(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 488 431 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **91202223.3**

(51) Int. Cl.[5]: **F02B 75/04**

(22) Date of filing: **31.08.91**

(30) Priority: **08.11.90 IT 171190**

(43) Date of publication of application:
03.06.92 Bulletin 92/23

(84) Designated Contracting States:
AT BE CH DE DK ES FR GB GR IT LI LU NL SE

(71) Applicant: **Mignone, Giuseppe**
San Matteo Fondo, 38
I-14010 Cisterna d'Asti, Asti(IT)

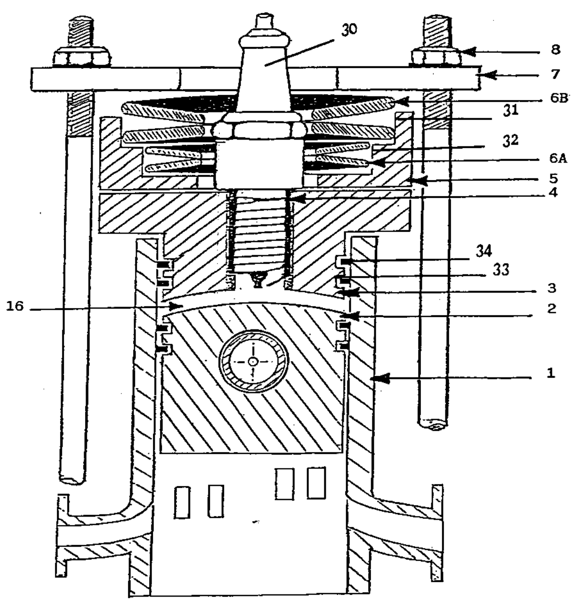
(72) Inventor: **Mignone, Giuseppe**
San Matteo Fondo, 38
I-14010 Cisterna d'Asti, Asti(IT)

(74) Representative: **Riccardi, Sergio et al**
Riccardi & Co. Via Macedonio Melloni, 32
I-20129 Milano(IT)

(54) Internal combustion engine with variable combustion chamber.

(57) In an internal-combustion engine of new conception, either a mobile supplementary piston (3), or an oscillating membrane (9) is added in the cylinder (1) or a connecting rod (11) with variable length is adopted; which, suitably calibrated have the function of varying the volume of the combustion chamber (16), to maintain the compression pressure constant at all RPM rates and the ignition pressure limited at all RPM rates to improve the working cycle, modifying it, increasing its performance and efficiency, eliminating the detonation and the consequent use of anti-knock agents which pollute the atmosphere.

Figure 1



EP 0 488 431 A2

The present invention refers to an internal-combustion engine at constant compression pressure at any rate of revolutions per minute (RPM) and with controlled ignition pressure at any rate of revolutions per minute (RPM), with variable combustion chamber with the object of obtaining positive results in both cases.

The internal combustion engines now existent are based on the principle of keeping the compression pressure high to increase the efficiency, but in this way there is an insuperable limit constituted by the phenomenon of detonation, inasmuch as the volume of the combustion chamber diminishes increasing the compression.

If, in the internal-combustion engine the requirements and the system for having a constant compression pressure at all RPM rates is created, a positive result will be obtained, inasmuch as the compression pressure plays a primary role with regard to the efficiency. The object of the present invention is however that of eliminating this unresolved problem inherent in the concept followed up to now in order to realise internal combustion engines.

Said problem is resolved according to the present invention by means of the internal combustion engine having the characteristics recited in claim 1. Further advantageous embodiments are indicated in the depending claims.

The internal combustion engine according to the present invention is illustrated, in its various embodiments all however described as purely illustrative but not limiting examples of the scope of the invention, in the appended drawings in which:

Figure 1 is a schematic sectional view of a first embodiment of the system for a two-stroke engine;

Figure 2, 3, 4 and 5 are analogous schematic sectional views of further embodiments of the system, again for a two-stroke engine;

Figure 6 is a diagram showing a working cycle of the engine according to the present invention;

Figure 7 is a schematic sectional view of the system of the invention applied to a four-stroke engine; and

Figure 8 is an analogous schematic sectional view of a variation brought to the system shown in Figure 7.

In the various figures of the appended drawings, like reference numbers indicate equal and equivalent elements, that is destined to carry out the same functions.

In all the figures the piston 2 is shown in the phase of its compression, when it has arrived at the top dead center, to show the displacement of the complementary piston 3 or of the elements equivalent to this with various fillings of the air-fuel mixture.

Now making reference to the appended drawings, Figure 1 represents a system according to the present invention applied as an illustrative but not limiting example to a two-stroke engine with gaseous mixture, constituted by a cylinder 1, where at the inside runs piston 2 above which the complementary piston 3 is arranged. Piston 3 is constituted of a mushroom-like shape, the upper part of which sits on cylinder 1. At the centre of this a threaded hole 4 is made, where a normal spark ignition 30 is screwed. On the head of piston 3 a cylinder 5 is fixed with appropriate seats, in this case in the form of steps 31, 32, having the purpose of housing the springs in this case in cup form, 6A, 6B.

These springs have double action, inasmuch as they maintain the compression pressure constant and limit the ignition pressure with the oscillation of piston 3. These are held by the plate or flange 7 and exert a pressure on the piston 3 and push it against the head of cylinder 1.

The pistons 2 and 3 are equipped with grooves 33 and elastic rings 34 for containing gases in cylinder 1.

