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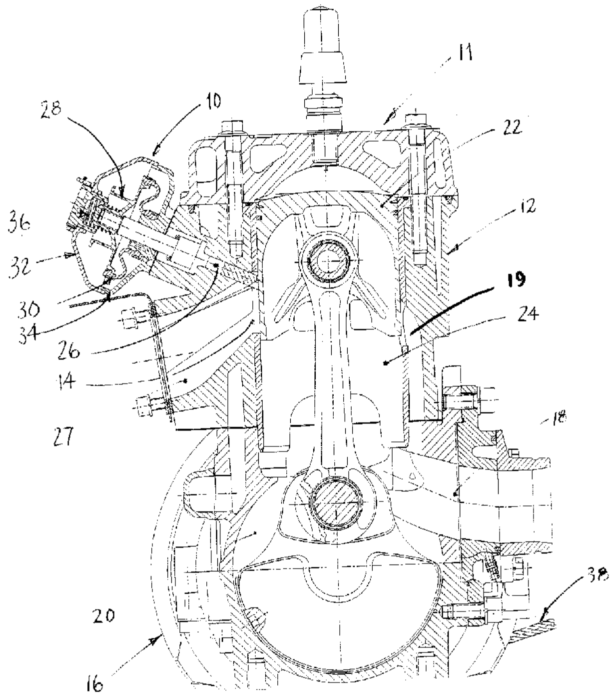
(54) **ENSEMBLE DE SOUPAPES UTILISANT UN ELEMENT SOUS PRESSION POUR CONTROLER LES CONDITIONS DE FONCTIONNEMENT D'UN MOTEUR A DEUX TEMPS**

(54) **VALVE ASSEMBLY USING PRESSURIZED MEDIUM FOR CONTROLLING OPERATING CONDITIONS OF A TWO-STROKE ENGINE**



(57) A valve assembly is located adjacent a cylinder structure of a two-stroke engine and includes a valve adapted to vary the height of the exhaust port of this engine. The source of pressure to vary this height is a pressurized medium or a vacuum. The valve includes a restricting member adapted to vary exhaust port height from a full-flow height to a restrictive height. The valve is capable of actuating and controlling the restricting member according to the engine speed N generated by the engine to obtain its optimum efficiency.

ABSTRACT OF THE SPECIFICATION

A valve assembly is located adjacent a cylinder structure of a two-stroke engine and includes a valve adapted to vary the height of the exhaust port of this engine. The source of pressure to vary this height is a pressurized medium or a vacuum. The valve includes a restricting member adapted to vary exhaust port height from a full-flow height to a restrictive height. The valve is capable of actuating and controlling the restricting member according to the engine speed N generated by the engine to obtain its optimum efficiency.

VALVE ASSEMBLY USING PRESSURIZED MEDIUM FOR CONTROLLING OPERATING CONDITIONS OF A TWO-STROKE ENGINE

FIELD OF THE INVENTION

The invention relates to a valve assembly adapted to vary the height of the exhaust port of a two-stroke engine wherein a restrictive member is actuated by a pressurized medium or a vacuum for varying such height. In operation, the engine produces an engine speed N which is used for determining the height of the exhaust port and obtaining optimum efficiency of the engine.

BACKGROUND OF THE INVENTION

In order to ensure that two-stroke engines have a high power capacity at high speed, a high volumetric efficiency is required and the charge losses must be minimized. This can be accomplished by a higher opening of the exhaust passage in conjunction with resonance effects. Owing to the relative height of the exhaust port, that adjustment of the exhaust system to the maximum power capacity of the engine involves, in the medium speed range, not only an appreciable decrease of the useful stroke, but also a large increase of the charge losses. As a result, the torque decreases and fuel consumption increases greatly. A higher torque in conjunction with a lower fuel consumption can be obtained at lower speeds only if the height of the exhaust port is lower than it is at higher speeds.

For this purpose it is known to provide in the exhaust passage a restricting member, which has at its end disposed adjacent the exhaust port a restricting edge which in the restricted position of the restricting member is substantially flush with the peripheral surface of the cylinder bore. The restricting member is adjustable to vary the relative height of the exhaust port as is required under given operating conditions of the engine.

US patent No. 4,399,788, entitled "INTERNAL COMBUSTION ENGINE COMPRISING MEANS FOR CONTROLLING THE AXIAL EXTENT OF AN EXHAUST PORT IN A CYLINDER", discloses a system comprising a valve having a restricting member which is actuated and controlled by the exhaust gas pressure developed by the engine in the exhaust gas system.

More particularly, the valve comprises a diaphragm for adjusting the restricting member which is gripped in the valve housing and engages a linkage, which is connected to the restricting member. A pressure-applying duct is connected to the exhaust gas system and is adapted to direct the exhaust gas pressure in the system to the diaphragm. A return spring opposes the action of the exhaust gas pressure on the diaphragm and tends to move the restricting member to its restrictive position.

One disadvantage of this system is that the exhaust gas temperature is very high. A high temperature resistant diaphragm is thus required. Exhaust gas is also very dirty because of the oil, fuel and mixture condensation and the carbonisation which occurs during ignition. In time, this creates a malfunction of the valve.

Using a pressure source created in the exhaust system cannot be very accurate because of the production tolerance, the engine operation mode and the temperature of the exhaust gas affecting this pressure source and because it generates a transitional zone between exhaust pressure p_1 (the pressure which initiates the movement of the restricting member) and exhaust pressure p_2 (the pressure for which the exhaust port is fully exposed) where the efficiency of the engine is not optimum.

Finally, this system requires the use of a larger diaphragm for two-stroke engines, that creates a lower pressure in the exhaust system in order to increase efficiency and to reach different design parameters.

It is also known to use a valve having a restricting member which is actuated and controlled by the pressurizing mixture developed by the engine in the upper part of the cylinder. This system has a major disadvantage in that the pressurized mixture from the cylinder is very hot and very dirty due to the carbonisation occurring during ignition. This can cause the restricting member and/or the measurement device to become clogged with soot. This system also generates a transitional zone between two pressures where the efficiency of the engine is not optimum and it also uses a calibrated spring for which, when the pressure of the pressurizing mixture is enough high, the restricting member is then actuated.

Consequently, these two prior art systems, in using a specific pressure (from the exhaust pipe or from the upper part of the cylinder) for actuating the restricting member are not optimum because for different throttle openings, the movement of the restricting member is not initiated according to different engine speeds (RPM), but according to the pressure created in the exhaust pipe or in the upper part of the cylinder.

Moreover, these systems, because they operates according to a specific actuating pressure, require the use of different calibrated return springs for engines developing different power outputs.

The invention seeks to provide a two-stroke engine; said engine when activated producing an engine speed N; said engine including: (a) a cylinder structure having an inside peripheral wall which defines a cylinder bore with an exhaust port; and (b) a piston axially reciprocable in said cylinder bore and adapted to open and close said port;

wherein the improvement includes:

- a source of pressurized medium;

- a restricting member for varying exhaust port height from a full-flow height to a restrictive height;

- a valve located adjacent said cylinder structure; said valve being adapted to actuate and control said restricting member with pressurized medium according to the engine speed N.

The invention further seeks to provide a valve assembly located adjacent a cylinder structure of a two-stroke engine; said engine when activated producing an engine speed N; said cylinder structure having an inside peripheral wall which defines a cylinder bore with an exhaust port; said valve assembly including a valve, a source of pressurized medium and a restricting member for varying exhaust port height from a full-flow height to a restrictive height; said valve being adapted to actuate and control said restricting member with pressurized medium according to the engine speed N.

In a preferred embodiment of the present invention the novel valve assembly includes a valve having a restricting member connected to a valve piston, a bellows mounted with the valve piston, and a compression spring. The restricting member is mounted in the cylinder structure adjacent the port and is adjustable between a full-flow height, at which the restricting member exposes the exhaust port throughout its axial extent, and a restricted height, at which the restricting member restricts the axial extent of the exhaust port.

The valve assembly also has a duct connected to the valve, through which the pressurized air from the crankcase moves. This pressurized air applies pressure on the bellows in the valve, thereby moving the restricting member towards the full-flow height. Normally, the compression spring keeps the restricting member at the restrictive height.

