



(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
17.09.2003 Bulletin 2003/38

(51) Int Cl.7: F01L 7/02

(21) Application number: 03425148.8

(22) Date of filing: 11.03.2003

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IT LI LU MC NL PT RO SE SI SK TR
Designated Extension States:
AL LT LV MK

(72) Inventor: **Maroccia, Giuseppe**
73100 Lecce (IT)

Remarks:

Diese Anmeldung ist am 11 - 03 - 2003 als
Teilanmeldung zu der unter INID-Kode 62
erwähnten Anmeldung eingereicht worden.

(30) Priority: 14.03.2002 IT LE20020011

(71) Applicant: **Maroccia, Giuseppe**
73100 Lecce (IT)

(54) Distribution system for internal combustion engine

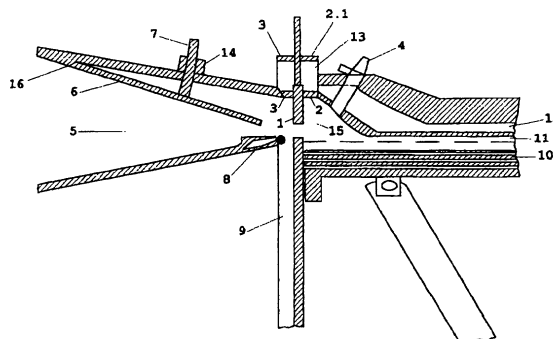
(57) The object of the invention is a distribution for the four-stroke engines, made up of guillotine valves (1) parallelly placed to the axis of the cylinder (9) and over the heading, or horizontally placed to this last one. The valves (1) move in a rectilinear and reciprocating motion.

There is the possibility to inject the fuel practically to the inside of the cartridge chamber, when the suction-valve is lightly opened, and to cool completely the heading that, free from valves and conduits, can fully be crossed by the freezing-liquid.

In a variant, they could also be horizontally placed on the top of the heading.

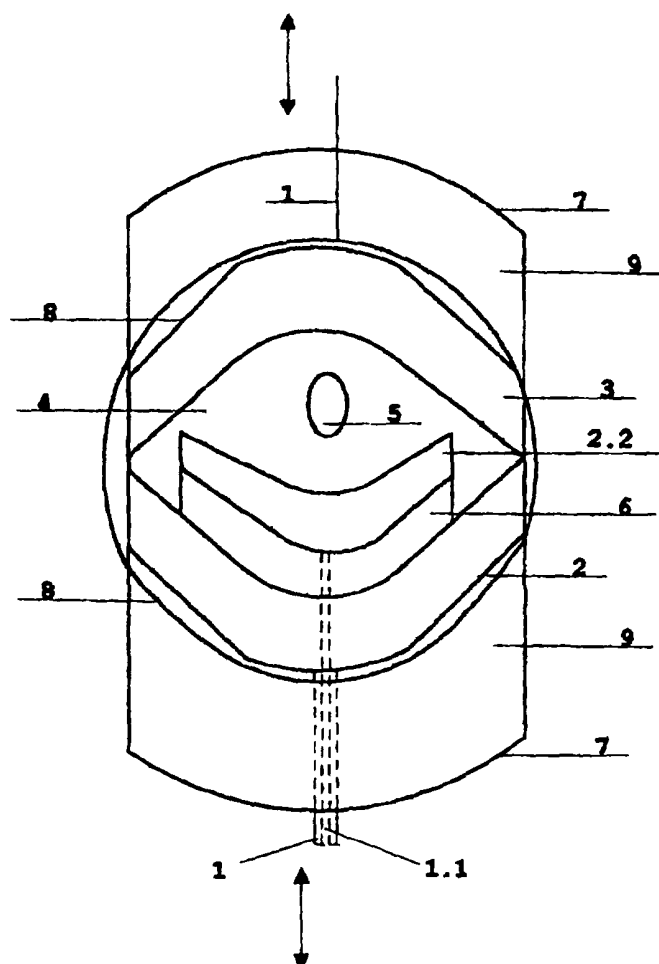
They can also be two for each conduit and both mobile. Their task is to vary the diameter and the section of the relative conduits when the motor's operating regime changes.

FIG. N° 3



- 1) SUCTION VALVE
- 2) INTERNAL COMPRESSION RING
- 2.1) EXTERNAL COMPRESSION RING
- 3) EXTERNAL COMPRESSION RING
- 4) SPARKING PLUG
- 5) INTAKE CONDUIT
- 6) PARTIALITATOR'S BULKHEAD
- 7) STEM
- 8) INJECTOR
- 9) CYLINDER
- 10) PISTON
- 11) P.M.S.
- 12) COOLING CONDUITS
- 13) LUBRIFICATION OIL
- 14) GUIDE
- 15) FIREBOX
- 16) BULKHEAD'S LINKED

FIG. N°7



- 1) VALVE'S STEM
- 1.1) SECOND SUCTION VALVE'S STEM
- 2) SUCTION VALVE
- 2.2) SECOND SUCTION VALVE
- 3) EXHAUST VALVE
- 4) HEAD
- 5) SPARKING PLUG
- 6) HEAD
- 7) VALVE'S HOUSING
- 8) HEAD'S BORDER
- 9) LUBRIFICATION AND COOLING OIL

Description

[0001] This description is to equipment of the licence entitled "System of distribution for an internal combustion engine". Such an invention has for object a system of distribution for an internal combustion four-stroke petrol and diesel engine characterized by circular guillotine, suction and intake valves vertically placed above the side part of the heading. They both move in a rectilinear and reciprocating motion.