The plate or flange 7 is anchored with bolts 8 to the engine body; the anchorage bolts 8 of plate 7 can also be a means of calibration by respective nuts and exerting a pressure on springs 6A, 6B, of figures 1 and 5 (which can be constituted in various forms, spiral-shaped, cup-shaped, leaf-shaped etc, with elements with variable pitch and load at fixed calibration for a determined type of engine); the calibration of springs 6A, 6B, can occur also with the addition of discs on the head of piston 3, or under the flange or transverse 7 on the shank of the piston rod to vary the pressure of the calibration of the said springs; the piston 3 has a hole 4 for screwing the spark ignition; the forms of piston 3, of the springs 6A, 6B, 14, can be different from that represented as an example in drawings of the figures 1, 2, 4, 5 inasmuch as they must be suitable to maintain the compression pressure constant and limit the ignition pressure in the combustion chamber of cylinder 1; the pistons 2 and 3 have forms, cavities or reliefs suitable for the type of internal combustion engine used; furthermore, the piston 3, the springs and the accessories inherent to the functioning of these, will be equipped with conventional internal and/or external cooling and lubrification systems, which it is not necessary to illustrate here in greater detail.

Up to now the mechanical composition is described, represented in Figure 1, with the object of achieving the improvement objectives of the new thermodynamic cycle, represented in the diagram of Figure 6 with a broken line.

The fundamental characteristics of said engine are, as already mentioned, essentially two, and that is those to obtain (1) an internal combustion engine with constant compression pressure at all RPM rates; and (2) a controlled ignition pressure at all RPM rates.

With these two principles the thermodynamic efficiency of the internal combustion engine is improved.

Currently, the internal combustion engines which give the best results are those with rather high compression. But greatly increasing the compression pressure comes up against the phenomenon of detonation. For clarity the parameters are outlined and one begins to establish, for example, that at the ignition point the compression pressure increases by about five times. Therefore, if the intake mixture is compressed at 6 atm, one will have 6x5 = 30 atm and detonation does not occur, increasing the compression pressure to 8 atm or more, one has 8x5 = 40 atm and one begins to hear some unusual noise in the engine and to prevent this detonation anti-knock additives are currently added, almost all pollutants. If one proceeds to increase the compression pressure the detonation phenomenon is accentuated. This signifies that the detonation occurs mostly through the ignition pressure. If one manages to keep the ignition pressure within the limits of 35-40 atm, the phenomenon of detonation does not occur. So one can deduce that it is not the compression pressure to cause the detonation, but rather the ignition pressure. In the new engine represented in Figure 1, the detonation due to the ignition phase does not take place because by increasing the volume of the combustion chamber, the ignition pressure is limited.

CONSTANT COMPRESSION PRESSURE AT ALL RPM RATES

The constant compression pressure is obtained in cylinder 1, where the piston 2 and piston 3, arranged over piston 2, giving origin to a variable combustion chamber, controlled by the calibration spring 6A overhanging piston 3. In calculating the space between the engine piston 2 and the piston 3 one must take into consideration that, when the engine is running idle, the space between the two pistons is such as to have the maximum compression pressure, allowed by spontaneous combustion. One assumes, for example, to establish a compression relationship of 7 atm; this compression pressure is kept constant by spring 6A installed on piston 3 and calibrated for the compression pressure of 7 atm. During the acceleration, since the filling of the cylinders is greater, in a normal engine the compression pressure increases, whilst in the engine of the present invention the compression pressure will always stay constant, since piston 3 transmits the pressure to the spring 6A which compressing because of the larger quantity of mixture sucked into the said cylinder, increases the volume of the combustion chamber. In fact, the stroke of the piston 2 is always the same, but the quantity of material taken in is not the same; therefore, when the engine piston 2 compresses, it will cause a greater pressure in the combustion chamber 16 which, in turn, is exerted on overhanging piston 3, sliding and held in position by the counter spring 6A, calibrated in this case at 7 atm. When the compression pressure tends to exceed 7 atm, the counter spring 6A, because of greater compression, is compressed and piston 3 slides, keeping the pressure constant at all RPM rates of the engine, from minimum to maximum filling. The result obtained is a constant compression pressure from minimum to maximum filling, avoiding spontaneous combustion at all RPM rates; therefore, since the efficiency of the engine increases with the compression one will constantly have maximum efficiency both at minimum and maximum RPM rate.

CONTROLLED IGNITION PRESSURE AT ALL RPM RATES

Currently, to avoid detonation, the fuel is mixed with anti-knock agents, which are very dangerous because they are pollutants. The present invention has the object both of reducing the use of anti-knock agents and increasing the efficiency of the current internal combustion engines. The current internal combustion engines are constructed with a mobile piston and a fixed head. To increase the efficiency the compression pressure must be increased to the limit of the self-ignition and detonation. The new engine has the object of exceeding said limits, that is increasing the compression pressure and limiting the ignition pressure at all RPM rates, by means of the spring 6B, which intervenes in the moment of ignition, permitting, by being compressed, a further increase of volume in the combustion chamber, limiting the ignition pressure to a calibrated value in order to avoid the detonation and cancel , consequently, the use of anti-knock agents. A further characterizing detail consists of the fact that the limitation of the ignition pressure with the spring 6B permits a minor stress of the mechanical parts. In figure 1 a system is illustrated in order to make, in the combustion chamber, the compression pressure constant at all rpm rates and the limitation of the ignition pressure occurs again at all revolutions per minute.

