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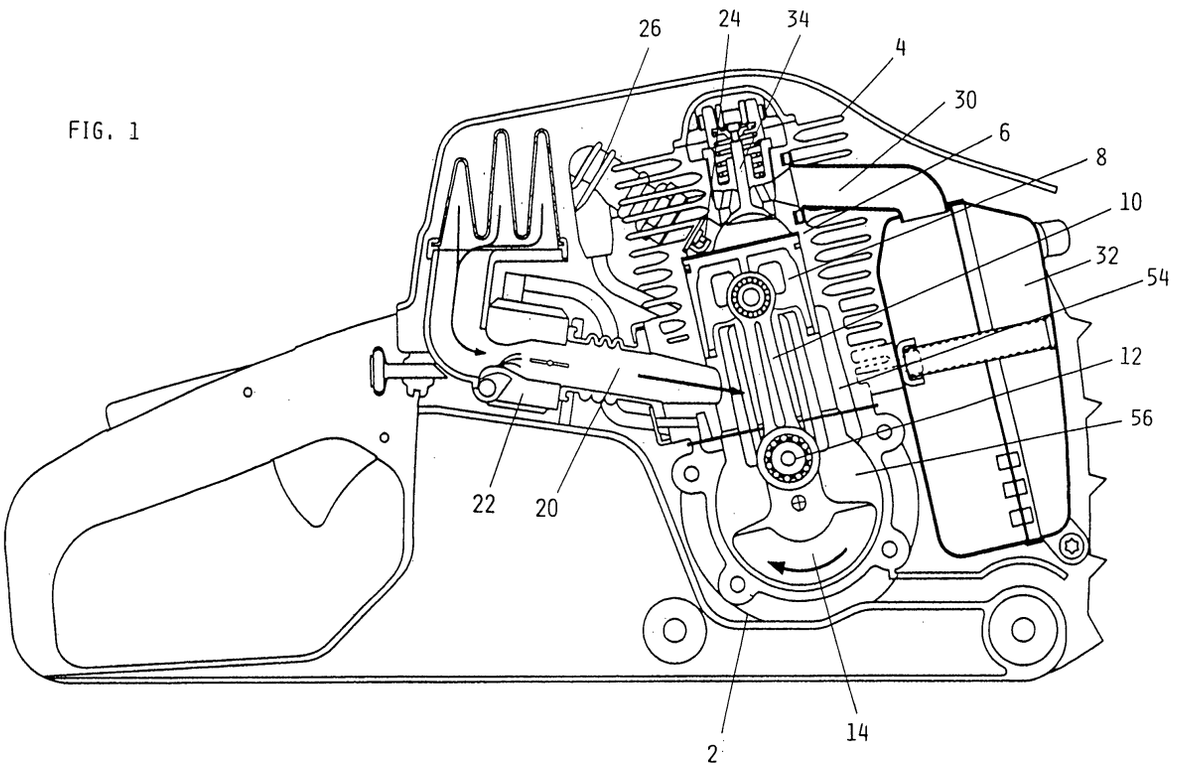
(54) Three-phase internal combustion engine for portable devices

(57) A three-phase internal combustion engine, in particular for portable devices such as power chain saws, brush cutters, hedge trimmers, blowers, atomizers, etc., characterised by comprising an engine block (2) in which there is provided at least one cylindrical seat (6) for the reciprocating movement of a piston rigid with a connecting rod-crank unit, the mixture entry ports (20) and the mixture transfer channels opening into said seat, said seat also comprising a combustion chamber provided with a valve (34) for the exit of exhaust gas, said valve being operated by the rotation of a shaft (16) rigid with the crank (14).

FIG. 1



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Description

[0001] This invention relates to a three-phase internal combustion engine, in particular for portable devices such as power chain saws, brush cutters, hedge trimmers, blowers, atomizers, motorcycles, outboard motors, garden lawn mowers, etc.

[0002] Portable devices such as power chain saws, brush cutters, blowers, atomizers etc. with a two-phase internal combustion engine are known in which the output shaft is connected to an operating member of the cutting tool or of the fan.

[0003] These two-phase engines comprise an engine block in which, for the reciprocating movement of the piston, there is provided a cylindrical seat into which the mixture entry ports, the mixture transfer channels and the spent gas discharge ports open.

[0004] These known engines have however the drawback that during piston descent, the mixture which passes through the transfer ports can mix with the spent gas, which results on the one hand in a decrease in efficiency and on the other hand environmental pollution due to unburnt mixture leaving through the discharge ports.

[0005] Four-phase engines have also been proposed which present other drawbacks, and in particular:

- a heavy complex engine due to the crankcase with lubricating oil, the valves, the cams, rods and rocker levers for valve movement, the reduction gears and the crankcase vent,
- the possibility of oil loss by agitation or spillage when in the operating configuration,
- the need to continuously monitor the lubricating oil level and to replace it when necessary,
- increased pollution deriving from oil consumption, which increases with increased operating time, as the segments undergo wear.

[0006] An object of the invention is to eliminate these drawbacks by providing an internal combustion engine of high efficiency, low fuel consumption and very low weight, while at the same time not giving rise to environmental pollution.