A solenoid-valve is installed on the duct, such solenoid-valve directs or blocks the pressurized air to the bellows in the valve. The solenoid-valve is controlled by a device such as an Electronic Control Unit (ECU), which measures the engine speed N produced by the engine when the latter is activated.

Other objects and features of the invention will become apparent by reference to the following specification and to the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

A detailed description of the preferred embodiment of the invention is provided herein with reference to the following drawings, wherein:

Figure 1 is a graph showing curves which represent the relation of the output power of an engine and the available pressure according to the engine speed of the engine for a 100% throttle opening;

Figure 2 is a graph showing curves which represent the relation of the output power of an engine and the available pressure according to the engine speed of the engine for a 50% throttle opening;

Figure 3 is a graph showing curves which represent the relation of the output power of an engine and the available pressure according to the engine speed of the engine for a 30% throttle opening;

Figure 4 is a graph showing curves which represent the relation of the output power of an engine and the available pressure according to the engine speed of the engine for a 20% throttle opening;

Figure 5 is a graph showing curves which represent the relation of the available pressure according to the engine speed of the engine for different throttle opening;

Figure 6 is a perspective view of a two-stroke engine with a valve assembly constructed in accordance with the present invention located adjacent a cylinder structure;

Figure 7 is a sectional view taken along lines 7-7 of figure 6.

Figure 8 is a perspective view of a two-stroke engine with a valve assembly constructed in accordance with the present invention located adjacent a cylinder structure wherein a vacuum pipe is mounted between a ECU and a crankcase;

Figure 9 is a diagrammatic view of an engine with a valve assembly constructed in accordance with a first variant mounted thereon;

Figure 10 is a diagrammatic view of an engine with a valve assembly constructed in accordance with a second variant mounted thereon; and

Figure 11 is a diagrammatic view of an engine with a valve assembly constructed in accordance with a third variant mounted thereon.

In the drawings, the preferred embodiment of the invention is illustrated by way of example. It is to be expressly understood that the description and drawings are only for the purpose of illustration and as an aid to understanding, and are not intended as a definition of the limits of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, figure 1 illustrates that for a 100% throttle opening, the restricting member has to be actuated at 6600 RPM (actuating speed of the engine for a 100% throttle opening ($AS_{100\%}$)) in order to permit a higher opening of the exhaust passage. Indeed, if no higher opening is allowed around that point, the engine will reach a power output of 60 KWatt (line 1 (restrictive height)) while if a higher opening is allowed, the engine will reach a power output of almost 80 KWatt (line 2 (full-flow height)).

In the prior art systems, in order to initiate the movement of the restricting member at around 6600 RPM ($AS_{100\%}$), it must calibrate the return spring in relation to the diaphragm area to obtain the force needed to move such restricting member with the available pressure. As illustrated in figure 1, the available pressure ($AP_{100\%}$) is 120 mbar for this operating condition. Thus, by selecting the adequate return spring, the prior art systems only allow movement of the restricting member for this actuating pressure, namely 120 mbar.

As illustrated in figure 2, for a 50% throttle opening, the restricting member has to move around an actuating speed of 6680 RPM ($AS_{50\%}$) while the available pressure is around 95 mbar ($AP_{50\%}$) for this operating condition. Figure 3 and 4, respectively illustrate that for a 30% throttle opening, the restricting member has to move around an actuating speed of 7000 RPM ($AS_{30\%}$), and for a 20 % throttle opening, the restricting member has to move around an actuating speed of 7290 RPM ($AS_{20\%}$) while the available pressures are only around 61 mbar ($AP_{30\%}$) and 36 mbar ($AP_{20\%}$) respectively.

Figure 5 illustrates four lines which represent the relationship of available pressures according to the engine speed of the engine wherein lines 3, 4, 5 and 6 are respectively for a throttle opening of 100%, 50%, 30% and 20%. In using a return spring calibrated to move under an actuating pressure of 120 mbar, as illustrated by the line 3, the restricting member will be actuated at the adequate actuating speed, namely around 6600 RPM ($AS_{100\%}$). However, in using the same return spring and with a throttle opening of 50%, because the pressure may only reach 120 mbar at approximately 7800 RPM (see line 4), the restricting member will then initiate its movement around 7800 RPM instead of 6680 RPM ($AS_{50\%}$). Finally, as illustrated by lines 5 and 6, the restricting member will never be actuated for these operating conditions because the available pressure will never reach the actuating pressure, namely 120 mbar.

Thus, prior art systems using a predetermined actuating pressure and a corresponding calibrated return spring do not allow optimum operation of the engine.

Referring now to figure 6, a valve assembly constructed in accordance with the present invention is generally designated by the reference numeral 8.

Figure 7 illustrates a valve 10 located adjacent a two-stroke engine 11. It is understood that the word “two-stroke engine” includes an engine having at least one cylinder such as an one, two, three or more cylinder engines. The engine 11 comprises a cylinder 12 having an exhaust port 14 and a crankcase 16 having an inlet port 18 and an internal chamber 20. A piston 22 is reciprocable in the cylinder bore 24 and is adapted to control the ports 14 and a transferring port 19. When the engine 11 is operating at low or medium speeds, the exhaust port 14 should not be exposed prematurely by the piston 22, as the latter moves downwardly by the expanding gases. Such a premature exposure of the exhaust port 14 is prevented by a restricting member 26. This restricting member 26 is slidably mounted in a guide passage having a longitudinal direction that is approximately radial with respect to cylinder bore 24 and extends at an acute angle to the axis of an exhaust passage 27. The exhaust passage 27 communicates with the exhaust port 14.

The valve 10 which is adapted to actuate the restricting member 26 comprises a valve piston 28 connected to the restricting member 26; a bellows 30 mounted with the valve piston 28 and gripped in the wall of the valve 10 formed with a cover 32 and a valve housing 34; and a compression spring 36. A duct 38 is connected to the crankcase 16 and is adapted to apply the pressurized air from the internal chamber 20 to the bellows 30. The compression spring 36 creates a pre-load on the valve piston 28 in order that the restricting member 26 stays at the restricting height, at which it restricts the exhaust port 14.

Referring now to figures 6 and 7, the valve assembly 8 includes the valve 10, a solenoid-valve 40, an Electronic Control Unit, commonly called an ECU, and a check valve 42 which is mounted on the duct 38. The solenoid-valve 40 directs the pressurized air to or blocks it from the bellows 30 in the valve 10. The solenoid-valve 40 is controlled by the ECU which measures engine speed N of the engine 11.

As the engine speed N increases, at a certain point it will be necessary to provide a higher opening of the exhaust port 14. To this end, the ECU activates the solenoid-valve 40 which directs the pressurized air to the bellows 30 which moves the restricting member 26 towards the full-flow height. The check valve 42 eliminates the negative pressure from the crankcase 16. As the engine speed N decreases, at a certain point it will be necessary to delay the exposure of the exhaust port 14, and to this effect the ECU deactivates the solenoid-valve 40. This blocks the pressurized air and the section under the bellows 30 is then opened to the atmosphere.

As illustrated in figure 8, instead of opening to the atmosphere the area beneath the bellows 30, a vacuum pipe 44 may be mounted between the ECU and the crankcase 16 in order to use the negative pressure created in the crankcase for increasing the speed at which the pressurized air is evacuated from beneath the bellows 30, and thus increasing the speed at which the restricting member 26 moves towards its restrictive position. The compression spring 36 may then be smaller because such negative pressure will suck the air located under the bellows 30 while the compression spring 36 may be calibrated just sufficiently for keeping the restricting member 26 at its restricting height. A check valve 46 eliminates the pressure from the crankcase 16.

Referring to figure 9 wherein a valve assembly constructed in accordance with a first variant is illustrated, a vacuum, instead of pressurized air, may be used. Indeed, while a valve assembly may use the pressurized mixture created when the piston descends, the vacuum created when the piston ascends may also be used. Obviously, the bellows 30, the spring 36 and the check valve 42 are mounted in order that the restricting member 26 moves towards the full-flow height when the vacuum is directed by the solenoid-valve 40 to the bellows 30 located in the valve 10. Also, when the vacuum is blocked by the solenoid-valve 40, the spring 36 operates in order that the restricting member 26 stays at the restricting height.