In the diagram of Figure 6, the area outlined by the broken line delimited by the curves P1, P2 indicates the passive work done to compress spring 6A; the line P2 P3 (in common) indicates the ignition phase. It must be emphasized that in this phase in a conventional engine the thrust of the blow is absorbed by the engine shaft, while in the system of the present invention the thrust is absorbed by compressing the spring 6B; finally the area (outlined by the broken line) delimited by the curves P3 and P4 indicates the useful work restored in the expansion phase of the springs 6A and 6B. It is pointed out that in whatever way one can realise the variation of the distance between the crankshaft and the upper surface of piston 2, this includes the volume variation system of the volume of the combustion chamber 16.

Figure 1 represents an embodiment, in which cup-form springs have been utilised, pressing on piston 3 in order to control the compression pressure and the ignition pressure in the combustion chamber 16 with the movement of the piston 3. The construction of the system has been carried out as follows. Above piston 3 cylinder 5 is positioned, constructed with suitable circular seats to contain the cup-shaped springs 6A and 6B, which are of two types. The spring 6A has the purpose of controlling and maintaining the compression pressure constant. Having finished the compression phase in the combustion chamber, the combustion occurs which causes further displacement of piston 3 and consequently cylinder 5. During the combustion the further displacement of piston 3 pushes the cylinder 5 and the spring 6B limits the ignition pressure, due to the increase of the volume of the combustion chamber. The cylinder 5 is provided with two steps 31, 32 of different heights and diameters, which are the supports of the stroke limit for said springs, with the aim of avoiding their damage by permanent deformation. Naturally, keeping to the principles described, the modality and embodiments can be widely varied. For example, another way to realise the system is represented by Figure 2. In place of piston 3 an oscillating membrane 9 is used, fixed on the head of cylinder 1, pressed by springs 6A and 6B, in which the movement of the membrane is relatively minimal during the compression and ignition phase. Another method is represented by Figure 3: the pressure above membrane 9 is exerted by compressed gases, introduced in the chamber formed between membrane 9 and the cover 10, or one can partially fill the space existing above the membrane with a cooling liquid, and above the liquid there is a compressed gas, in order to keep the membrane under cooling. Another way to make the combustion chamber 16 variable and maintain the pressure constant is represented by figure 4. In this case one varies the distance between the centre of the crank 12 of the engine shaft and the maximum height on the surface of the head of piston 2.

This variable combustion chamber 16 is obtained in practice with the main connecting rod 11 with its length variable by means of a spring or pneumatic joint 14 between the axes of crank 12 of the engine shaft and of the piston pin 13 of the main piston 2 just as shown in figure 4, so as to realise the variation of the distance between the crankshaft 12 and the upper surface of piston 2.

In the description of figures 1 - 6 carried out up to now, reference has been made to an internal combustion engine without valves, that is two-stroke, only for simplicity of demonstration. Therefore, the same principle or system is also applied in the four-stroke engine, as shown in figure 7.

In fact, in cylinder 1 there are seats for the suction valves 17 and exhaust valves 18, as well as hole 4 in which the spark ignition 30 is screwed. It can be noted that the support 51 of the stack and guide of the cup-shaped springs 6A, 6B is fixed in order to reduce the weight of the mass moving with the oscillation of piston 3. Also the spark is fixed in cylinder 1 in hole 4. It is clear that also in the four-stroke engine one can adapt all the systems indicated for the two-stroke engine, and that is piston 3, membrane 9 and the lengthening of the connecting rod 14, referred to in the abovementioned figures 1 -6 which amongst other things have the aim of maintaining the compression pressure constant at all RPM rates, a constant ignition pressure at all RPM rates for a variable combustion chamber.

As seen in Figure 8, the valves 17 and 18 can be connected unilaterally and thus driven by one only camshaft 20. It is pointed out that, in this case, one has a larger surface exposed to the gases, and thus a greater heat loss and therefore cooling during combustion.

One must finally note that in the preceding detailed decription and in the drawings reference is made to two and four stroke internal combustion engines, but one must emphasize the fact that the system of the present invention can be applied to any type of internal combustion engine, and therefore also diesel cycle engines.

Furthermore one must realise that numerous modifications, variations, additions and or substitutions of elements can be made to the system of the present invention, without with this departing away from either its spirit or object and without going out of its scope of protection, as has also been defined in the appended claims.

Claims

1. Internal-combustion engine characterized in that means to vary the volume of the combustion chamber are provided in the cylinder or cylinders of the engine in order to maintain the compression pressure constant at all RPM rates and the combustion or ignition pressure limited at all RPM rates.

2. Internal combustion engine according to claim 1, characterised in that said means are constituted by a supplementary mobile piston, situated above the normal piston of the cylinder.

3. Internal combustion engine according to claim 2, characterised in that on the head of said mobile supplementary piston suitably calibrated springs are applied, capable of carrying out a double function, and that is maintaining the compression pressure constant and limiting the ignition and combustion pressure with the oscillation of the supplementary piston during the phases of igntion and combustion.

4. Internal combustion engine according to claim 3, characterized in that said springs are cup springs, in which a first lower group keeps the compression pressure constant and a second upper group limits the ignition pressure, situated between a cap fixed to the supplementary piston and a plate or support flange fixed to the body of the engine.