[0007] This and further objects which will be apparent from the ensuing description are attained according to the invention by a three-phase internal combustion engine particularly for power chain saws, brush cutters, hedge trimmers, blowers, atomizers, etc. as claimed in claim 1.

[0008] The invention is described in detail hereinafter with reference to the accompanying drawings, in which:

Figure 1 is a longitudinal section through a portion of a power saw provided with the single-cylinder engine according to the invention in the mixture intake phase;
Figure 2 shows it in the same view as Figure 1 during commencement of the mixture compression phase;
Figure 3 shows it in cross-section;
Figure 4 is a detailed view of the exhaust valve operating rod;
Figure 5 shows a first variation of the engine;
Figure 6 is a cross-section through a two-cylinder V-engine;
Figure 7 shows it in the same view as Figure 1;
Figure 8 shows a second variant of the two-cylinder engine; and
Figure 9 is a cross-section through Figure 8.

[0009] As can be seen from the figures, the internal combustion engine of the invention is described herein as a drive member for a cutting tool, and in particular a power chain saw to which it is applied. The engine can evidently also be used for driving other portable machines such as bush cutters, hedge trimmers, blowers, atomizers, or other machines such as motorcycles, mopeds, outboard motors, garden lawn mowers, etc.

[0010] The internal combustion engine according to the invention comprises essentially an engine block 2 containing a cylindrical seat 6 provided with cooling fins 4 and slidingly housing a piston 8 provided with a connecting rod 10 pivoted on a pin 12 to a crank 14. A shaft 16 rigid with the crank 14 operates a sprocket wheel 18 which engages the links of a chain.

[0011] The cylindrical seat 6 contains the exit of the feed conduit 20 for the mixture originating from the carburettor 22, the electrodes of the ignition spark plug 26 and a further aperture 28 provided at the head of the cylinder to connect the cylindrical chamber to a conduit 30 for discharging the exhaust gas to a silencer 32 via a valve 34.

[0012] The valve 34 is axially slidable within a U-shaped socket 36 containing a coil spring 38 interacting with a flange 40 on which a rocker lever 42 acts.

[0013] In the absence of external thrusts the spring 38 maintains the valve 34 in the configuration in which it closes passage between the cylindrical seat 6 and the exit port 30.

[0014] The other arm of the rocker lever 42 is acted upon by the end of a rod 44 rigid at its other end with a bush 46 which by way of an interposed roller bearing 48 embraces a cylindrical member 50 having an eccentric hole 52, to form an annular ring of variable thickness for engaging the output shaft 16.

[0015] The cylindrical member 50 is rigid with the shaft 16 such that when the passage port between the cylindrical seat 6 and the conduit 30 is closed, i.e. with the spring unstressed, the thinnest part of the annular ring lies above the shaft 16.

[0016] The internal combustion engine of the invention operates in the following manner, starting from the configuration in which the piston 8 (see Figure 1) is at its top dead centre and the valve 34 is in the configuration which closes communication between the cylindrical seat 6 and the exit port 30. Mixture is drawn from the

conduit 20 during the rising of the piston 8, and during its descent the mixture is compressed in the chamber 56 and then made to pass through the transfer ports 54 into the cylindrical seat 6.

[0017] During the piston descent the shaft 16 rotates to axially move the operating rod 44 of the rocker lever 42 by means of the ring 50, such as to initially compress the spring 38 in opposition to its elastic reaction and then to cause the valve 34 to descend, to connect the cylindrical seat 6 to the exit port 30 and enable the spent gas contained in the cylindrical seat 6 to flow out.

[0018] When the piston reaches its bottom dead centre and commences its upward phase, it causes:

- initiation of closure of the valve 34,
- compression of the mixture contained in the cylindrical seat 6.

[0019] Slightly before the piston reaches its top dead centre, the spark is struck between the electrodes 24 of the spark plug 26, to ignite the mixture which surrounds them. From this point the combustion propagates with rapid pressure increase to the rest of the mixture, to again cause the piston to descend and hence enable the spent gas to expand.

[0020] It should be noted that the spent gas present in the cylindrical chamber has a density different from the fresh mixture originating through the transfer ports 54, so that stratification of the substances occurs without their mixing, with the result that exit of unburnt mixture through the port 30 is prevented.

[0021] In the embodiment shown in Figure 5 the valve is positioned to the side of the piston and the rod 44 acts directly on the valve.

[0022] Figures 8 and 9 represent a two cylinder in-line engine, the valves 34 of which are operated by the rotation of a shaft 58 with cams 60 rigid with a first toothed wheel 62 connected by a toothed belt 64 to a second toothed wheel 66 rigid with the output shaft 68.

[0023] From the aforegoing it is apparent that the engine of the invention presents numerous advantages, and in particular:

- a drastic reduction in harmful gas leaving the exhaust pipe due to elimination of unburnt mixture,
- a reduction in the percentage of oil in the petrol mixture as the cylindrical seat does not comprise the traditional two-phase engine discharge port,
- high efficiency as a result of no loss of unburnt mixture from the exhaust, as happens in two-phase engines.