Figure 10 illustrates a valve assembly constructed in accordance with a second variant wherein an air pump is used, such air pump providing the pressurized air instead of using the pressurized air from the crankcase 16.

Finally, figure 11 illustrates a valve assembly constructed in accordance with a third variant wherein water is used instead of pressurized air.

It is understood that the dimension of the bellows 30 and the characteristic of the spring 36 are determined in order to allow movement of the restricting member 26 in accordance to the type of the source of pressure used.

It is understood that the ECU may use other input signals than the engine speed N for actuating the valve 10. Indeed, a throttle opening may be measured for determining the rate of acceleration A of the engine 11. As it is well known in the state of the art, the throttle opening may be measured at the throttle valve located in the carburettor, such carburettor controlling fuel supplies to the engine 11.

It may be possible to use the rate of acceleration in order to reduce or eliminate the delay between the opening of the solenoid-valve 40 and the actuating of the restricting member 26. Even if this delay may be very short, there is always a small delay due to the capacity of the source of pressure and/or the inertia of the restricting member 26. Thus, it may be desirable to open the solenoid-valve 40 earlier. If the rate of acceleration A of the engine 11 is very high (for instance around 10 000 RPM), the solenoid-valve 40 may open earlier than the predetermined engine speed. For instance, the ECU may activate the solenoid-valve 500 RPM before the predetermined engine speed. The ECU may thus actuate the valve 10 according to the engine speed N and the rate of acceleration A.

It is understood that while the invention may include a mounted solenoid-valve and/or a mounted Electronic Control Unit, commonly called an ECU, such solenoid-valve and/or such ECU may be located adjacent the engine and/or the valve assembly instead to be mounted thereon.

The above description of the preferred embodiment should not be interpreted in any limiting manner since variations and refinements are possible which are within the spirit and scope of the present invention. The scope of the invention is defined in the appended claims.

THE EMBODIMENTS OF THE INVENTION FOR WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A two-stroke engine including:

- a cylinder structure having an inside peripheral wall which defines a cylinder bore with an exhaust port;
- a piston axially reciprocable in said cylinder bore and adapted to open and close said exhaust port;
- a crankcase connected to said cylinder structure including an inside wall which defines an internal chamber;
- said engine when activated producing an engine speed N and developing pressurized air in said internal chamber;

wherein the improvement includes:

- a restricting member for varying exhaust port height from a full-flow height to a restrictive height;
- a valve assembly located adjacent said cylinder structure and including a valve; said valve being adapted to actuate and control said restricting member with pressurized air according to the engine speed N.

2. The engine as claimed in claim 1, wherein said valve comprises: a valve piston connected to said restricting member and a bellows mounted with said valve piston; said restricting

member being mounted in said cylinder structure adjacent to said exhaust port and adjustable between a full-flow height, at which said restricting member exposes said exhaust port throughout its axial extent, and a restrictive height, at which said restricting member restricts the axial extent of said exhaust port.

3. The engine as claimed in claim 1 or 2, wherein said valve assembly includes a mounted solenoid-valve; said solenoid-valve being adapted in operation to direct or block the pressurized air to said bellows.

4. The engine as claimed in any one of claims 1 to 3, wherein said solenoid-valve includes a mounted Electronic Control Unit, commonly called an ECU; said ECU being adapted to measure the engine speed N and to activate or deactivate said solenoid-valve.

5. The engine as claimed in any one of claims 1 to 4, said engine further including, when activated, a rate of acceleration A and said ECU being adapted to measure the rate of acceleration A for activating or deactivating said solenoid-valve.

6. The engine as claimed in any one of claims 1 to 5, wherein said valve assembly further includes a vacuum pipe to increase

the speed at which the pressurized air is evacuated from beneath said bellows.

7. A two-stroke engine including:

- a cylinder structure having an inside peripheral wall which defines a cylinder bore with an exhaust port;

- a piston axially reciprocable in said cylinder bore and adapted to open and close said exhaust port;

- a crankcase connected to said cylinder structure including an inside wall which defines an internal chamber;

- said engine when activated producing an engine speed N and developing a vacuum in said internal chamber;

wherein the improvement includes:

- a restricting member for varying exhaust port height from a full-flow height to a restrictive height;

- a valve assembly located adjacent said cylinder structure and including a valve; said valve being adapted to actuate and control said restricting member with a vacuum according to the engine speed N.

8. The engine as claimed in claim 7, wherein said valve comprises: a valve piston connected to said restricting member and a bellows mounted with said valve piston; said restricting

member being mounted in said cylinder structure adjacent to said exhaust port and adjustable between a full-flow height, at which said restricting member exposes said exhaust port throughout its axial extent, and a restrictive height, at which said restricting member restricts the axial extent of said exhaust port.

9. The engine as claimed in claim 7 or 8, wherein said valve assembly includes a mounted solenoid-valve; said solenoid-valve being adapted in operation to direct or block the vacuum to said bellows.

10. The engine as claimed in any one of claims 7 to 9, wherein said solenoid-valve includes a mounted Electronic Control Unit, commonly called an ECU; said ECU being adapted to measure the engine speed N for activating or deactivating said solenoid-valve.

11. The engine as claimed in any one of claims 7 to 10, said engine further including, when activated, a rate of acceleration A and said ECU being further adapted to measure the rate of acceleration A for activating or deactivating said solenoid-valve.

12. The engine as claimed in any one of claims 7 to 11, wherein said valve assembly further includes a pressurized pipe to increase the speed at which the vacuum is evacuated from beneath said bellows.

13. A two-stroke engine; said engine when activated producing an engine speed N; said engine including: (a) a cylinder structure having an inside peripheral wall which defines a cylinder bore with an exhaust port; and (b) a piston axially reciprocable in said cylinder bore and adapted to open and close said exhaust port;

wherein the improvement includes:

- a source of pressurized medium;
- a restricting member for varying exhaust port height from a full-flow height to a restrictive height;
- a valve assembly located adjacent said cylinder structure; said valve being adapted to actuate and control said restricting member with pressurized medium according to the engine speed N.

14. The engine as claimed in claim 13, wherein said valve comprises: a valve piston connected to said restricting member and a bellows mounted with said valve piston; said restricting member being mounted in said cylinder structure adjacent to said

exhaust port and adjustable between a full-flow height, at which said restricting member exposes said exhaust port throughout its axial extent, and a restrictive height, at which said restricting member restricts the axial extent of said exhaust port.

15. The engine as claimed in claim 13 or 14, wherein said valve assembly includes a mounted solenoid-valve; said solenoid-valve being adapted in operation to direct or block the pressurized medium to said bellows.

16. The engine as claimed in any one of claims 13 to 15, wherein said solenoid-valve includes a mounted Electronic Control Unit, commonly called an ECU; said ECU being adapted to measure the engine speed N for activating or deactivating said solenoid-valve.

17 The engine as claimed in any one of claims 13 to 16, said engine further including, when activated, a rate of acceleration A and said ECU being further adapted to measure the rate of acceleration A for activating or deactivating said solenoid-valve.

18 The engine as claimed in any one of claims 13 to 17, wherein

said valve assembly further includes a vacuum pipe to increase the speed at which the pressurized medium is evacuated from beneath said bellows.

19. The engine as claimed in any one of claims 13 to 18, wherein said source of pressurized medium is an internal chamber of a crankcase connected to said cylinder structure.

20. The engine as claimed in any one of claims 13 to 18, wherein said source of pressurized medium is an air pump.

21. The engine as claimed in any one of claims 13 to 18, wherein said source of pressurized medium is a water impeller assembly.

22. A valve assembly located adjacent a cylinder structure of a two-stroke engine; said engine when activated producing an engine speed N and including a rate of acceleration A; said cylinder structure having an inside peripheral wall which defines a cylinder bore with an exhaust port; said valve assembly including a valve, a source of pressurized medium and a restricting member for varying exhaust port height from a full-flow height to a restrictive height; said valve being adapted to actuate and control said restricting member with pressurized

medium according to the engine speed N.

23. The valve assembly as claimed in claim 22, comprising a valve including a valve piston connected to said restricting member and a bellows mounted with said valve piston; said restricting member being mounted in said cylinder structure adjacent to said exhaust port and adjustable between a full-flow height, at which said restricting member exposes said exhaust port throughout its axial extent, and a restrictive height, at which said restricting member restricts the axial extent of said exhaust port.