5. Internal combustion engine according to claim 3, characterized in that said springs are spiral springs which are compressed between the head of the supplementary piston and a support plate or flange fixed to the body of the engine.

6. Internal combustion engine according to claim 1, characterized in that said means are constituted by an oscillating membrane fixed to the head of the cylinder, subject to pressure of elements able to maintain the compression pressure constant and the combustion or ignition pressure limited.

7. Internal-combustion engine according to claim 6, characterized in that said elements which press on the membrane are constituted by suitably-calibrated springs preferably cup-shaped.

8. Internal-combustion engine according to claim 6, characterized in that said elements which press on the membrane are constituted by compressed gases introduced into the chamber formed by said membrane and said cover of the cylinder.

9. Internal-combustion engine according to claim 8, characterized in that between the membrane and the surface of the compressed gas a cooling liquid is also introduced.

10. Internal-combustion engine according to claim 1, characterized in that said means for varying the volume of the combustion chamber are constituted by a connecting rod with length variable by means of a spring or pneumatic joint between the axes of the crankshaft of the engine and the plunger of the main piston of the cylinder, thus varying the distance between said crankshaft and the upper surface of said piston.

Figure 1

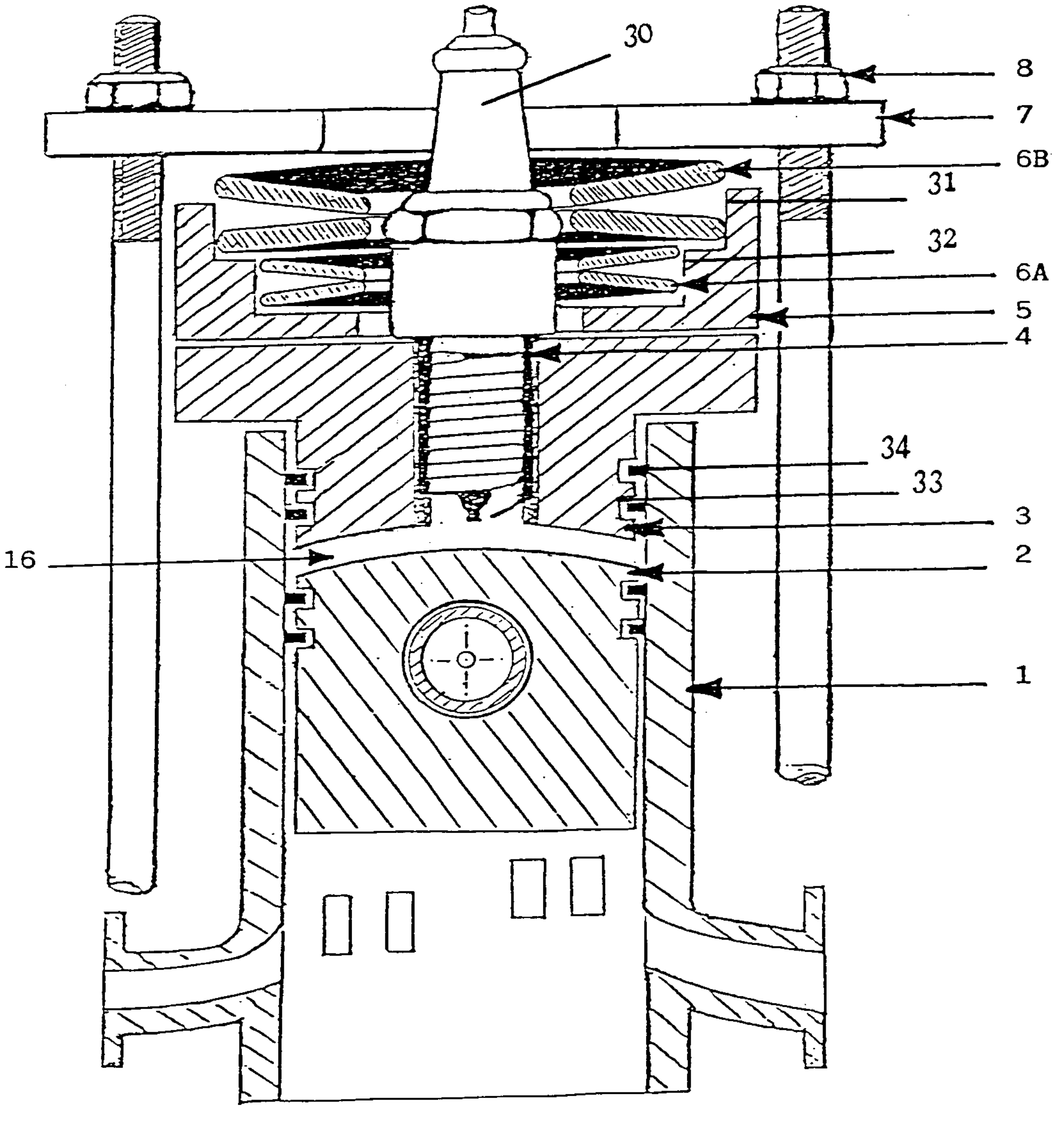


Figure 3

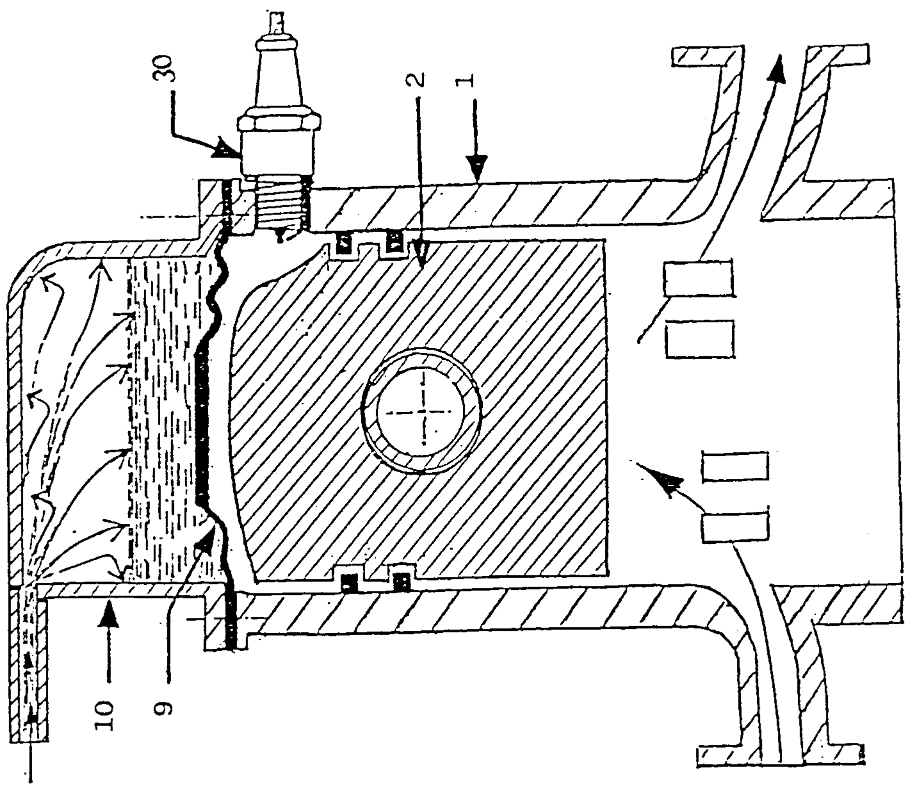
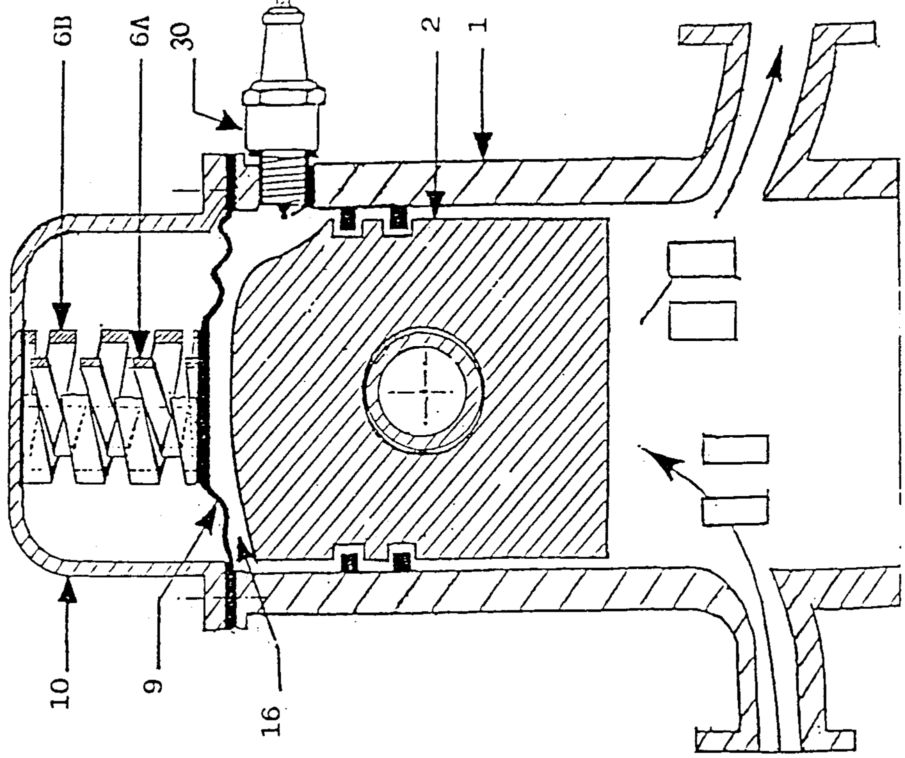