Claims

1. A three-phase internal combustion engine, in particular for portable devices such as power chain saws, brush cutters, hedge trimmers, blowers, atomizers, etc., **characterised by** comprising an engine block (2) in which there is provided at least one cylindrical seat (6) for the reciprocating movement of a piston rigid with a connecting rod-crank unit, the mixture entry ports (20) and the mixture transfer channels opening into said seat, said seat also comprising a combustion chamber provided with a valve (34) for the exit of exhaust gas, said valve being operated by the rotation of a shaft (16) rigid with the crank (14).

2. An engine as claimed in claim 1, **characterised in that**, in the absence of external stresses, a spring (38) maintains the valve in the configuration in which it closes the port (30).

3. An engine as claimed in claim 1, **characterised by** associating with the valve a rod (44) rigid with a cam (50) keyed onto the shaft (16) of the crank (14).

4. An engine as claimed in claim 3, **characterised by** associating with the valve (34) an arm of a rocker lever (42), the other arm of which interacts with the rod (44) rigid with a cam (50) keyed onto the shaft (16) of the crank (14).

5. An engine as claimed in claim 1, **characterised in that** the valves (34) are operated by the rotation of a shaft (58) comprising cams (60) which is rigid with a first toothed wheel (62) connected by a toothed belt (64) to a second toothed wheel (66) rigid with the output shaft (68).

