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DE FR IT(30) Priority: **07.11.1995 GB 9522793**(71) Applicant: **Robert Cort limited**
Reading RG2 0DL (GB)(72) Inventor: **Wrigley, Deborah Ann**
Shropshire, DY14 8RG (GB)(74) Representative: **Stuart, Ian Alexander et al**
MEWBURN ELLIS
York House
23 Kingsway
London WC2B 6HP (GB)(54) **Compressed gas motor**

(57) A motor piston (18) is caused to reciprocate in a motor cylinder (12) by compressed air fed to alternate sides of the cylinder (12), under the control of a valve (32). A control piston (20;22) is linked to the motor piston (18) for movement in a control cylinder (14;16). As it

moves towards one end, it expels air from the cylinder (14;16) through an outlet (38). For the last part of the stroke, the outlet (38) is closed off by the piston (20;22), so air pressure rises. This pressure is conveyed (40) to the valve (32), and causes it to switch, thus causing the pistons (18,20,22) to be driven the other way.

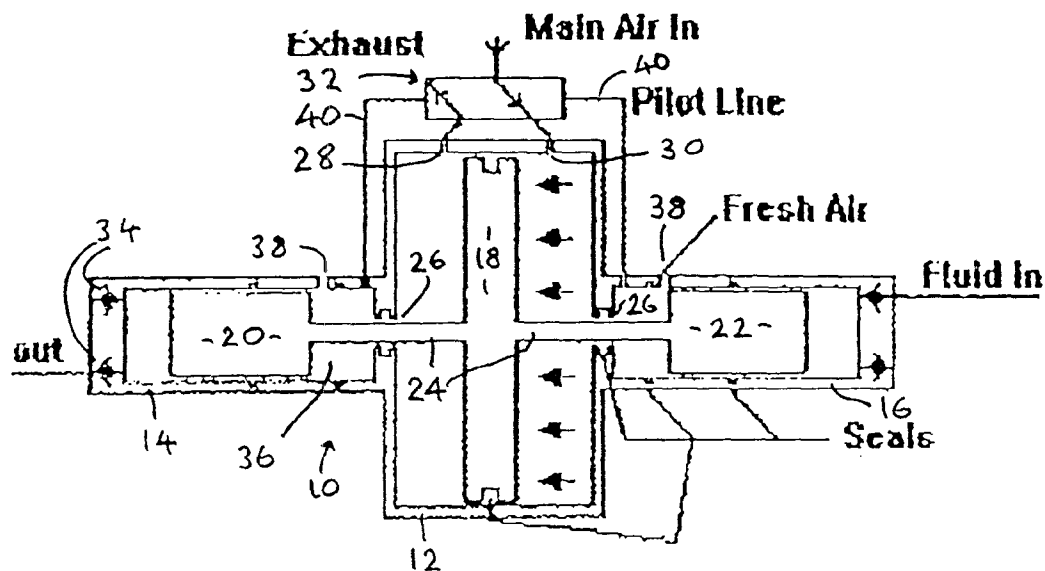


Fig 1

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Description

The present invention relates to a motor which is powered by compressed gas (typically air), and to a fluid pump which uses such a gas motor to effect pumping.

Known reciprocating gas pumps all use valves for directing compressed gas alternately to one side and the other side of a piston in a cylinder, for causing the piston to reciprocate. Various mechanisms are used for triggering the switching of the valve. These include designs involving push-rods, pneumatic timing ports, magnetic pilot valves, and special seals. In all cases, whatever the nature of the triggering event, the movement of the main valve is actually caused by allowing some of the compressed gas supply to act upon the end of the valve. This makes it very difficult to achieve a rapid and accurate response. Consequently known gas motors tend to be inefficient, with the pistons not reliably travelling for the full intended stroke. There are particular problems if the motors are intended to operate over a range of speeds, and particularly at high speed.

The present invention concerns a gas motor having a main (gas-driven) piston/cylinder arrangement, and also at least one secondary piston/cylinder arrangement which effects compression of a secondary gas supply when the main piston is nearing the end of an intended stroke. The compressed secondary gas supply is used to move the main switching valve.

The secondary gas may be atmospheric air.

The secondary piston/cylinder arrangement may employ a secondary piston which is linked with the main piston so that it reciprocates synchronously, in its own cylinder. This secondary piston/cylinder may serve as a fluid pump, as well as having a switching function. Thus the second cylinder may have a port communicating with atmospheric air, which port is arranged to be closed as the secondary piston moves towards one end of its stroke. Thus further movement in the same direction compresses air trapped in the cylinder. This compressed air then serves for moving the main switching valve.

In a preferred arrangement, the main piston and cylinder are coaxial with a pair of smaller secondary piston/cylinder assemblies. All three pistons are connected so as to reciprocate together. One end region of each secondary cylinder may serve as a fluid pump/ there being check valves so that, in a generally conventional way, fluid is sucked in and pushed out as the secondary pistons reciprocate. On the other sides of the secondary pumps, there are air spaces in the secondary cylinders, each having a port communicating with the atmosphere. As the main piston approaches the end of its intended stroke, one of the secondary pistons moves to obstruct its port. Continuing movement therefore compresses the atmospheric air in the associated air space. The air spaces are communicated with the main valve controlling the gas supply to the main cylinder, so that this is switched.