[0002] Actually, the shape of the feeding-valves of the four-stroke petrol or gas oil engines is that of a mushroom. It is efficacious, but it doesn't encourage an effectual and rapid flowing of the fluids in entrance and in exit because of the valve-stem and its mushroom. Moreover, it doesn't allow the fuel to be injected in the right quantity and with the right velocity because of the presence of such elements.

[0003] That imposes to inject a bigger quantity of combustible to provide for all described disadvantages with a consequent bigger waste of petrol or gas oil, and with the use of timing diagrams that don't allow an effectual combustion and a rapid downflow of the mixture and of the unburnt gases. All this causes a bigger difficulty in controlling the consumptions and the pollution. To obviate to such disadvantages, more and more often, plurivalve distributions are used in order to increase the quantity of the admitted air in the cylinder to aid the power and a reduction of consumptions. But, obviously, the insuperable ostacle is constituted by the surface of the necessarily limited cartridge chamber besides the increase of the parts in motion that involves, moreover, the rise of costs and the losses of power due to frictions. Moreover, it is well-known that the quantity and the flowing velocity of the mixture or of the air in entrance, or of the gases in exit, changes in accordance with the variation in the working engine: it is smaller to medium low regimes, greater to those high ones. From here the necessity to bring into harmony the shape, the lenght and the diameter of the suction and intake-conduits when the motor's regime of rotation changes. Moreover, to the aim to eliminate any narrow passage or impediment to the free flowing of the fluids in entrance and in exit, the removal of the accelerator's throttle, placed to the top of the suction system, might turn out convenient. Then, the typical mushroom shape of the valves doesn't permit to the heading and to the same ones, no type of crossing of the freezing fluid with the intake-valves, therefore, exposed to considerable themic solicitations. This inevitably provokes a worsening of the propeller's total thermic efficiency, and minimum repercussions on the total quality of the internal organs.

[0004] Really, recently, it is in order to contain and to optimize the consumption, to use feeding-systems to direct injection of the fuel.

[0005] But, if on the gas oil engines remarkable benefits in terms of cost-benefit relation have been had, equally it cannot be said on the petrol engines in which

it's not succeeded to obtain feeding-systems to direct injection that guarantee real advantages to acceptable and sustainable costs.

[0006] Moreover, more and more impellent is the exigence to build new close propellers on a small scale and weight that, in particular on the marine and/or motor-cyclist propellers, might allow a bigger versability on the mean's utilization. From here the application of this invention turns out favourable.

[0007] This device (in both the described variants) bases itself on some geometrical-fluidynamical considerations: the concept is that the available area of the fluid in entrance or in exit in a conduit ("curtain zone", that is the side surface of an ideal cylinder that has for base the diameter of the seat and for height the lift of the valve), is equivalent to $(2\Pi r \times h) \times 0,9$, where $2\Pi r$ is the valve's circumference and, therefore, the available zone of the fresh mixture or of the gases in exit constituted by the valve, h is the lift of the valve itself and $0,9$ generally is the connection between the valve's diameter and the final opening of the suction or intake conduit (and, afterwards, of the seat).

[0008] Well, if instead of obtaining such a geometric result with a traditional mushroom valve (or two) it is obtained "unrolling" the total lenght of the circumference of the same ones along the circumference of the cylinder, and eventually adding the lift of the two total valves in order to obtain the lift of the only valve, in such a way obtained, the same result will be obtained. With the difference, moreover, that such valve will occupy little space, to all advantage of the available space in the heading for the cooling and of the free flowing of the mixture or the intake gas to the inside of the conduits, besides the advantages of removing the necessary heat through the lubricating oil that will graze the valves in their rectilinear and reciprocating motion.

[0009] Nevertheless, it is necessary to point out that the lift of the valve will never be the sum of the two traditional mushroom valves, because the area in entrance is redistributed in the circumference on the whole. Then the nearly total lak of the load's losses of the fluid in entrance or in exit, will also allow the same coefficient of volumetric efficiency with a smaller area in entrance.

[0010] Moreover, to a productive-industrial level, such an invention turns out favourable considering that, for its utilization, the actual engines can also be used. Such a result is simply obtained replacing the heading in the same ones and, naturally the system of distribution, and installing over the same ones the device object of this description.

[0011] With that taking advantage of the greater part of the constructive and industrial technologies currently used by manufacturing companies of the field, and shortening the times of planning and development of the gifted propellers of such a system of distribution.

[0012] The system, object of the invention, is entirely described in the Fig.1.

[0013] It is made up of guillotine valves the intake-

valve Fig.1(10) and the suction-valve Fig.1(5) vertically sited along the cartridge chamber's wall Fig.1(14). They move in a rectilinear and reciprocating motion, and can also be moved by a system of rods and compensators Fig. 1(2-11), with these last in the fulcrum as you can see in the Fig. 1 (4), that is, not in the middle of the rods, but with their side turned towards the valve, and with the recall of this last one that can be also obtained (as in the figure) by means of a spring Fig. 1 (3) tire or in any other suitable way to the purpose. As you can observe the suction Fig. 1(8) and exhaust conduits Fig.1 (16) perfectly appear rectilinear and free from any obstacle to the free flowing of the respective fluids. The injector Fig.1 (7) appears sited close to the suction-valve and this allows the fuel to be directly injected into the cartridge chamber Fig.1(14), when the first one starts the lift. Then, the heading appears completely grazed by the cooling conduits Fig. 1(15) and, together with the sparking plug Fig.1(6), is installed in the perfect position to obtain an entire and efficacious combustion of the mixture. The central control system can also be provided by a single cam-shaft Fig.1 (1) sited in the middle of the heading. As you can observe, the intake-valve Fig. 1 (10) may also be sited under the P.M.S.