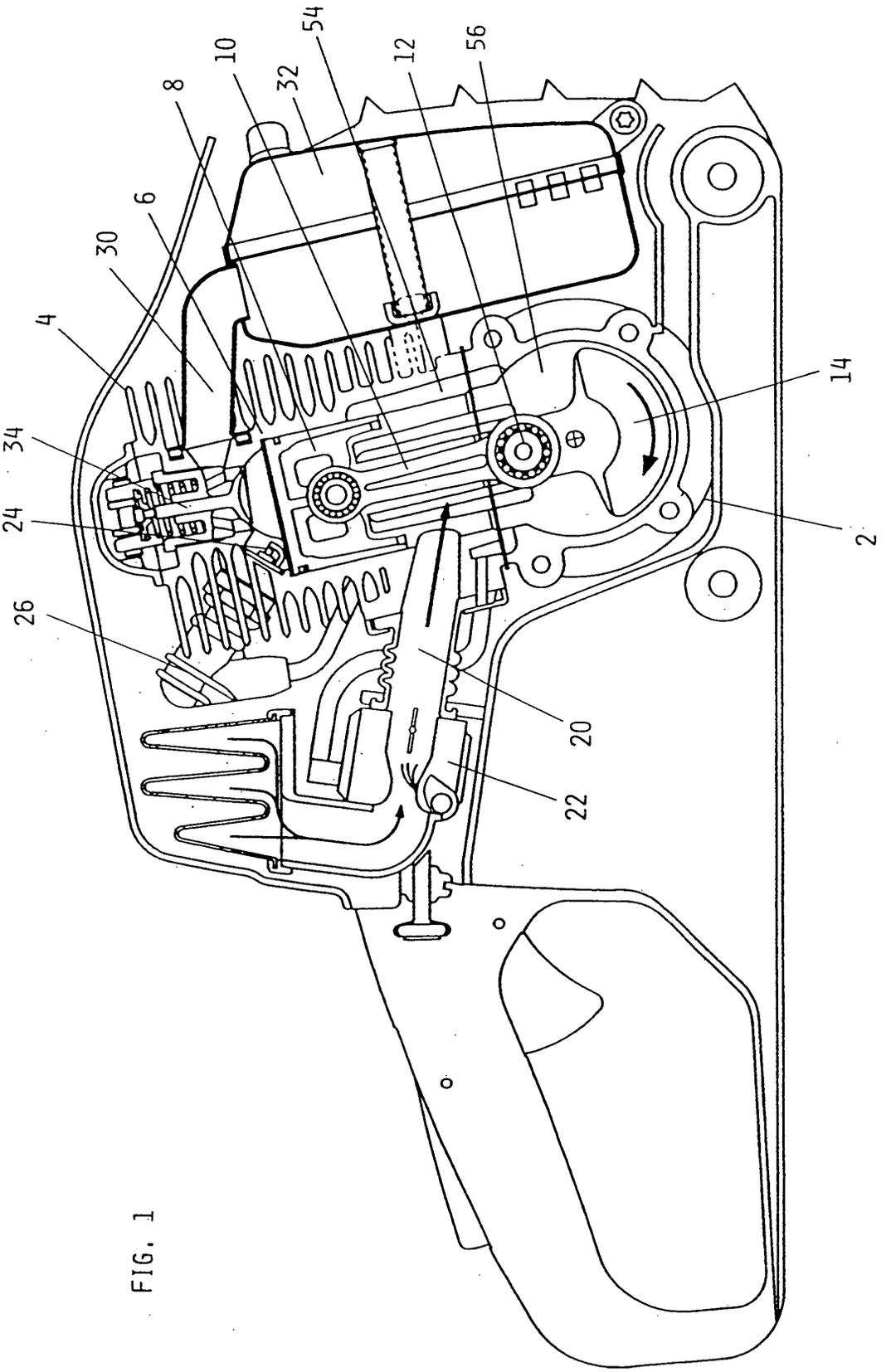


FIG. 1

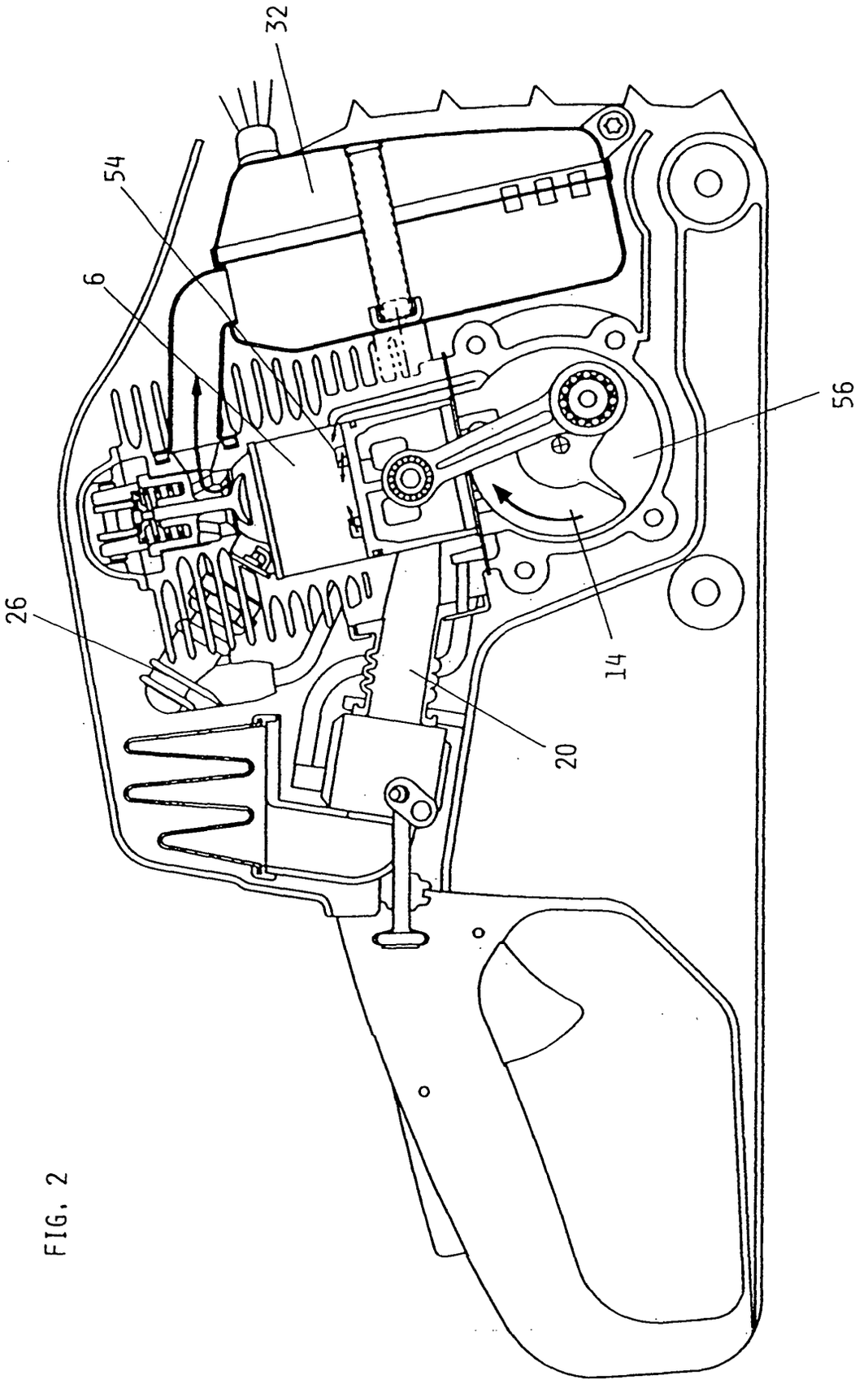