Figure 2



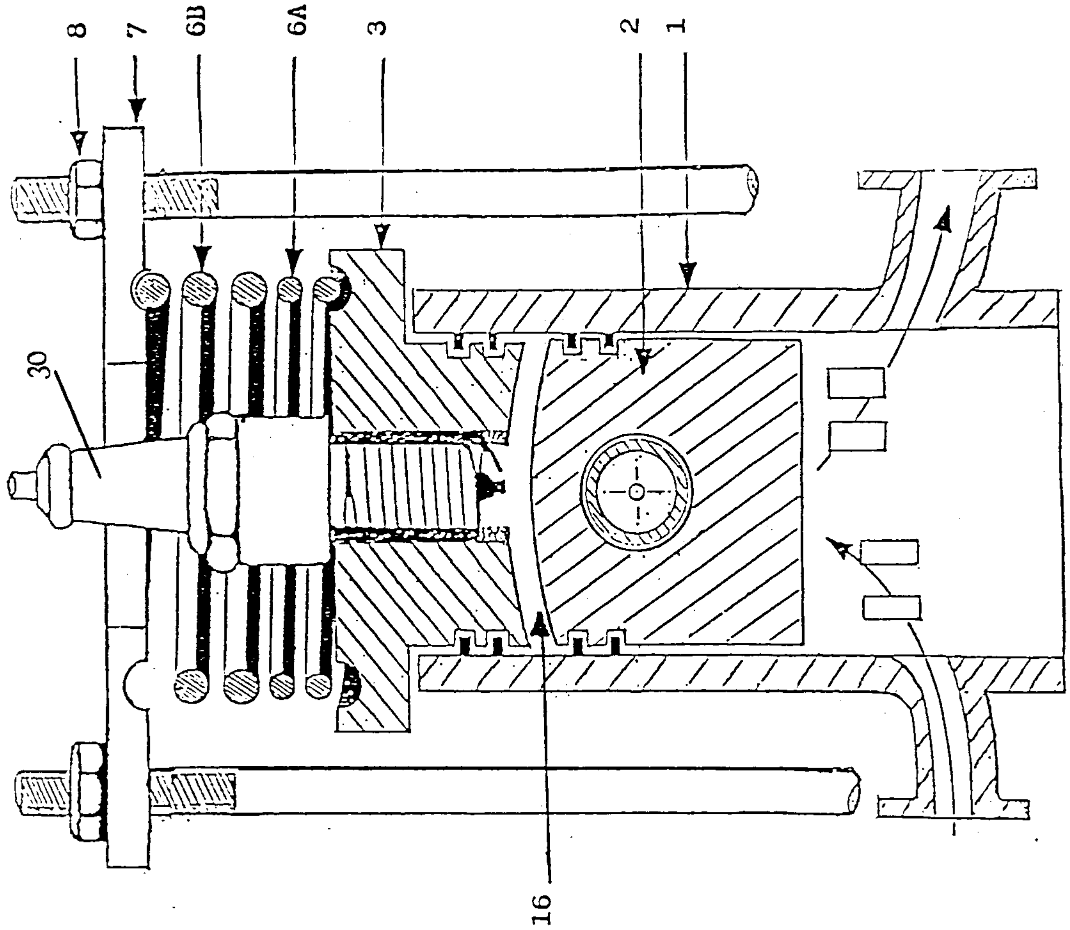


Figure 5

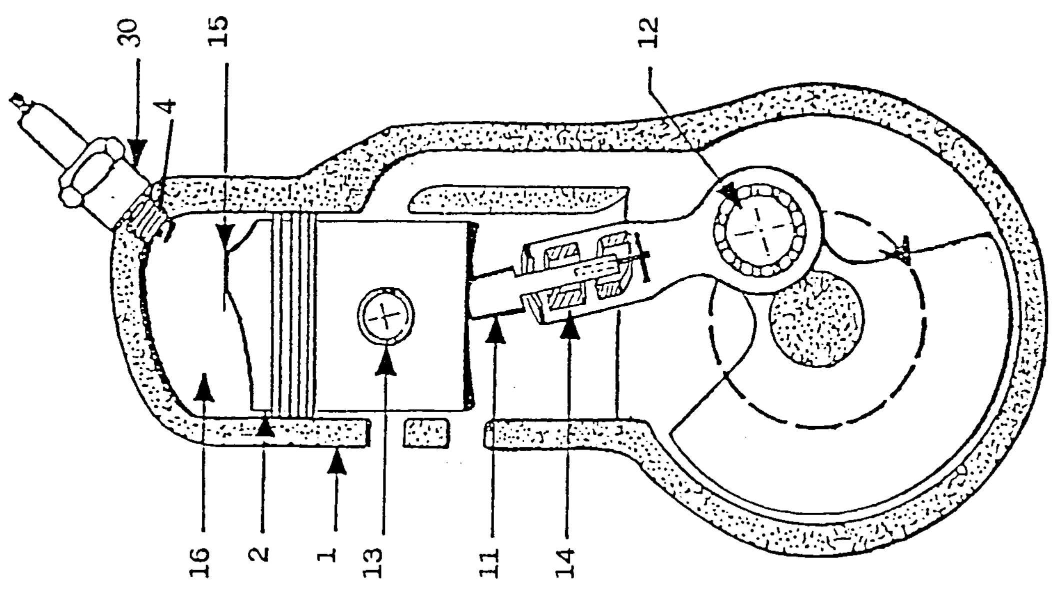