[0014] Fig.1 (12), and this allows, once that the piston Fig.1(13) has completed the reascent, to remove some heat from the valve, lubricating it in the meanwhile;

while the suction-valve Fig.1(5) is sited upon the fixed point to allow a more ideal cartridge chamber's conformation to obtain the perfect combustion of the mixture.

[0015] In the Fig.2, you can observe a map of the heading with one of the possible system of distribution previously described. In the figure are described: the suction-valve Fig.2 (1) which is laterally and vertically sited to the heading and to the cartridge chamber, near the intake one Fig.2 (2). It is possible to notice that the distribution can also occur through a single cam-shaft Fig.2 (7). As you can observe, the two compensators Fig.2 (3) are not precisely parallel between them but lightly off line to obtain the correct alignment of the compensators with the rods and the valves.

[0016] Moreover, they are in the fulcrum with some pins Fig.2 (8) which are not sited in the exact middle of the compensators, but with the major side turning towards the valve.

[0017] That will create a lever effect that will allow, under the same millimeters of lift of the eccentric a greater lift of the same one.

[0018] If you minutely observe this invention in its working, you can notice that the suction stroke, escribed in the Fig. 3, starts when the intake-gases practically are quite flowed down.

[0019] The spark advance of the suction-valve's opening, considering the absence of the flat valve, will be minimum and due, besides to the inertia of the same one, to the requirement to fit together the moment in which the piston Fig.3(10) comes down (and therefore when the depression to the inside of the cylinder is cre-

ated) with an already happened opening of the suction-valve Fig.3(1) and with the injector Fig.3(8) that injects the fuel to the inside of the cylinder not hardly the valve also has been minimally opened.

[0020] In the suction-conduit Fig.3(5) a regulation system of intake conduits of the diameter of the same one Fig.3(6), mobile in the extremity turned towards the heading and linked in the external side of the conduit, is placed Fig.3(16). It will always allow to have the velocity of the afflux of the mixture A/B or of the constant and optimal air to the regime of the motor's utilization. It is set in action by a stem Fig.3(7) which slides along a guide Fig.3(14) and set in action by electric and hydraulic servomechanisms or other suitable devices to the purpose. However, if in the design to equipment of this description it is mobile only in an extremity, it will also be able for both, to allow the complete modelling and the conformation of the entire conduit. Moreover, in the same design, one is designed, two opposite between them and mobile in one or in their both extremities may be installed.

[0021] The opening of the valve begins some degrees before the achievement of the P.M.S. Fig.3(11) from the piston. The suction-valve Fig.3(1), in the moment immediately after its opening, allows the injector Fig.3(8), sited close to the suction-valve, to inject the fuel directly in the firebox Fig.3(15) and it is sited above the P.M.S. of the piston Fig.3(11). A remarkable characteristic of the valve are the compressing rings that, in the case of that sited to the inside of the cartridge chamber Fig.3(2), will be of metallic material, while for those sited to the outside of such zone Fig.3(2.1 e 3), the same ones could also be of synthetic material.

[0022] Their purpose is to assure the ideal lodging of the valve and a perfect sliding of it. It will be lubricated through the oil placed to the inside of the valve's zone of lodging Fig.3(13) which will graze the same one during the rectilinear and reciprocating motion of the same one, cooling it at the same time.

[0023] Such a system allows, besides the valve's lubrication, the removal of some heat coming from the inside of the cylinder, diminishing their wear and improving the thermic and mechanic efficiency of the motor.

[0024] After the explosion stroke, the successive combustion stroke of the mixture may have also a greater duration regarding that of a traditional motor to allow, on the one hand, the maximum exploitation of the thrust due to the explosion-expansion stroke and, on the other hand, the total combustion of the mixture. All this turns to advantage of a complete combustion of the same, of inferior consumptions (infact, all the mixture's combustion in order to generate expansion might be exploited) and of strongly reduction of noxious emissions.

[0025] The exhaust stroke described in the Fig.4 will be able to begin before the achievement of the P.M.I. from the piston. That in order to permit the synchrony between the build up phase of the piston (and, therefore, the phase in which the compression from the same is

created), and the opening rings of the valve. It begins, therefore, with the exhaust valves opening Fig 4(1), sited under the P.M.S. of the piston Fig.4(12).

[0026] However, in presence of problems concerning the seal of the rings you can also observe the housing of the same above such point, giving to the conformation of the piston Fig.4(9) the task to realize a suitable cartridge chamber of the complete combustion of the mixture. The intake-valve Fig.4(1), as we pointed out above, in a possible application, with the exception of the suction one, could be also placed on the wall of the cylinder Fig.4(8). Its right position and sliding are assured from the compressing rings which, relatively to that placed to the inside of the cylinder Fig.4(4.1), will be of metallic material while those to the outside of such zone, could be of synthetic material Fig.4(2 e 4), to allow a reduction of the friction of sliding of the valve without sacrificing nothing as regards the seal of the same one.

[0027] It is important to notice that the intake-valve is cooled and lubricated from the oil contained in the lodging stroke of the same one Fig.4(5) which is grazed during its rectilinear and reciprocating motion.