FIG. 2

FIG. 3

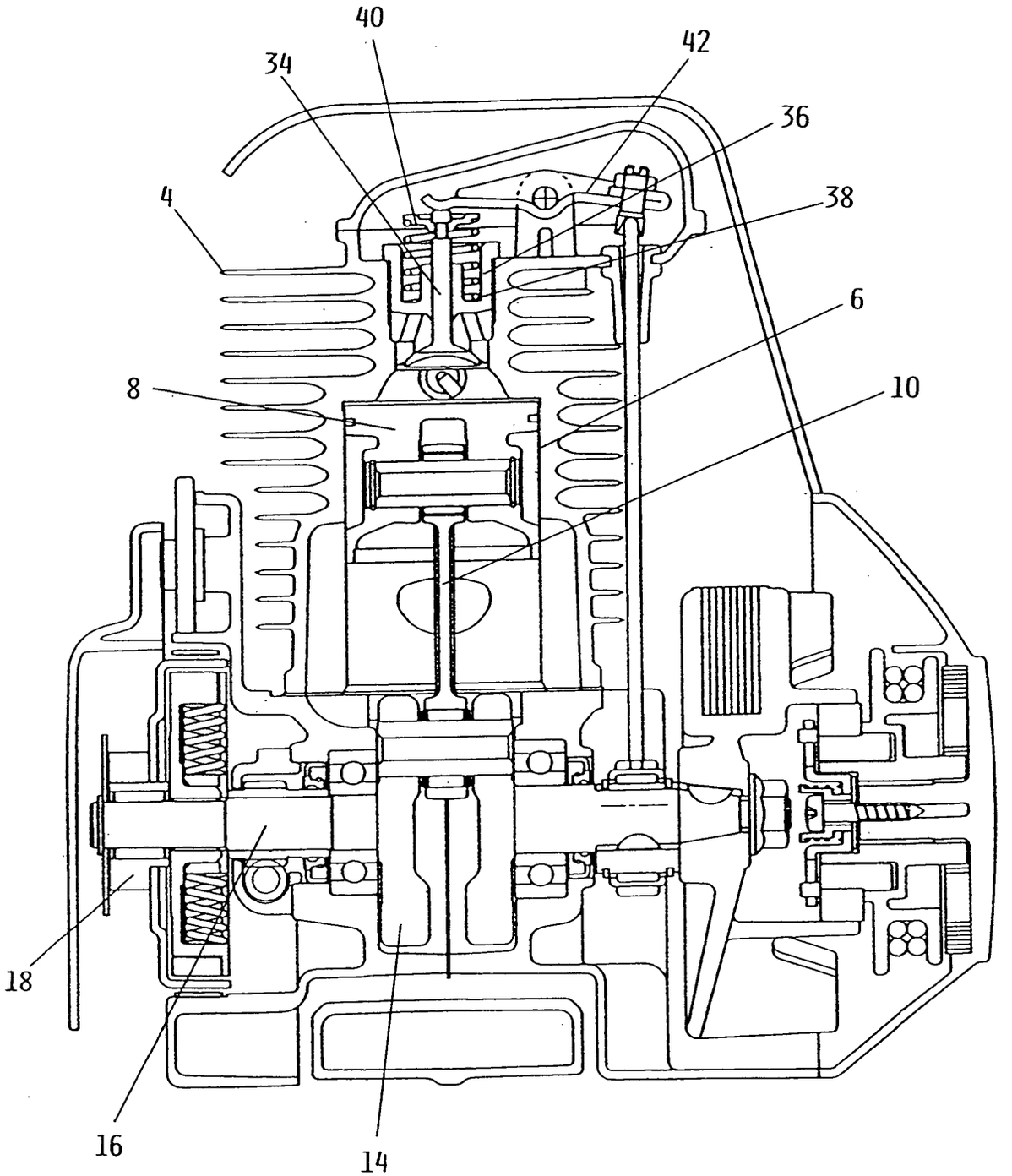
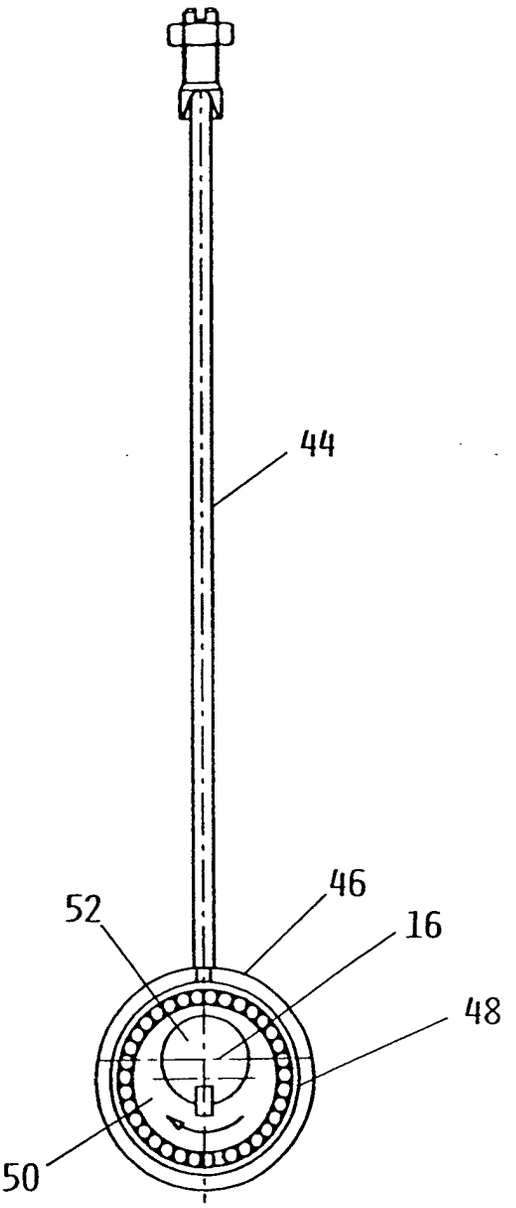


