 1.25 mm. wide and two sealing rings 26A and 26B which are 1.50 mm. wide. The sealing rings 25 and 26A are all made of a plastics material, for example polytetrafluoroethylene (P.T.F.E.) in the case of the sealing rings 25 and polyetheretherketone (P.E.E.K.) in the case of the sealing rings 26A, and the sealing rings 26B may be made of a carbon matrix-carbon fibre composite material, for example one comprising about 99% by weight of carbon, or some other material with a high carbon contant, i.e. more than 50% by weight.

Each sealing ring 25, 26A or 26B is in fact a split ring with its ends 27 and 28 reduced in thickness

and overlapping, each lying in a recess in the other, and with a recess 29 to receive the lug 22 of the spring 20.

Two longitudinal grooves 30 are formed in the part 8 of the valve member, these being deeper than the grooves 17 and joining them. In each groove 30 there is a spring 31 which presses outwardly two blocks 32 of ceramic material, for example silicon nitride, or a carbon-containing material, for example a resin with carbon fibres incorporated in it, which in turn press outwardly, against the lining 13, a bar-shaped seal 33 made of the same material. The contact faces 34 between the parts 32 and 33 are inclined to allow for expansion and contraction and are ground to prevent passage of gas between them. The blocks 32 are in sliding contact with the sealing rings 26B.

CLAIMS:

1. A rotary valve member for controlling the supply and exhaust of gas to and from the cylinder of an internal combustion engine, the valve member being formed with two circumferential grooves containing sealing rings made of plastics material and/or sealing rings consisting predominantly of carbon and springs for pressing the sealing rings against a surrounding stator wall, the valve member also being formed with two further grooves extending along it and joining the circumferential grooves, each further groove containing a sealing bar made of a ceramic material or a carbon-containing material and a spring for pressing the sealing bar against the stator wall.

2. A valve member according to claim 1 in which each circumferential groove contains a row of sealing rings and a single spring for pressing them all outwardly, the single spring being in the form of an almost complete circle.

3. A valve member according to claim 2 in which the sealing rings nearest the sealing bar are made of a composite material consisting predominantly of carbon and other sealing rings are made of plastics material.

4. A valve member according to any preceding claim in which each sealing ring is a split ring and has its two ends reduced in thickness and overlapping one another and also has an internal recess which receives an outwardly-turned projection on a spring lying within the sealing ring.

5. A valve member according to any preceding claim in which each sealing bar has at each end an inclined flat inwardly-facing surface which engages an inclined flat outwardly-facing surface on a respective one of two blocks made of a ceramic material or a carbon-containing material which are pressed outwardly by opposite ends of a plate spring.

6. An internal combustion engine having a rotary valve member according to any preceding claim arranged to control the supply and exhaust of gas to and from the cylinder.

7. A component suitable for use in a valve member according to any preceding claim, the component being a hollow cylinder formed externally with grooves to receive the seals and springs and provided internally with gas inlet and outlet ducts supported in space within the cylinder, the arrangement being such that solid material occupies far less than half of the space within the cylinder.

8. A rotary valve member substantially as hereinbefore described with reference to the accompanying drawings.

9. An internal combustion engine substantially as hereinbefore described with reference to the accompanying drawings.

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