[0028] Once the intake device is opened, the gases will flow down through the intake conduit Fig.4(10) that, on the same level as the suction conduit, will be to variable section.

[0029] This purpose is obtained thanks to a bulkhead Fig.4(14) that will have the task to flange the conduit on the ground of the motor's regime of operation maintaining constant and optimal the velocity of the intake gases' outflow.

[0030] It will set in action by a stem Fig.4(6), will slide through a guide Fig.4(16) and will be set in action by servomechanisms, electroactuators, or other suitable devices to the purpose.

[0031] Also in this case, if in the design to equipment of this description it is mobile only in an extremity, at most, it may be mobile also in both, to allow the complete modelling and conformation of the entire conduit. Moreover, even if in the same design, one is designed, two opposite between them and both mobile in one or in both their extremities may be installed in the conduit.

[0032] Fitting together the two moments, it will take advantage of the synchrony between the build up phase of the piston (and therefore the phase in which the compression from the same to the inside of the cylinder is created) and the phase of valve's opening.

[0033] In such a way, it takes advantage of the absence of the flat valve and the mushroom to rapidly compress the intake-gases to the outside avoiding going too far with the exhaust and avoiding, moreover, dangerous and harmful crossings with the suction-valve that might allow the mixture in arrival to lead through the intake-valve opened in advance because of the losses of the load due to the presence of the flat valve and the stem, as well as from the inertia.

[0034] You can argue that the duration of the intake stroke could be smaller than that of a motor with the

mushroom valves.

[0035] Moreover, an important variant of such invention can be observed in the Fig.5 and in the Fig.6.

[0036] In these designs, it is possible to notice that the guillotine valves, previously described, can also be horizontally and over the heading arranged, rather than vertically and laterally of it.

[0037] The Fig. 5 describes the suction-valve.

[0038] In it you can notice the suction-valve Fig.5(1) and the injector Fig.5(5), vertically and immediately placed close to the suction-valve.

[0039] Also in this case, in the suction conduit Fig.5 (6) a regulation system bulkhead Fig.5(2) is placed. Its task is to maintain a constant velocity of the afflux of the fluid in entrance. It is set in action by a stem Fig.5(3) that will slide to the inside of a guide Fig.5(4) and set in action by the electric, hydraulic servomechanisms or other suitable ones to the purpose.

[0040] In the Fig.6, instead, it is possible to observe the intake-valve, horizontally placed, on the same level as the suction one, to the heading and perpendicular to the axis of it.

[0041] In it you can notice the intake-valve Fig.6(1), the piston Fig.6(6), as well as, as we pointed out before, the regulation system bulkhead Fig.6(2), placed to the inside of the intake conduit Fig.6(5), which is moved by a stem Fig.6(3), moved by electric, hydraulic and manual servomechanisms or other suitable ones to the purpose, and it will slide in a guide Fig.6(4).

[0042] A further advantage, especially for more pushed motors, will be obtained installing two suction-valves in the way indicated in the Fig.7.

[0043] In it, you can notice the dual suction-valves Fig.7(2 e 2.2), the exhaust-valve Fig.7(3), the sparking plug Fig.7(5), placed in the middle of the heading Fig.7 (6), the housing slots of the relative valves Fig.7(7), where, moreover, the lubrication oil will slide Fig.7(9), that will act as a freezing-liquid.

[0044] A such disposition of the valves will allow a bigger afflux of air in the cylinder, or it will allow to reduce the sizes of the two total valves. The dimensions of the second valve, however, could be inferior to those of the main valves: the task of the displacement stroke of its valve-stem Fig.7(1.1), as regards that of the main valve Fig.7(1), will be to harmonize their simultaneous opening.

[0045] Also in this case, as in the previous one, it is pleonastic to underline the importance that could be obtained from the more excellent structure of the cartridge chamber, free from encumbering valves.

[0046] In both the types of distribution, before described, you can also install only a guillotine valve and a traditional mushroom one.

[0047] The use of the described system of distribution presents the following advantages:

1-First of all it allows, in practice, to inject the fuel exactly to the inside of the cylinder when the suc-

tion-valve begins its opening, without the fuel meets no resistances from the other valves.

2-Then, it allows to increase the quantity of air in entrance and its rapidity in entrance. It also permits a rapid downflow of the intake-gases to the outside of the cylinder.

That is due to the fact that, the available area of the conduits and of the valves, under the same number of these last ones, appears increased: it only depends on the diameter of the cylinder (theoretically, each one can occupy the half of the same!) and on the lift due to the diagram of the motor.

In conclusion, greater is the diameter of the cylinder and greater is the available surface of the valves.

3-It is also concurred, moreover, the adoption of only two valves with weight saving, construction and production and working costs.

4-Such a device also allows a better cooling of the intake-valve. In fact, in a possible variant the oil, that grazes the walls of the cylinder, transported on it from the reciprocating motion of the piston, lubricating it in its rectilinear and reciprocating motion, allows it to embezzle a part of the heat produced by the operation of the motor.

This augments the suitable radiant surface for the digestion of the heat and, at the same time, improves the longevity of the internal organs and of the total available power.

5-It allows, moreover, a total cooling of the heading that, remaining free from the conduits and from the valves, can be completely crossed from the cooling-conduits, embezzling a bigger quantity of heat from this one and improving, therefore, the power and the consumptions and reducing the pollution.

6-It is concurred, moreover, the use of a diagram of distribution less pushed and with the crossings of the valves less accentuated (or inexistent) that turns to the power, to the consumptions of the fluency of gear and the demolition of the noxious emissions advantage.