FIG. 4



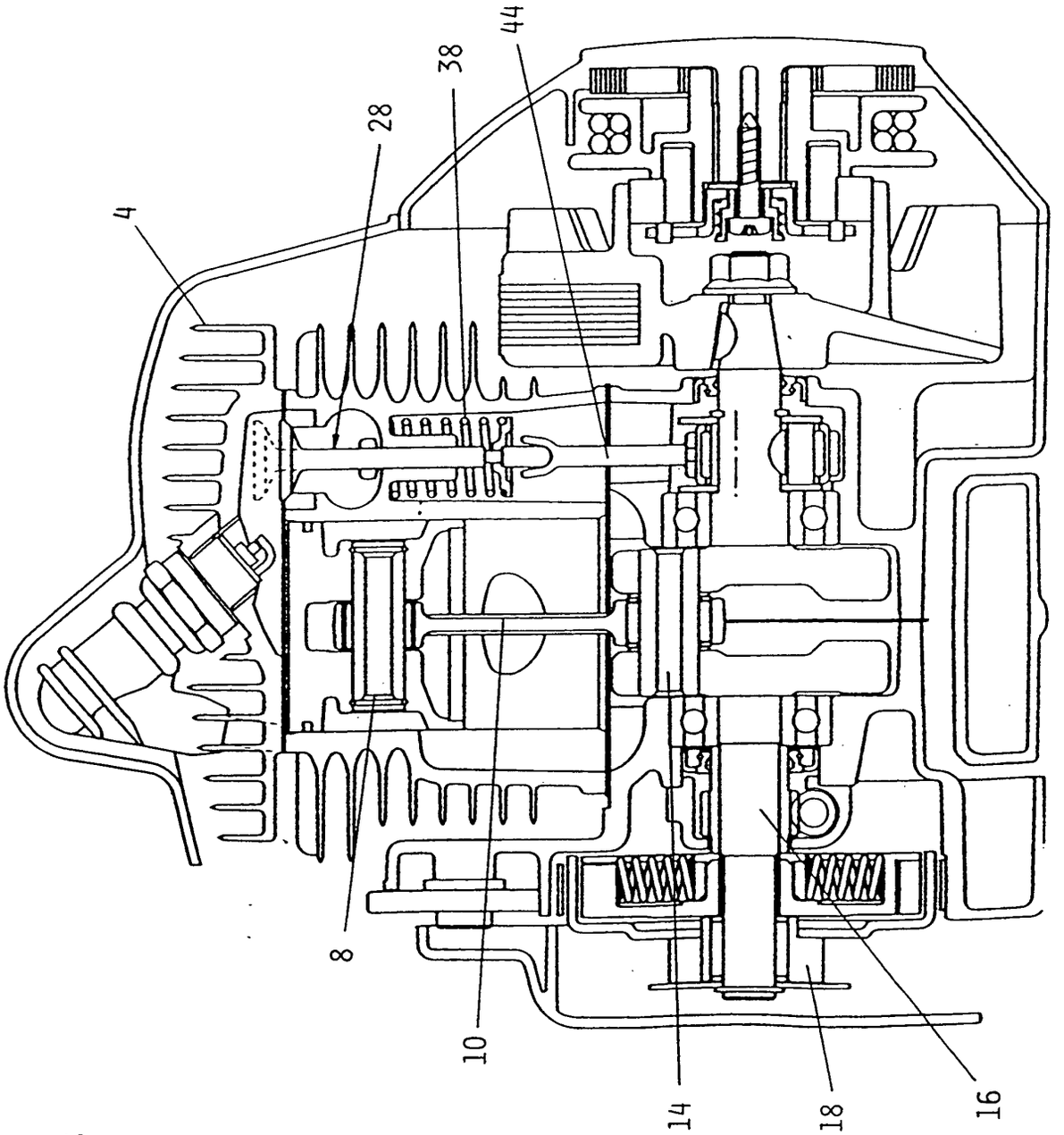


FIG. 5

FIG. 6