24. The valve assembly as claimed in claim 22 or 23, wherein said valve assembly includes a mounted solenoid-valve; said solenoid-valve being adapted in operation to direct or block the pressurized medium to said bellows.

25. The valve assembly as claimed in any one of claims 22 to 24, wherein said solenoid-valve includes a mounted Electronic Control Unit, commonly called an ECU; said ECU being adapted to measure the engine speed N for activating or deactivating said solenoid-valve.

26. The valve assembly as claimed in any one of claims 22 to 25, wherein said ECU being further adapted to measure the rate of acceleration A for activating or deactivating said solenoid-valve.

27. The valve assembly as claimed in any one of claims 22 to 26, wherein said valve assembly further includes a vacuum pipe to increase the speed at which the pressurized medium is evacuated from beneath said bellows.

28. The valve assembly as claimed in any one of claims 22 to 27, wherein said source of pressurized medium is an internal chamber of a crankcase connected to said cylinder structure.

29. The valve assembly as claimed in any one of claims 22 to 27, wherein said source of pressurized medium is an air pump.

30. The valve assembly as claimed in any one of claims 22 to 27, wherein said source of pressurized medium is a water impeller assembly.

31. A valve assembly located adjacent a cylinder structure of a two-stroke engine; said engine when activated producing an

engine speed N and including a rate of acceleration A; said cylinder structure having an inside peripheral wall which defines a cylinder bore with an exhaust port; said valve assembly includes a valve, a source of vacuum and a restricting member for varying exhaust port height from a full-flow height to a restrictive height; said valve being adapted to actuate and control said restricting member with vacuum according to the engine speed N.

32. The valve assembly as claimed in claim 31, comprising a valve including a valve piston connected to said restricting member and a bellows mounted with said valve piston; said restricting member being mounted in said cylinder structure adjacent to said exhaust port and adjustable between a full-flow height, at which said restricting member exposes said exhaust port throughout its axial extent, and a restrictive height, at which said restricting member restricts the axial extent of said exhaust port.

33. The valve assembly as claimed in claim 31 or 32, wherein said source of vacuum is an internal chamber of a crankcase connected to said cylinder structure.

34. The valve assembly as claimed in any one of claims 31 to 33, wherein said valve assembly includes a mounted solenoid-valve; said solenoid-valve being adapted in operation to direct or block the vacuum to said bellows.

35. The valve assembly as claimed in any one of claims 31 to 34, wherein said solenoid-valve includes a mounted Electronic Control Unit, commonly called an ECU; said ECU being adapted to measure the engine speed N for activating or deactivating said solenoid-valve.

36. The valve assembly as claimed in any one of claims 31 to 35, wherein said ECU being further adapted to measure the rate of acceleration for activating or deactivating said solenoid-valve.

37 The valve assembly as claimed in any one of claims 31 to 36, wherein said valve assembly further includes a pressurized pipe to increase the speed at which the vacuum is evacuated from beneath said bellows.

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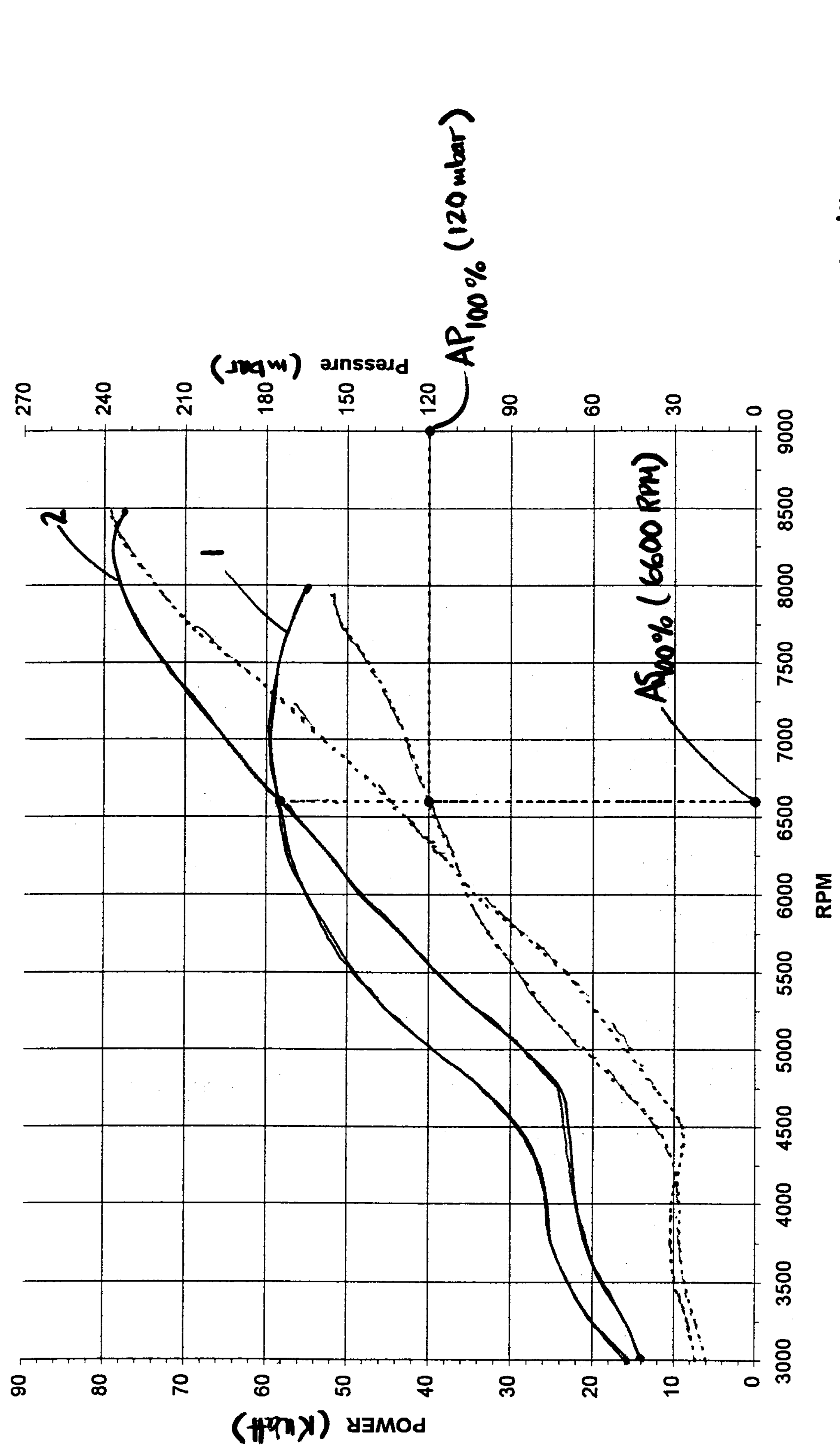


Fig. 1 (100% throttle opening)