It is obtained thanks to the absence of obstacles to the motion of the flows in entrance and in exit.

7-you can obtain an ideal structure of the cartridge chamber's shape considering the absence of the valves. So that, in comparison with the cartridge chamber of a two-stroke engine, you can obtain, furthermore, a squish effect, to allow the ideal turbulence of the mixture to the inside of the cylinder, in order to obtain a better homogeneity of the same one and, above all, a rapid and total combustion.

That to reduce the consumptions, the pollution caused by the unburned gases and to obtain a better thermic output of the motor and then a greater power.

8-Moreover, through the regulation systems of the suction and intake conduits placed in the respective

conduits, there is a better afflux of the mixture and a better downflow of the intake-gases on the ground of the motor's regime of operation eliminating, furthermore, the obstructing and the brake to the free and correct flowing of the mixture or of the just air in entrance, made up of the throttle placed above the suction system.

9-In the overfed motors, it is possible to reduce the c.d. turbo-lag, that is the delay in answer of the turbine in compressing the air to the inside of the cylinder due, moreover, to the distance between the intake-valve and the same overfeeding system.

Such an advantage is obtained reducing this distance and permitting in this way the intake-gases to operate on the turbine with a bigger velocity and kinetic energy.

In such propellers, the absence of the flat valves and stems in the suction conduit, will allow also a minor pressure of the overfeeding, considering the strong reduction in losses of load.

10-It is moreover concurred the reduction of the total height and of the weight of the heading with remarkable benefits in terms of total obstruction of the motor. This results particularly favourable in the case of the propellers intended to means in which the obstruction of the propeller holds an important role: ex motor-cycles, marine and aeronautic motors. 11-Among the main advantages of this invention, there is, moreover, the possibility to install it over existing motors, simply replacing to these ones the heading or, at most, the cylinder and the piston.

In this way, you might have a remarkable profit from the point of view of the project and production costs and from the point of view of the total quality of the propeller in its whole.

Claims

1. Device of distribution for an internal combustion four-stroke petrol and diesel engine **characterized by** circular guillotine, suction and intake valves vertically placed above the side part of the heading. They both move in a rectilinear and reciprocating motion.
2. Device of feeding for a four-stroke petrol and gas oil engine in accordance with the claim 1, made up of an injector immediately placed close to the suction-valve to allow the injection of the fuel to the inside of the cylinder after the suction-valve's opening.
3. Device of feeding for the four-stroke petrol and gas oil engines **characterized by** the guillotine intake-valve placed under the P.M.S. of the piston.
4. Device of feeding for a four-stroke petrol and gas

oil engine in accordance with the claim 1 **characterized by** a heading-control made up of a system of rods and compensators with these last ones in the fulcrum in their middle but off line with the major distance turned towards the valve and set in action by a central axis-cam. 5

The recall of the valves can be a recall-spring, pneumatic, electric or of another suitable device for the purpose. 10

5. Device of feeding for a four-stroke petrol and gas oil engine in accordance with the claim 1 with the control system of the heading made up of pneumatic and recall-spring or of other suitable devices to the purpose that move the valves, object of this invention through compression or extension. 15

6. Device of feeding for a four-stroke petrol and gas oil engine in accordance with the claim 1 **characterized by** regulation system bulkheads placed in the intake and suction conduits with the task to vary the diameter of the conduits on the ground of the motor's operating regime. 20

The suction conduit's bulkhead will be connected to the side placed to the beginning of the conduit, while the intake-bulkhead will be placed before the intake-valve. 25

They both are moved by hydraulic, electric controls or other suitable devices to the purpose, and slide along a guide through a stem. The same ones, nevertheless, could be mobile in both their extremities. Moreover, in the relative conduit, two opposite and independently mobile in one or in both their extremities could be installed. 30

These regulation system bulkheads can also be used on a two-stroke engine's suction conduit. 35

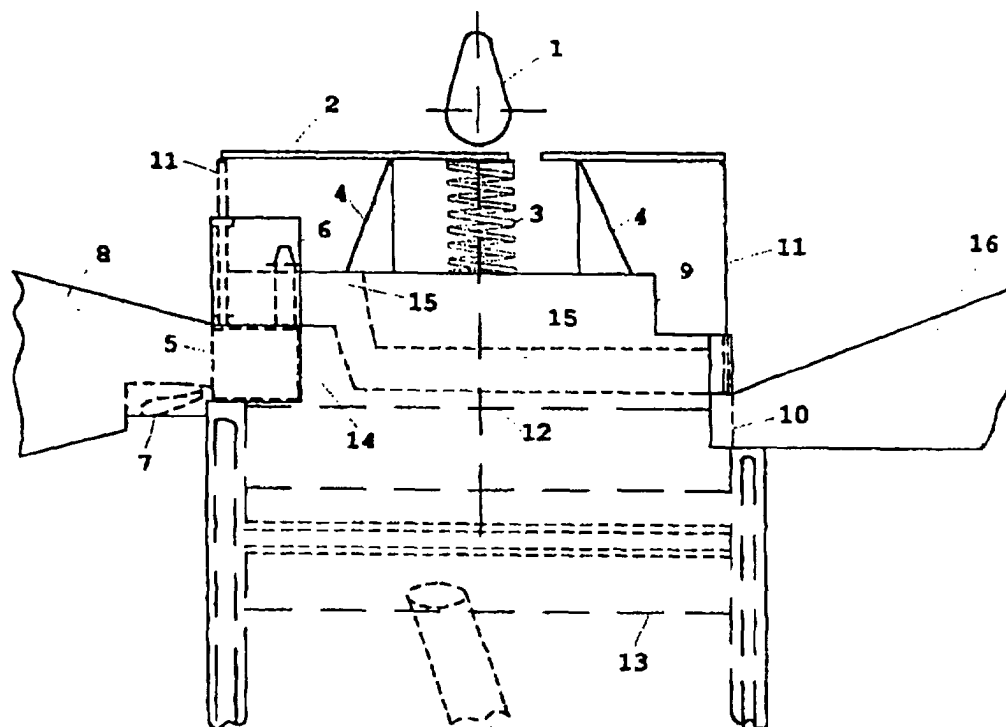
7. Device of feeding for the petrol and gas oil piston-engines, in accordance with the claim 1, **characterized by** the use of a guillotine suction-valve and a guillotine intake-valve, and the remaining with the traditional mushroom shape. 40