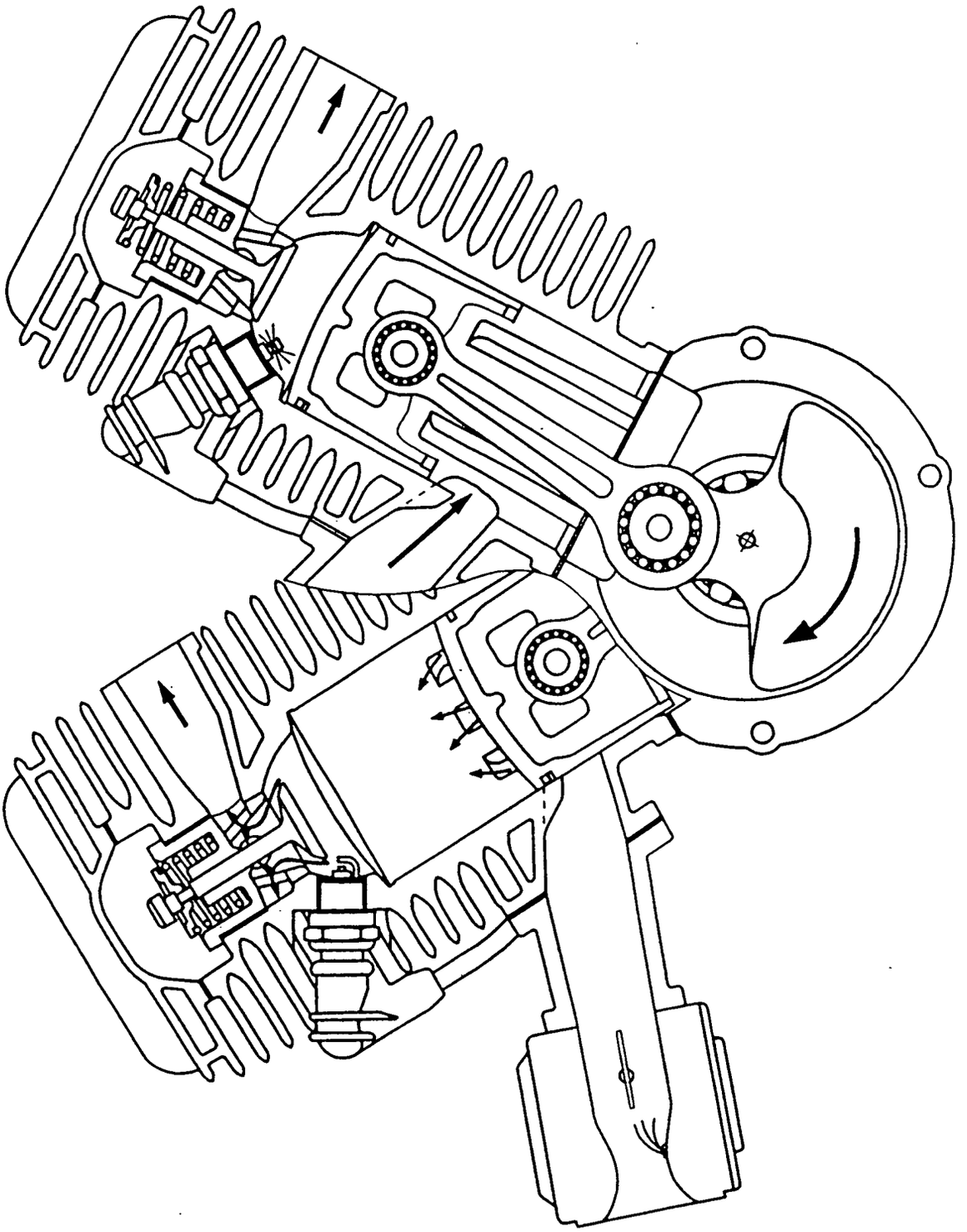


FIG. 7

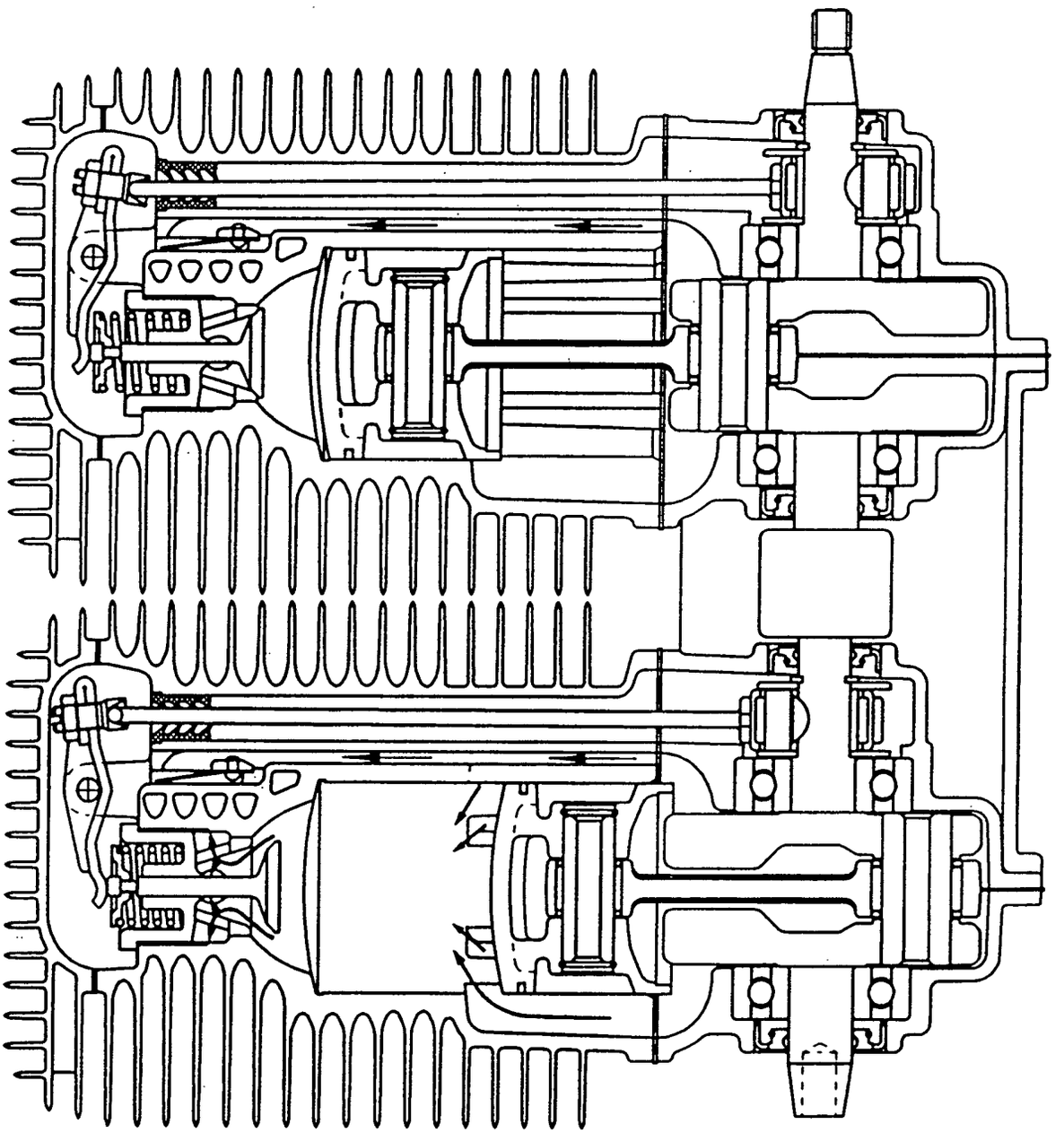