Thus in the present design, the task of moving the switching valve is removed from the main gas (usually air) supply, and devolved to a secondary fluid system, usually using atmospheric air. Thus there are independent signals to switch the valve, giving repeatable and continuous operation under a wider range of operating conditions. The pressure required to switch the valve can accumulate over a relatively long period, during which the powering of the main piston is not affected. Thus the main piston will carry out full strokes. The main piston can operate at quite low pressure particularly if (as would normally be the case) the secondary cylinders are of much smaller area, giving high compression.

An embodiment of the invention will now be described in more detail with reference to the accompanying drawings, in which:

Fig. 1 is a schematic sectional view of an air driven fluid pump embodying the invention and Fig. 2 is a like view of the pump, showing the pistons in a different configuration.

The illustrated pump has a casing 10 defining a large primary cylinder 12 and two small coaxial cylinders 14, 16, one on each side. The main cylinder contains a main piston 18, and the smaller cylinders contain smaller pistons 20, 22. They are linked by a coaxial rod 24. Between the main cylinder 12 and each small cylinder 14, 16, the rod passes through a sliding seal 26.

In the main cylinder, there are two ports 28, 30, disposed so that they are generally on different axial sides of the piston 18. The ports are coupled to a main valve 32 which, at any given time, links one of the ports to a compressed air supply, while connecting the other port to exhaust.

The two lesser piston/cylinder arrangements are identical to each other. At one end of the cylinder (e.g. cylinder 14) (in this embodiment, the outer end) there are a pair of ports 34 containing oppositely-oriented check valves. They will generally be connected to a hydraulic fluid system so that, as the piston (e.g. 20) reciprocates, it pumps hydraulic fluid. On the other side of the piston (e.g. 20) there is defined an air space 36. There is a port 38 normally communicating this to atmosphere. Thus, looking at the situation shown in Fig. 1, the pistons are moving to the left so that the air space 36 of the left cylinder 14 is growing, and air is passing in through the port 38. The air space 36 of the right hand cylinder 16 is decreasing, and so air is passing out through the port 38. However continued movement beyond the configuration shown in Fig. 1 causes the port 38 of the right hand cylinder 16 to be closed by the piston 22. Further movement of the piston 22 then compresses the air in the air space 36.

The air spaces 36 are communicated by pilot lines 40 to the main valve 32. The main valve is arranged so that it switches its configuration on receiving high pressure air through a pilot line. Thus Fig. 1 shows the valve

32 in the configuration for leftward movement. When the leftward movement is essentially complete, this causes a high-pressure air signal to be sent through the right-hand pilot line 40, causing the valve 32 to switch to the configuration shown in Fig. 2. The main compressed air supply then passes into the left-hand end of the main air cylinder 12, causing the pistons to be driven to the right.

Claims

1. A gas motor comprising:

a motor piston/cylinder assembly having a motor piston (18) and a motor cylinder (12), said cylinder (12) having first and second gas inlets (28,30) in respective opposite axial end regions;
gas supply means;
valve means (32) for coupling said gas supply means selectively to either one of said first and second gas inlets (28,30) of the motor cylinder; and
means for causing said valve means to switch between said first and second gas inlets, characterised in that said means for causing said valve means to switch comprises a control piston/cylinder assembly comprising a control cylinder (14;16) and a control piston (20;22); said control piston (20;22) being linked (24) to the motor piston (18) for movement therewith; said control piston/cylinder assembly (14,20;16,22) being arranged to urge compression of a secondary fluid when the control piston is nearing a first end of said control cylinder, thereby to generate a switching pressure; and
pilot line means (40) communicating the first end region of the control cylinder to said valve means (32) to communicate said switching pressure thereto; and wherein said valve means is arranged to switch said gas supply means from said first gas inlet (28) to said second gas inlet (30) when said switching pressure is communicated to it.

2. A gas motor according to claim 1 wherein said control piston/cylinder assembly (14,20;16,22) is arranged to urge said compression of a secondary fluid only when the control piston (20;22) is in a pre-determined end region of the control cylinder (14;16).

3. A gas motor according to claim 2 wherein said secondary fluid is air and said control cylinder (14;16) has an opening (38) in its cylinder wall communicating with atmosphere, which opening is closed by the control piston (20;22) as it moves into said pre-