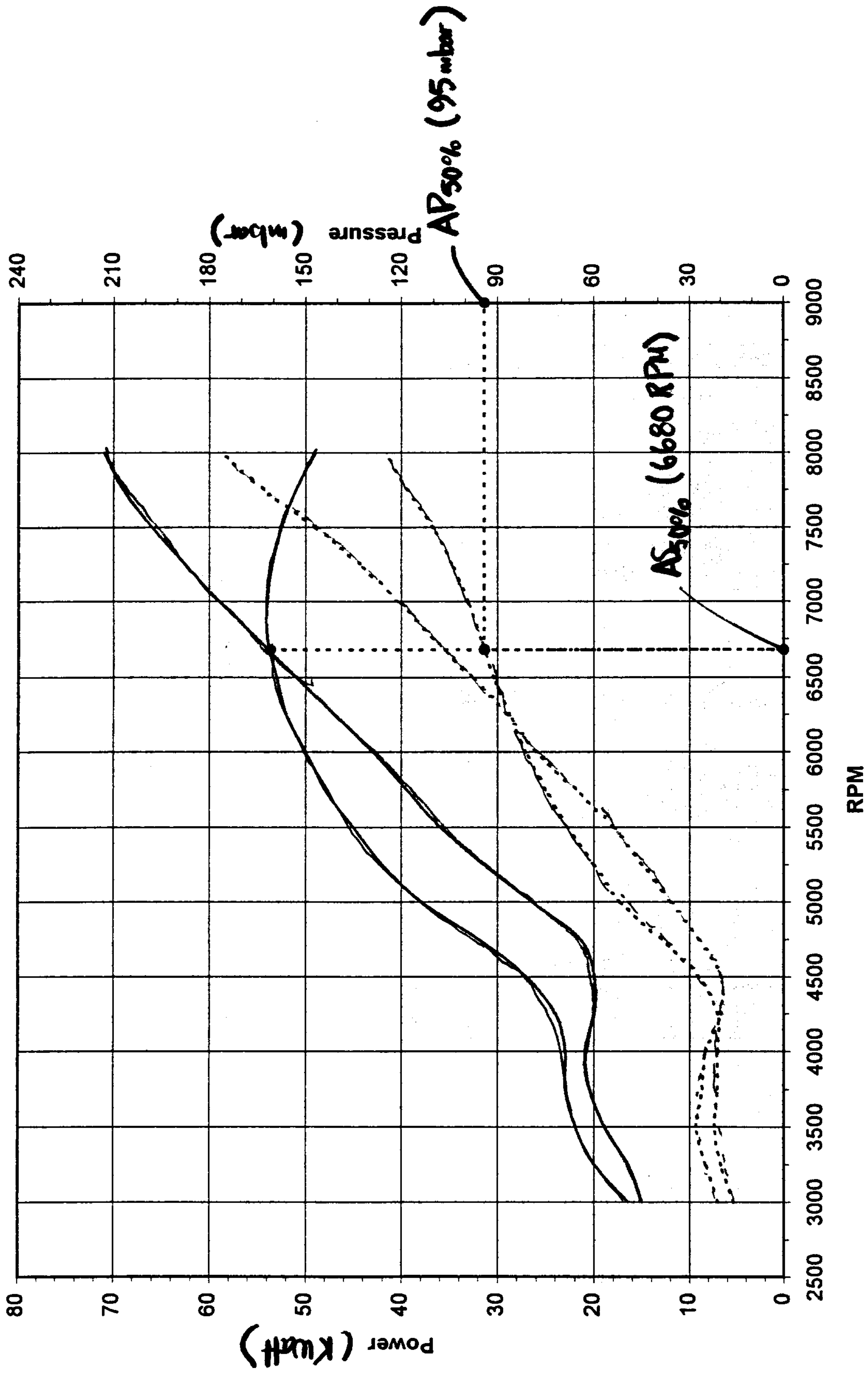


Fig. 2 (50% throttle opening)

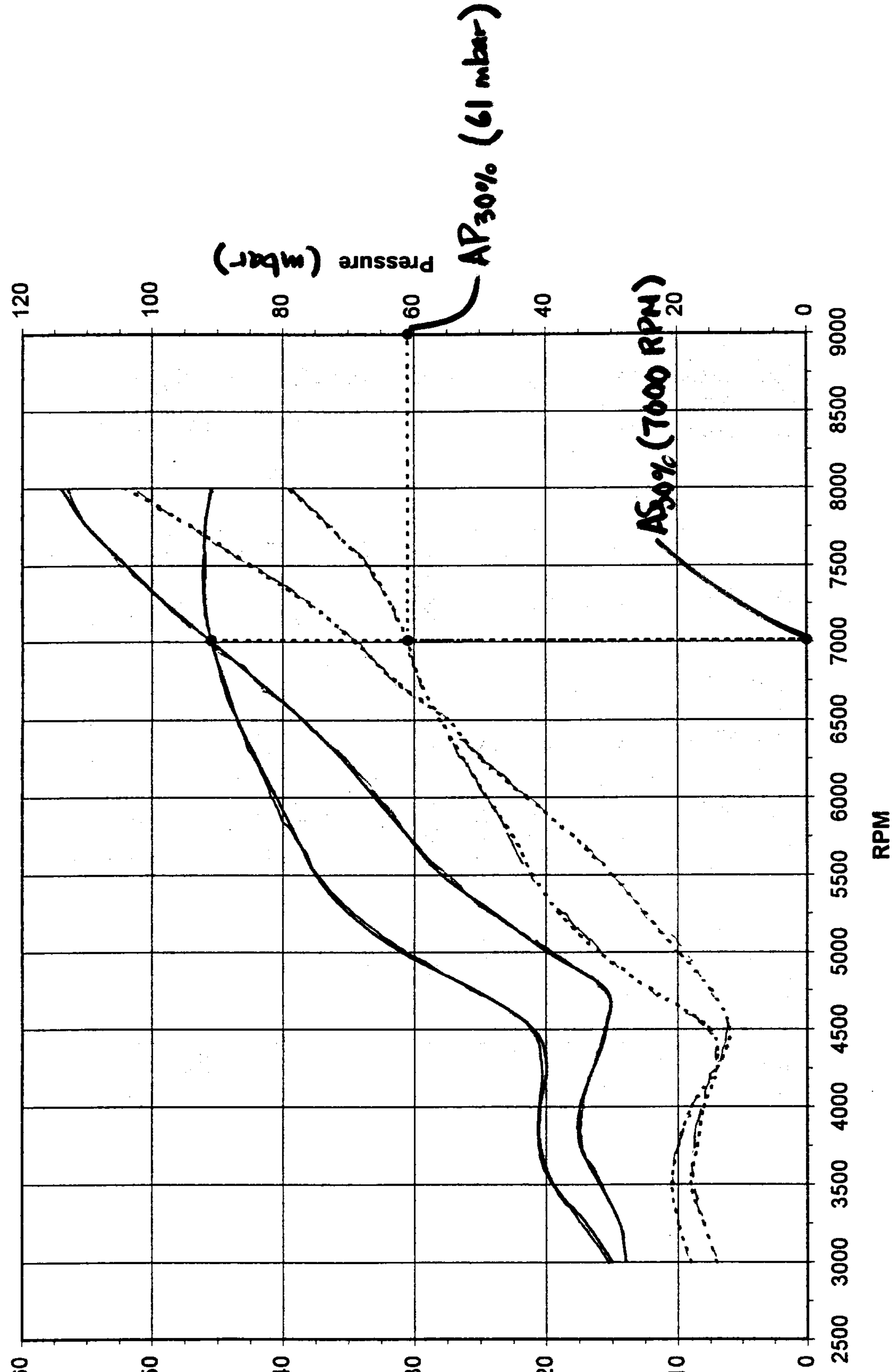


Fig. 3 (30% throttle opening)