FIG.8

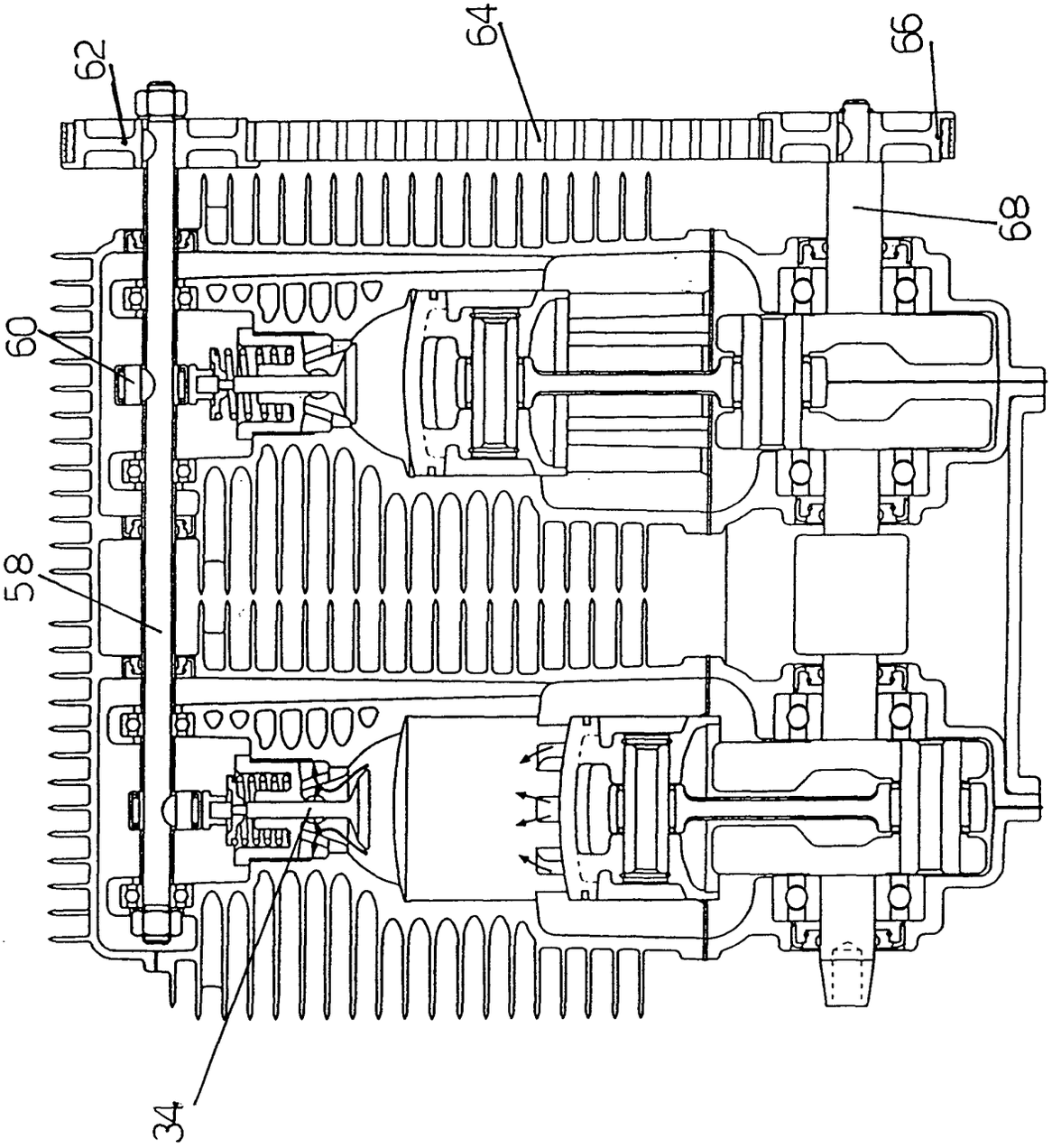


FIG. 9