8. Device of feeding for the four-stroke petrol and gas oil engines, **characterized by** the guillotine valves horizontally placed as regards the cylinder. 45

9. Device of feeding for the four-stroke petrol and gas oil engines, in accordance with the previous claim, made up of two suction-valves placed in succession and set in action by different in time controls. 50

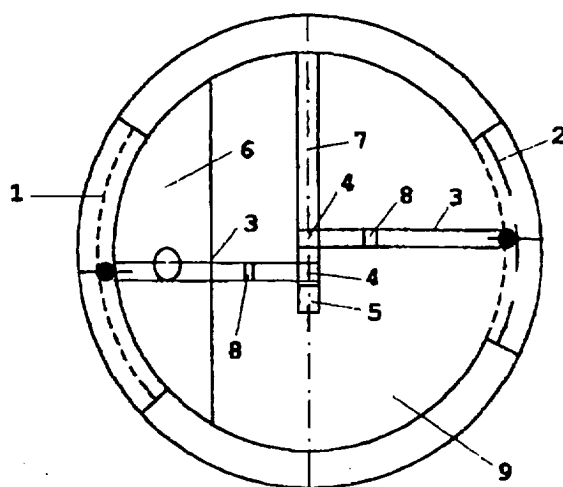
10. Device of feeding for a four-stroke petrol and gas oil engine, in accordance with the previous claims, placed at work and built according to the illustrated and described way and realized with different materials. 55

FIG. N°1/7



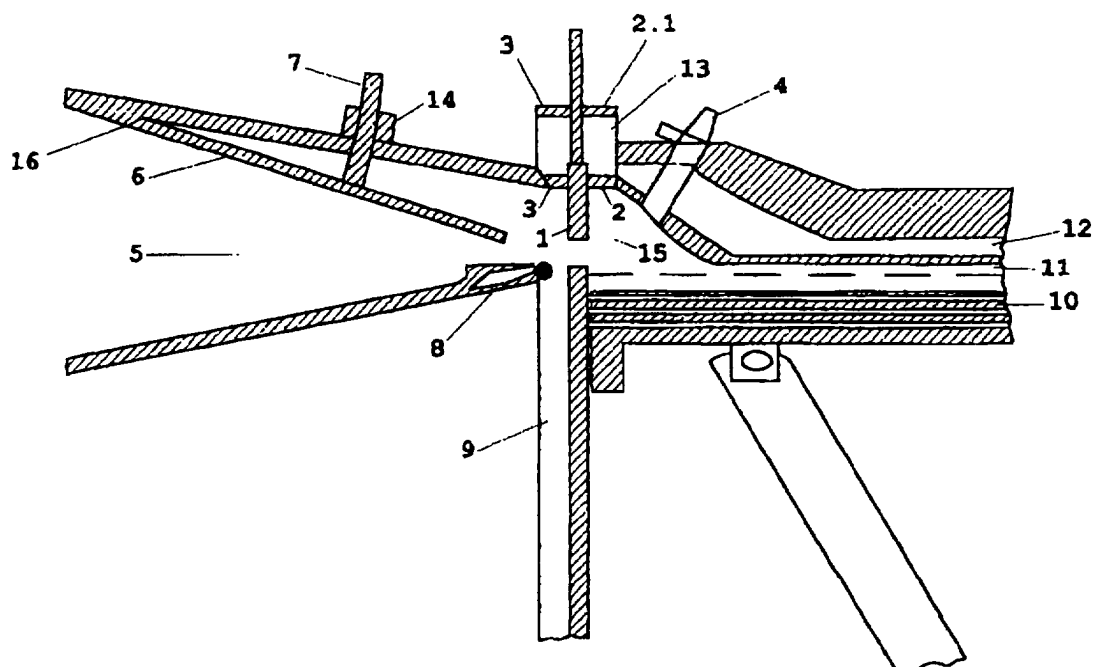
- 1) CAM SHAFT
- 2) RODS
- 3) MEANS OF A SPRING
- 4) FULCRUM
- 5) SUCTION VALVE
- 6) SPARKING PULG
- 7) INJECTOR
- 8) INTAKE CONDUICT
- 9) HEAD
- 10) EXAUST VALVE
- 11) COMPNSATORS
- 12) P.M.S.
- 13) PISTON
- 14) CHAMBER'S WALL
- 15) COOLING CONDUICTS
- 16) EXAUST CONDUICTS