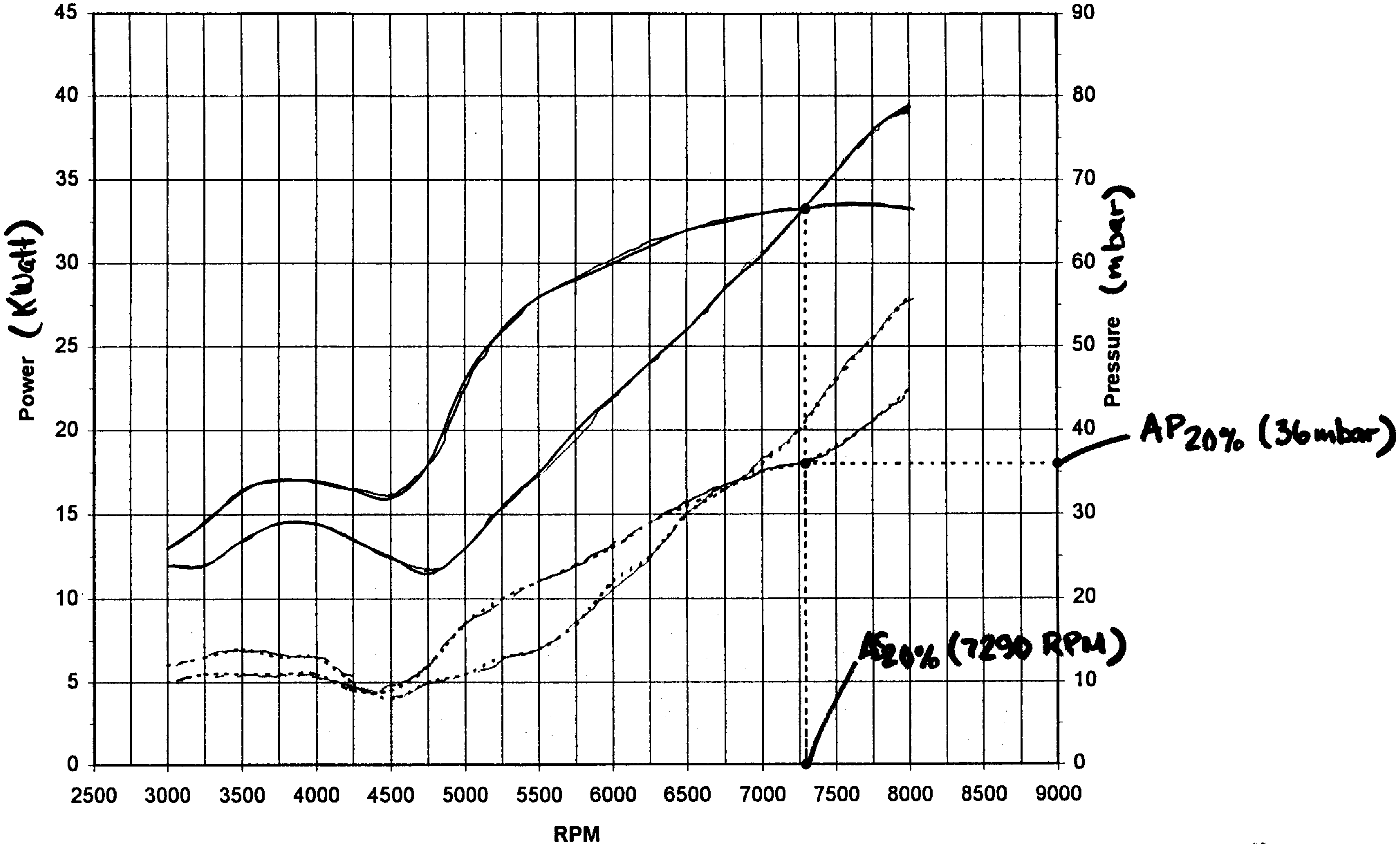


Fig. 4 (20% throttle opening)

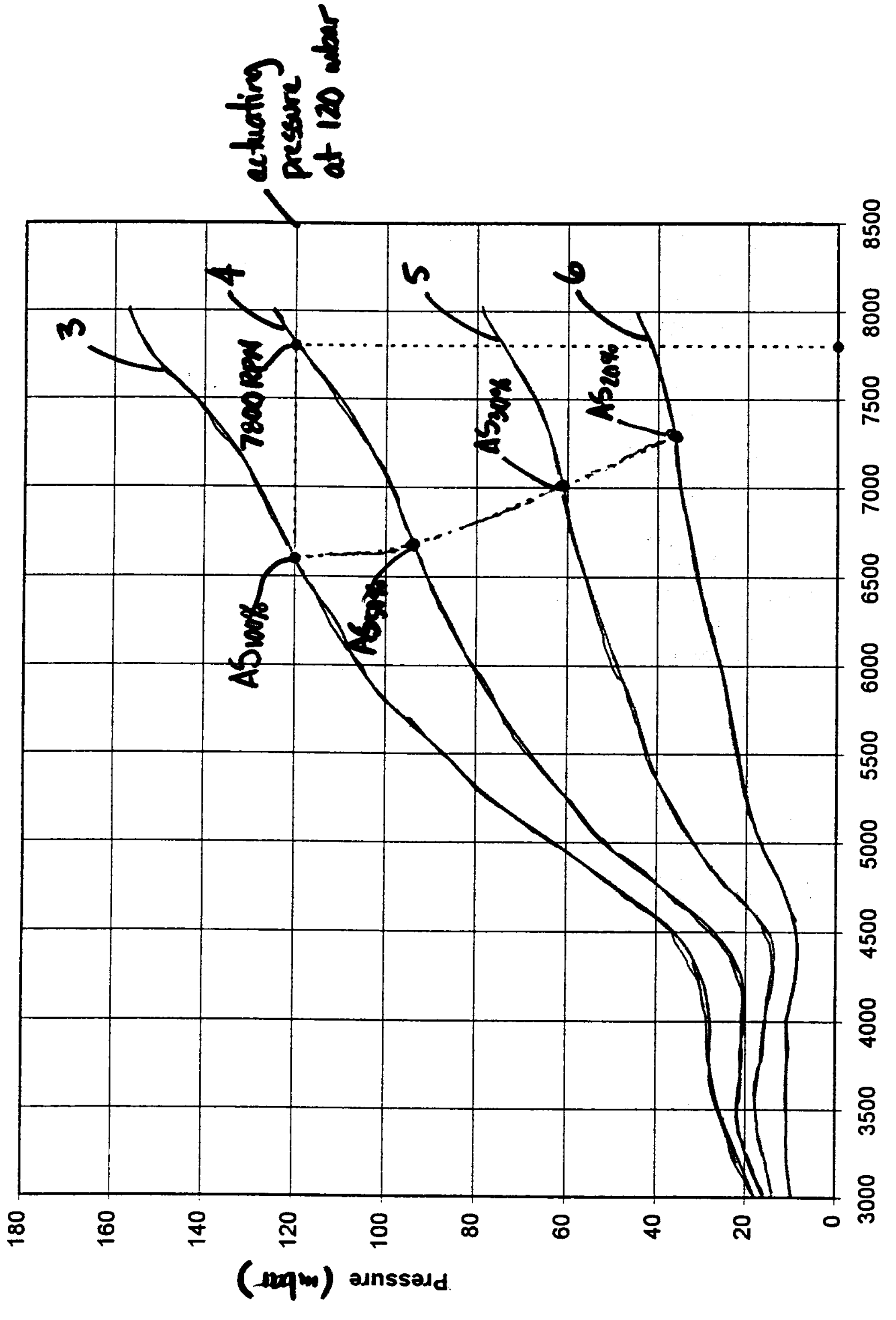

actuating pressure at 120 mbar
3
4
5
6
7800 RPM
AS100%
AS30%
AS20%
Pressure (mbar)
RPM
180
160
140
120
100
80
60
40
20
0
3000
3500
4000
4500
5000
5500
6000
6500
7000
7500
8000
8500