Figure 4

Figure 6

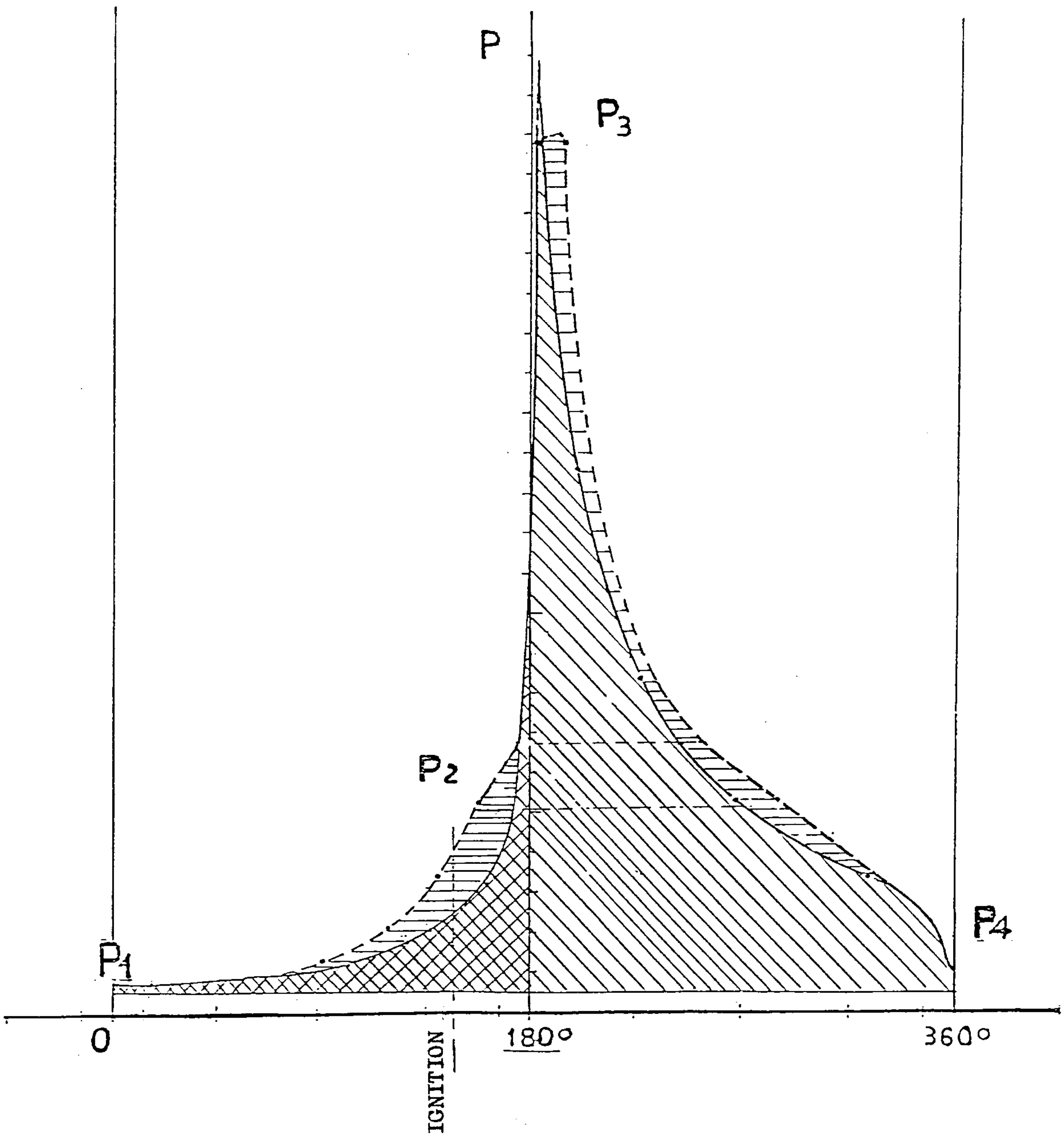
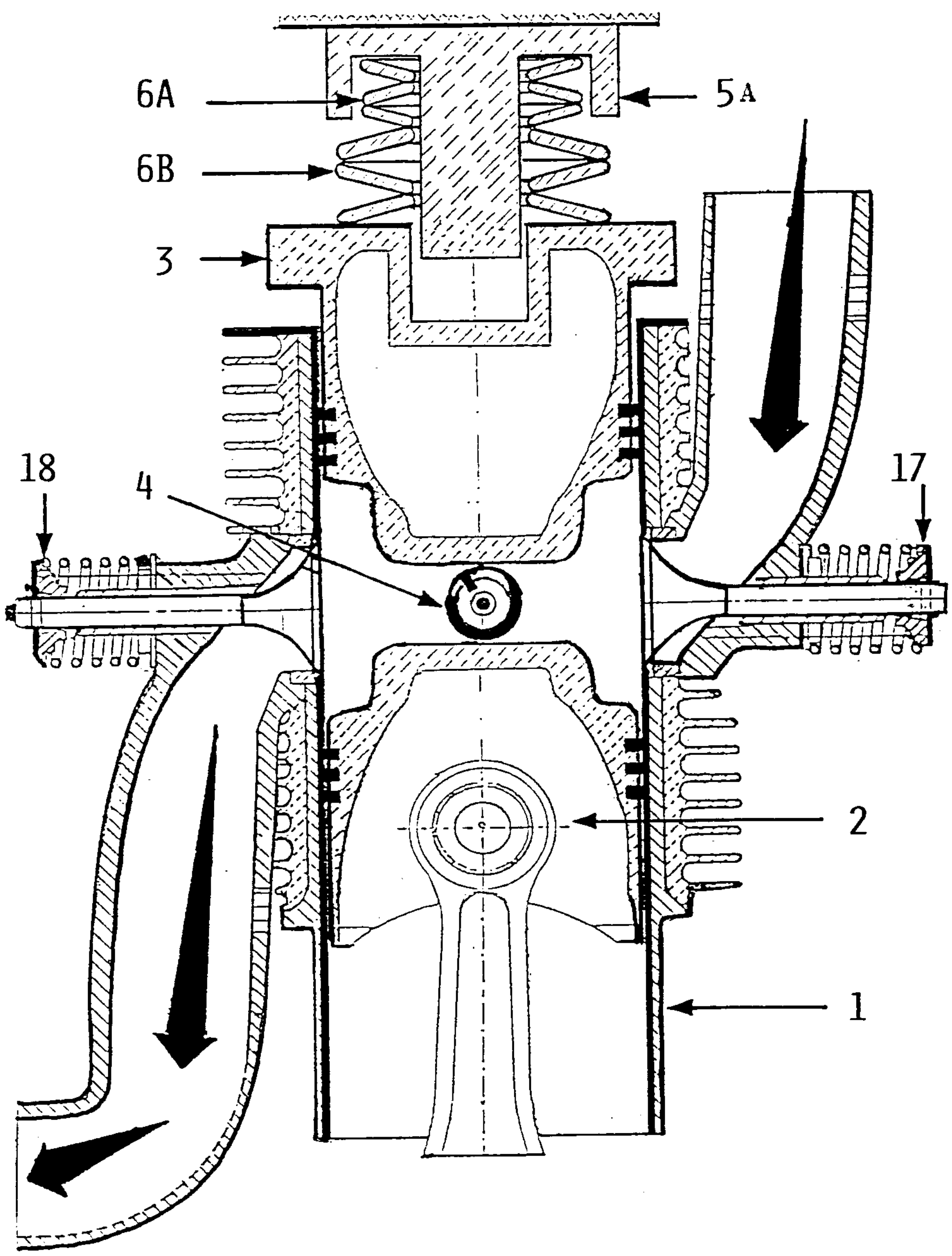