FIG. N° 2/7



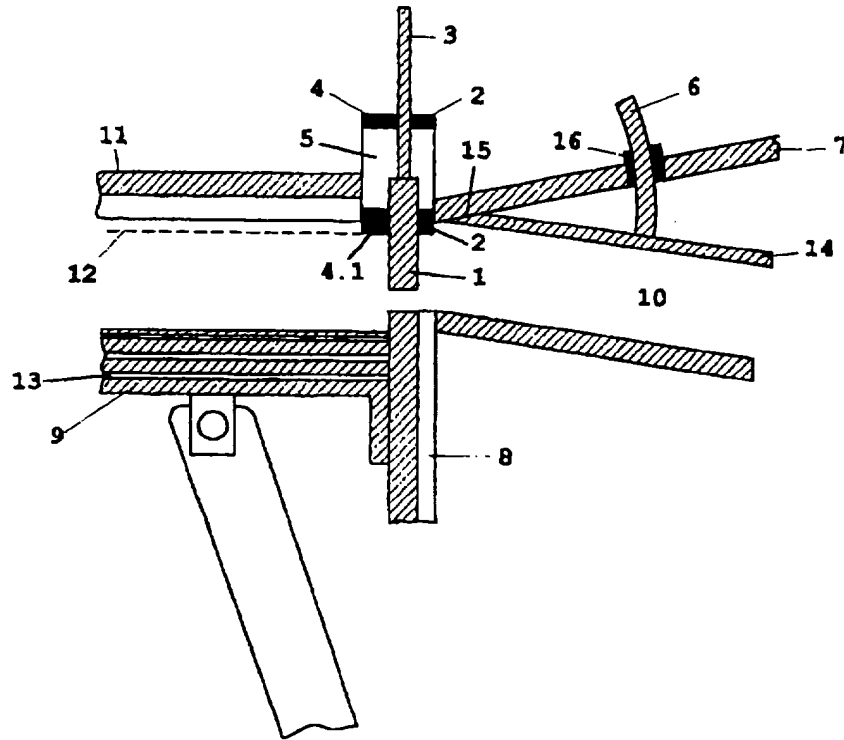
- 1) SUCTION-VALVE
- 2) EXHAUST VALVE
- 3) COMPENSATORS
- 4) CAM
- 5) CAM SHAFT SUPPORT
- 6) FIRE BOX
- 7) CAM SHAFT
- 8) FULCRUM
- 9) HEAD

FIG. N° 3/7



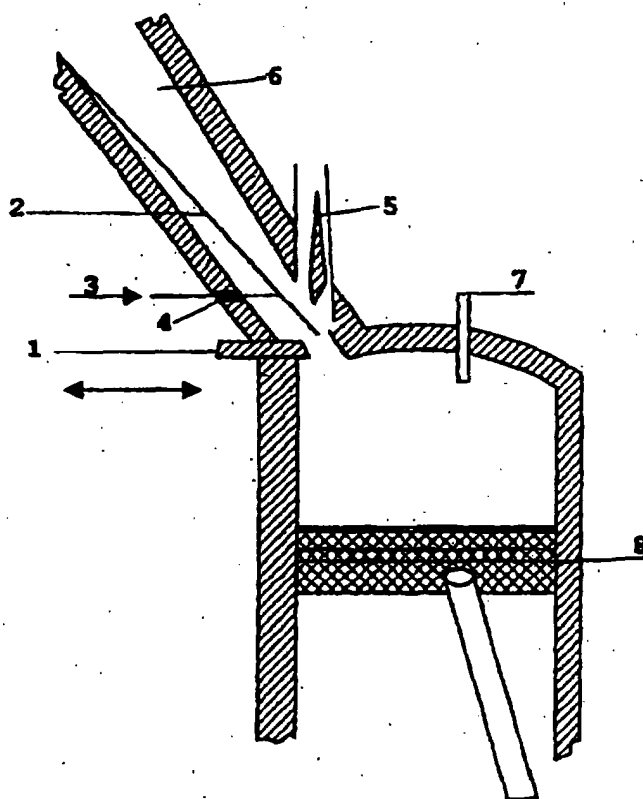
- 1) SUCTION VALVE
- 2) INTERNAL COMPRESSION RING
- 2.1) EXTERNAL COMPRESSION RING
- 3) EXTERNAL COMPRESSION RING
- 4) SPARKING PLUG
- 5) INTAKE CONDUIT
- 6) PARTIALITATOR'S BULKHEAD
- 7) STEM
- 8) INJECTOR
- 9) CYLINDER
- 10) PISTON
- 11) P.M.S.
- 12) COOLING CONDUITS
- 13) LUBRIFICATION OIL
- 14) GUIDE
- 15) FIREBOX
- 16) BULKHEAD'S LINKED