Fig. 5

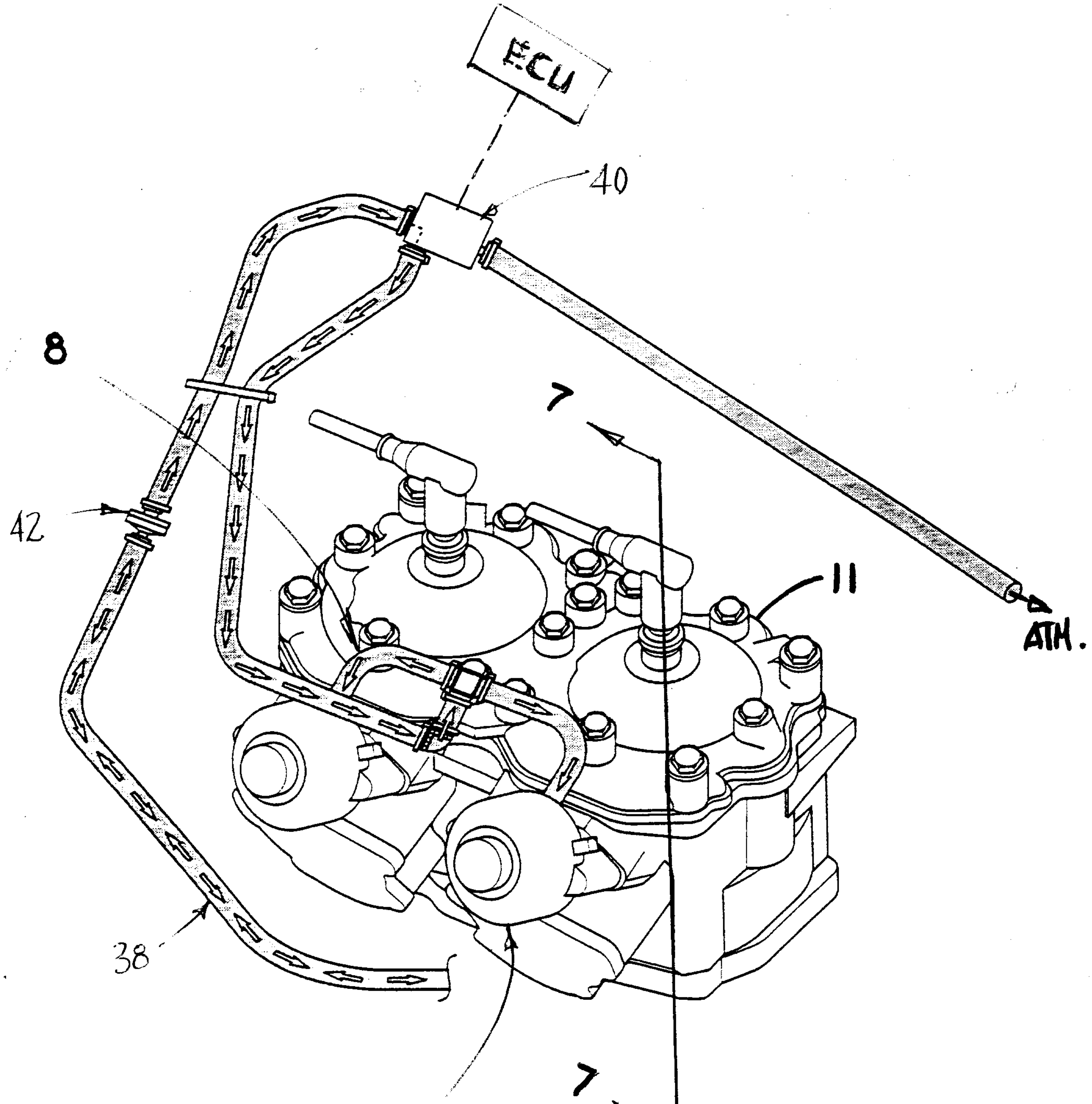


Figure 6

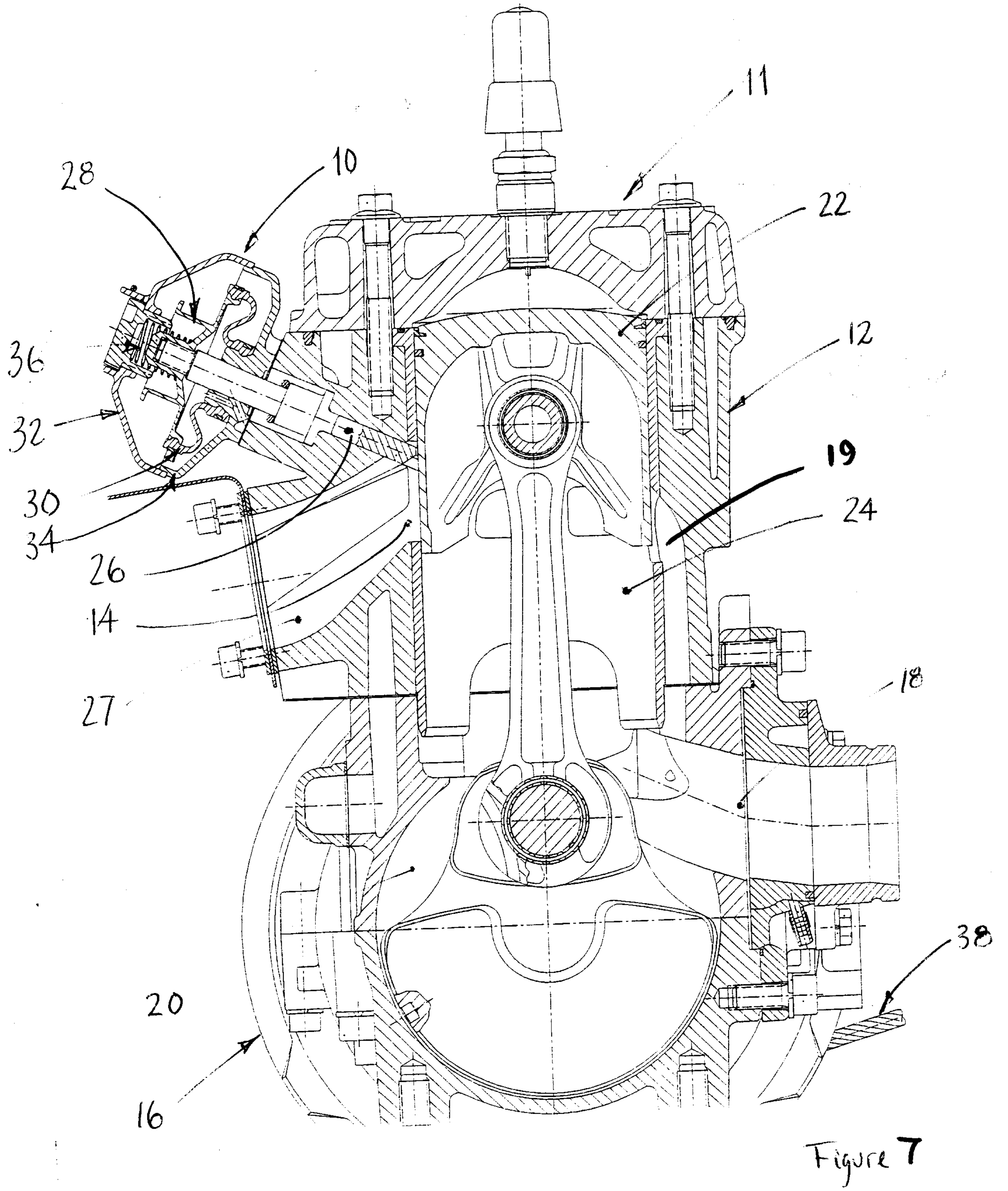


Figure 7

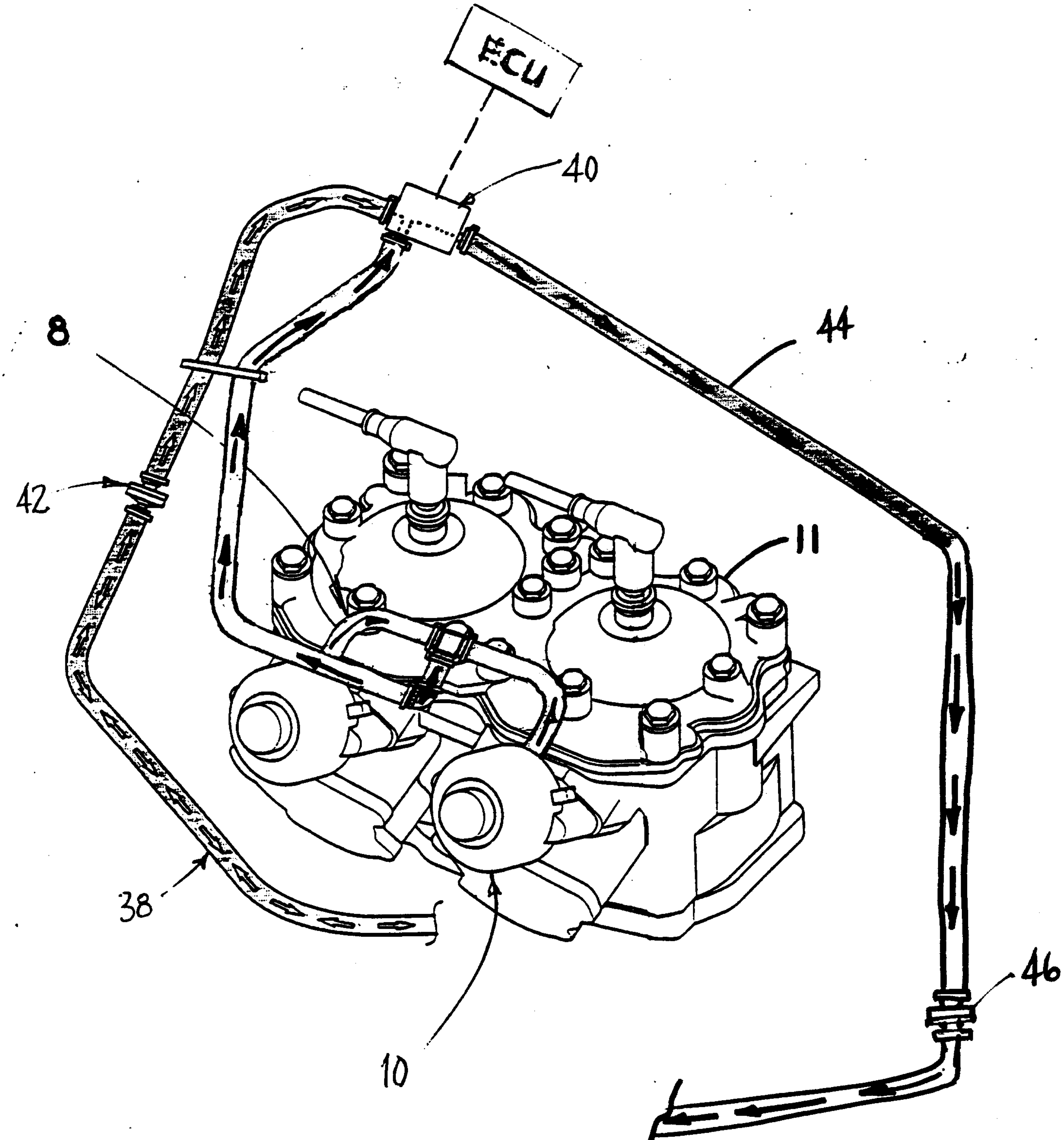


Fig. 8

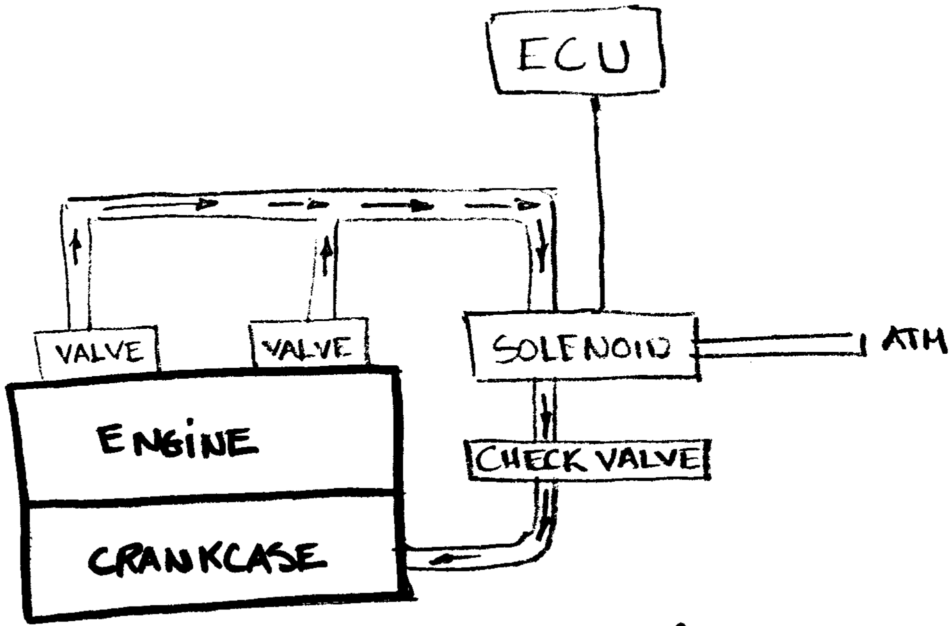