FIGURE 7



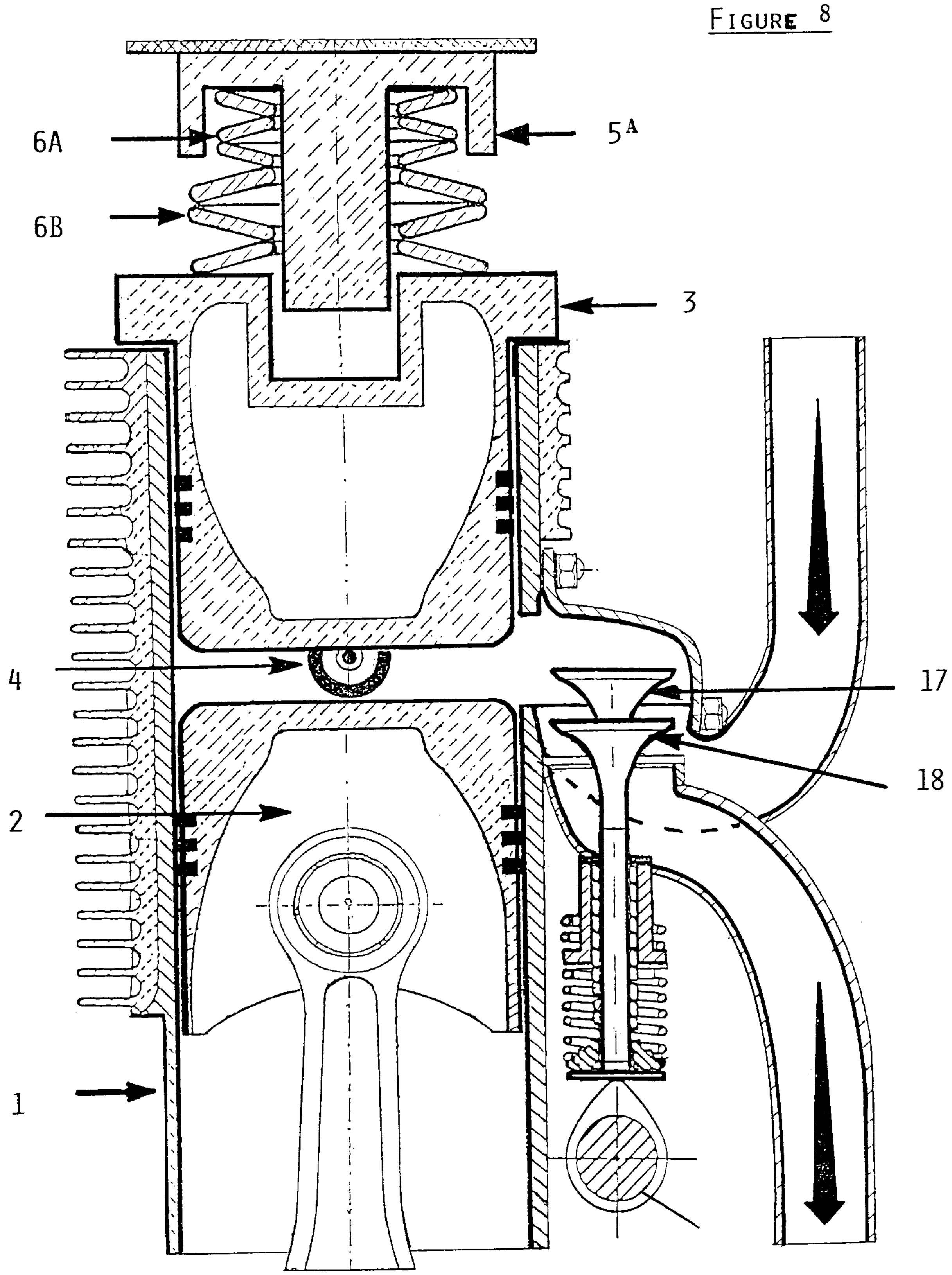


FIGURE 8
6A
5A
6B
3
4
17
18
2
1