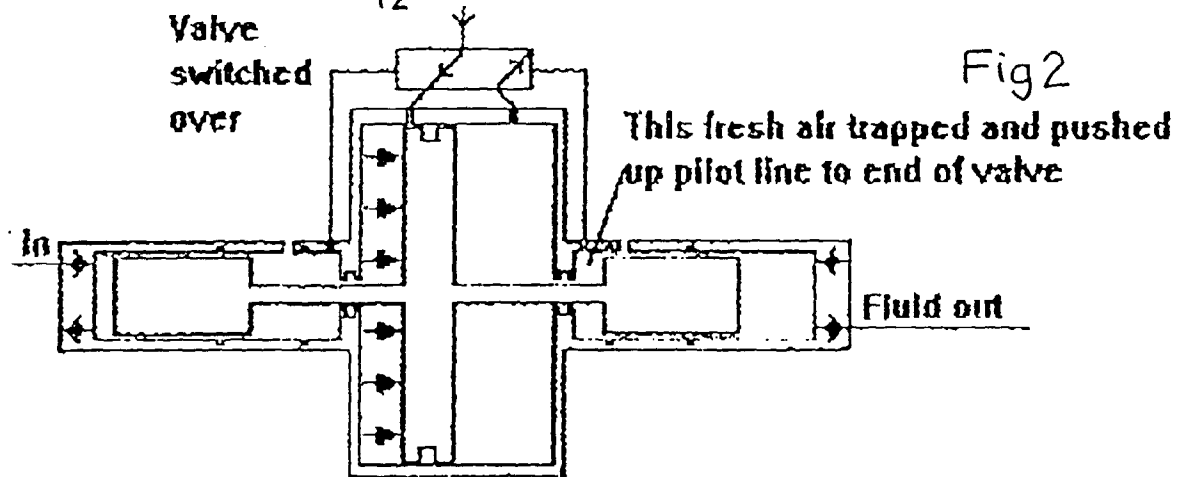
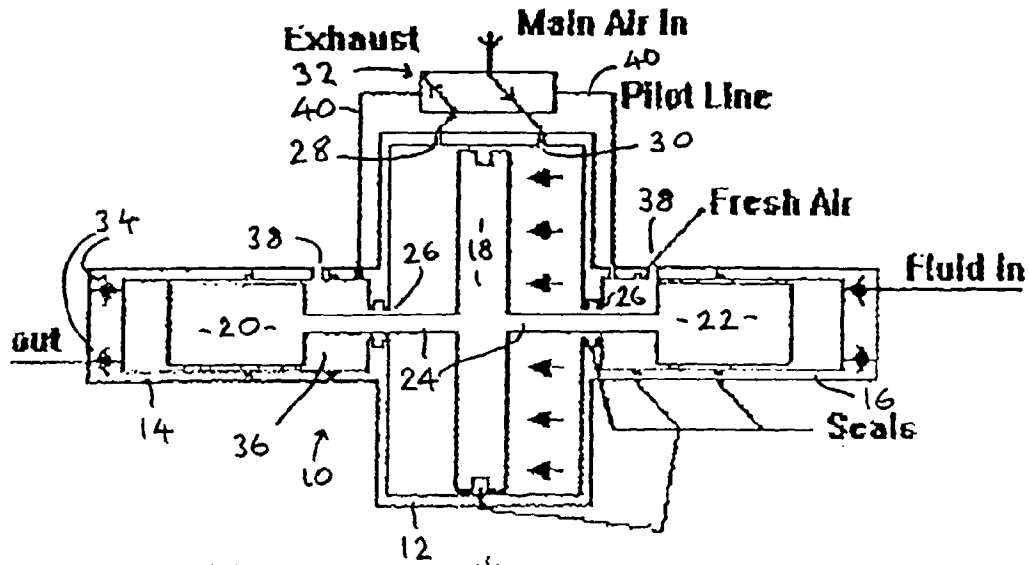
determined end region.

4. A gas motor according to any preceding claim wherein said control piston/cylinder assembly is arranged to act as a fluid pump, and has a pumping fluid inlet (34) and a pumping fluid outlet (34) in its second end region which is axially remote from said first end.

5. A gas motor according to any preceding claim wherein said control piston/cylinder assembly comprises a pair of like control cylinders (14,16) and control pistons (20,22) which are coaxial with the motor piston/cylinder assembly (12,18), each being arranged to urge compression of a secondary fluid to generate a switching pressure, and each having a respective pilot line means (40) for communicating said switching pressure to said valve means (32); said pair of control cylinders and pistons (14,20;16,22) being arranged to generate said switching pressures out of phase with each other; and wherein said valve means (32) is arranged to switch said gas supply means from said first gas inlet (28) to said second gas inlet (30) when said switching pressure is communicated to it from a first one of said control cylinders (14); and to switch said gas supply means from said second gas inlet (30) to said first gas inlet (28) when said switching pressure is communicated to it from the other one of said control cylinders (16).

6. A gas motor according to any preceding claim wherein said motor cylinder (12) is of substantially greater cross sectional area than the or each said control cylinder (14;16).

7. A gas motor according to claim 6 wherein said motor cylinder (12) has a cross sectional area which is at least four times that of the or each said control cylinder (14;16).





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EUROPEAN SEARCH REPORT

Application Number
EP 96 30 8004

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	US-A-4 286 929 (HEATH RODNEY T ET AL) 1 September 1981 * column 3, line 54 - column 7, line 59; figures *	1	F01B11/00
A	FR-A-2 591 659 (FOGAUTOLUBE SA) 19 June 1987 * page 4, line 13 - page 9, line 12; figures *	1	
A	WO-A-90 12197 (SPEEDER A S) 18 October 1990 * abstract; figures *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			F01B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 20 January 1997	Examiner Mouton, J
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