Fig. 9

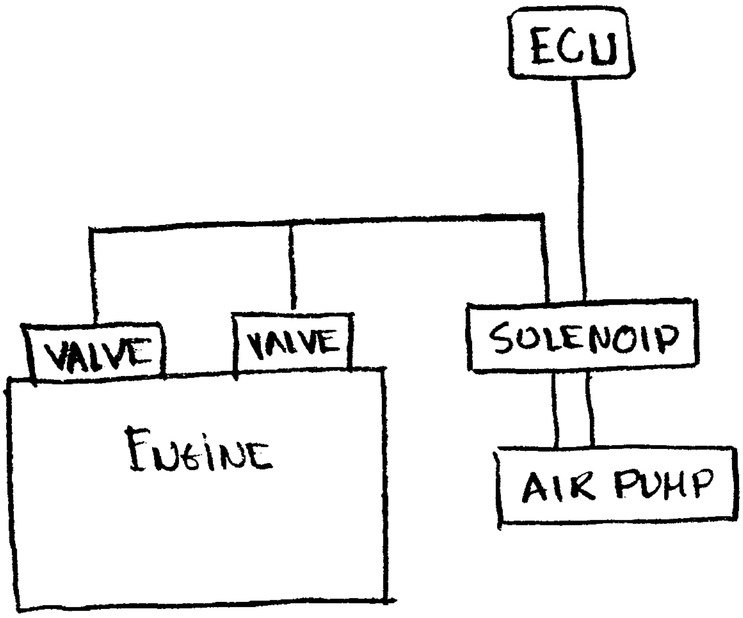


Fig. 10

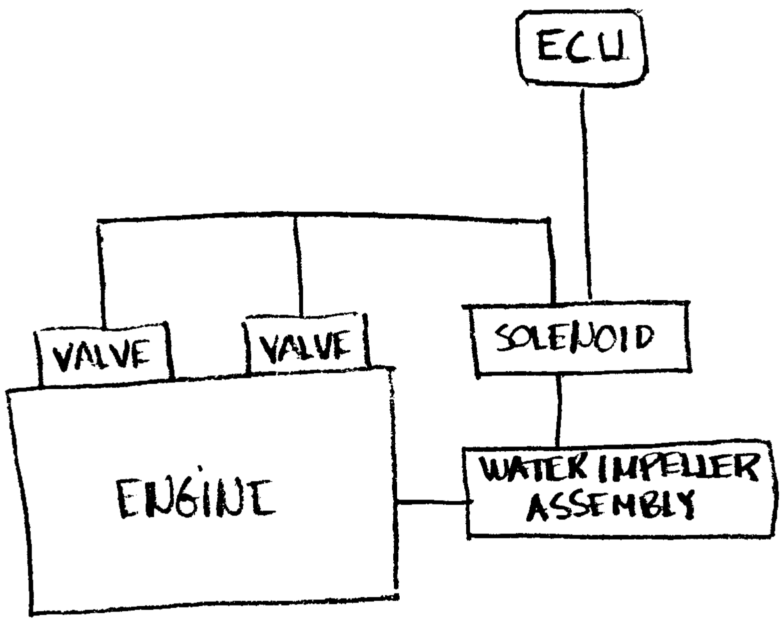
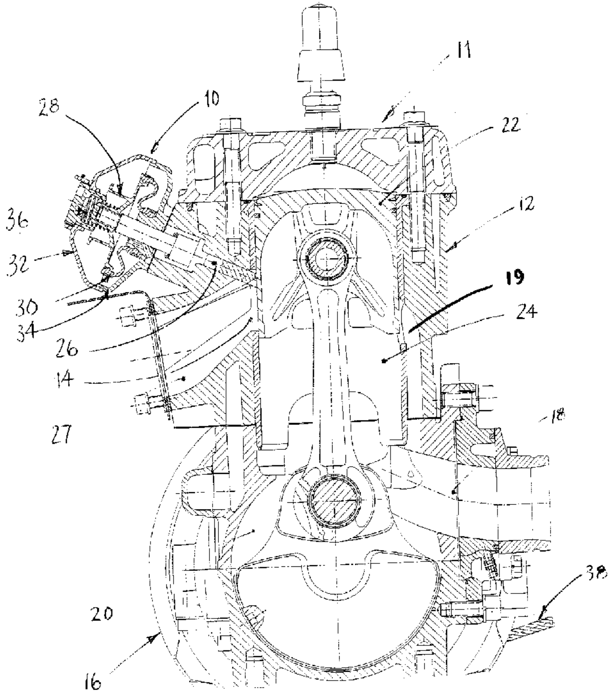


Fig. 11



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