FIG. N° 4/7



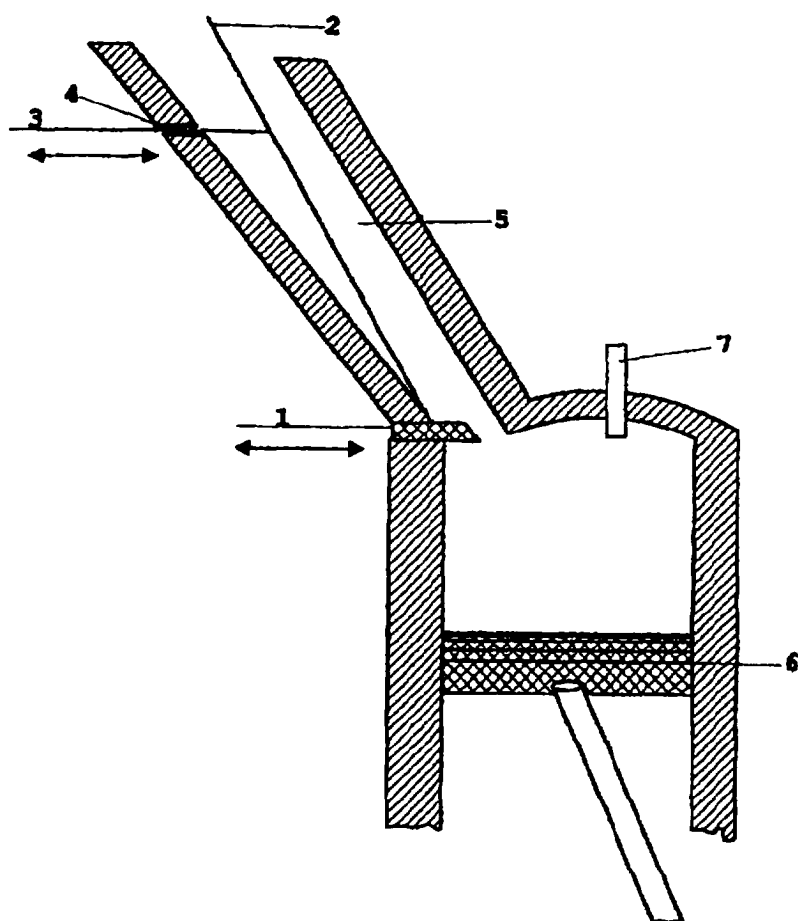
- 1) EXHAUST VALVE
- 2) EXTERNAL COMPRESSION RING
- 3) VALVE'S STEM
- 4) EXTERNAL COMPRESSION RING
- 4.1) INTERNAL COMPRESSION RING
- 5) LUBRIFICATION ED COOLING OIL
- 6) STEM BULKHEAD' S PARTIALITATOR
- 7) EXHAUST WALL
- 8) CYLINDER
- 9) PISTON
- 10) EXHAUST CONDUIT
- 11) HEAD
- 12) P.M.S.
- 13) PISTON'S COMPRESSION RINGS
- 14) PARTILITATOR'S BULKHEAD
- 15) BULKHEAD'S LINKED
- 16) GUIDE

FIG. N° 5/7



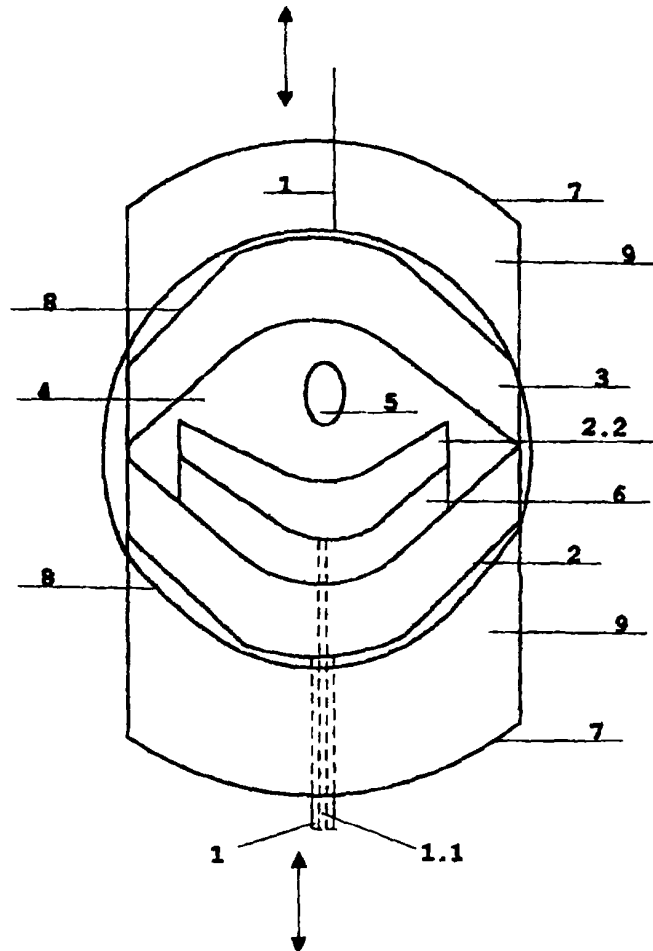
- 1) SUCTION VALVE
- 2) BULKHEAD'S PARTIALITATOR
- 3) BULKHEAD'S STEM
- 4) STEM'S GUIDE
- 5) INJECTOR
- 6) INTAKE CONDUIT
- 7) SPARKING PLUG
- 8) PISTON

FIG. N° 6/7



- 1) EXHAUST VALVE
- 2) PARTIALITATOR'S BULKHEAD
- 3) BULKHEAD'S STEM
- 4) STEM'S GUIDE
- 5) EXHAUST CONDUICT
- 6) PISTON
- 7) SPARKING PLUG

FIG. N°7/7



- 1) VALVE'S STEM
- 1.1) SECOND SUCTION VALVEL'S STEM
- 2) SUCTION VALVE
- 2.2) SECOND SUCTION VALVE
- 3) EXAUST VALVE
- 4) HEAD
- 5) SPARKING PLUG
- 6) HEAD
- 7) VALVE'S HOUSING
- 8) HEAD'S BORDER
- 9) LUBRIFICATION AND COOLING OIL