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(54) A FLEXIBLE CONTROL DEVICE FOR TIME-SECTION FACTOR

(57) The present invention provides a control device for continuously variable time and cross section which is added the throttle control valve (10), the element (8) of throttle control valve and the relevant drive mechanism 1 in the regular intake and exhaust system of internal combustion engine. The throttle control valve (10) is fixed in the cavity, which is composed of the fluid flow passage (11) in the cylinder head (7), the valve seat (12) and the valve (9). The throttle control valve (10) is cylindrical, and its axis of motion is just the same as that of the valve guide or is parallel with it. Through controlling the relative movement between the valve (9) and the throttle control valve (10) it is flexible to adjust the cross-section area of fluid flow passage, effective valve phase, working time, effective lift and swirl intensity of fluid movement in the course of periodic opening and closing of valve. The present invention can apparently improve the performance of cold start-up of the engine in the low temperature, and can make the engine have the perfect economical and dynamic performance, low noise and low emission. At the same time the direct control of EGR can be easily realized with it.

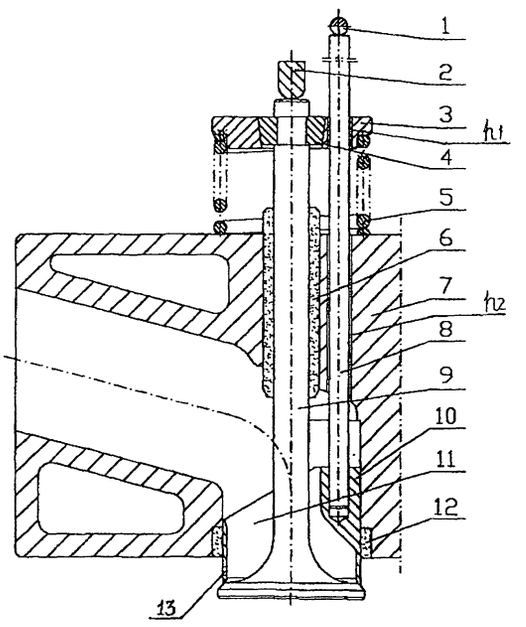

Fig. 3

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Description

FIELD OF THE TECHNOLOGY

[0001] The present invention is involved in the field of fluid throttle control, especially the intake and exhaust system (in this article, "intake and exhaust valve" and "throttle valve" have the same meaning) of valve-controlled internal combustion engine (in this article, "air valve" and "valve" have the same meaning), the valve and pump in fuel supply system, and continuously variable timed and cross-sectional control device of other gate-type fluid (in this invention, the definition of time and cross-section is $\Omega = \int f dt$, f: the cross-section of fluid flow passage, dt: the differential of time); through this device the continuous variable control can be applied to effective phase difference, working time, effective lift and vortex intensity of fluid movement of valve working of engine and the engine can attain the optimal performance.

BACKGROUND OF THE INVENTION

[0002] In the present, valve time, valve effective phase and valve lift is immutable in most of valve control device of internal combustion engine, then the relative parameters of cam lines are usually designed in the eclectic way. In this kind of design, engine can achieve optimal performance only in some of the working condition, however, most of engine must work in much more largo extent of speed and load, and it is impossible that engine can keep the optimal performance in all working condition; there are many problems, such as, lower economics and dynamics, larger temperature influence in low temperature start, heavy pollution of emission and bad combustion in accelerator, and so on. Except optimizing the physical dimension of intake and exhaust channel and scavenging mechanism, adopting technology of 4 valves, appropriate arrangement of valve, and optimizing the structure of combustion chamber, it is an important way that can improve the performance of engine by these technologies of variable valve effective phase, valve time and valve lift.

[0003] In patent literatures of China and foreign countries, there are many improved illustrations about one of valve effective phase, valve time and valve lift or all of them, including mechanical drive system, electromagnetic drive system, fluid power system and other hybrid drive system. In comparison with mechanism of immutable valve time, the variable valve time mechanism can apparently improve the dynamics and fuel economy of engine, and the fuel economy can be improved approximate 16%, the power can be improved about 20%. The engine workers have developed many programs to optimize the flow process and improve the dynamic behavior of fluid, however, only few systems which have simple function can have been used in the products of internal combustion engine because of many reasons, such as, manufacturing cost, operational reliability, complexity of mechanism and scope of application of systems.

[0004] In NO.970251(1997) paper of SAE (Society f Automotive Engineer), German Berg M et. Designed "Δ control — completely continuous variable valve control mechanism of machine"; it can continuously adjust the valve lift, valve time and effective valve phase, through attaching cam of a triangle, pull-rod or tappet, and lock cam in the valve head. In the experiment of this mechanism, it has satisfied result, and noise of engine sharply decreases in lower speed. But this mechanism and control system of it is too complex: the commonality of cam of a triangle and drive and control mechanism of it is inferior, in the same time the mechanism of determining the geometric parameter and control model of it cannot be dynamic adjustment; assessorial elements are heavily abraded because assessorial mechanisms bear great and complicated force; large drive power consumption; there are many factors that apparently affect the adjustment of this mechanism, for example, camshaft seat, temperature of oil and engine speed negatively influence the adjustment of slanting slid valve.

[0005] The NO.94193867.0 China patent of Michael. B.Lily is lift device of variable valve for internal combustion engine, which adjusts the air stream by changing pivot location of rocker and digital follower. Pivot and rocker or digital follower have tine suited with this pivot, and pivot changes the ratio between valve lift and cam lift through rolling over an immovable lath. Control gap is invariable for all locations of pivot, or is variable following the change of pivot location. The moving trace of pivot, which is characterized by the shoe plate of pivot and a fixed lath, may be a circle or an arc similar with this circle. Changing the interdependence between regulating clearance and pivot location can beget controlled change of phase and working time. Because this device has too many components and the mechanism is too complexity, then there are some shortages as following: because implementing diminution or enlargement of displacement is through varying one catch point of rocker, to overcome the force of valve spring the force of rocker will vary according to the movement of catch point, then the abrasion of lath is non-homogeneous, especially the abrasion is the most important when valve is at the position of maximum lift; valve clearance will vary following the variation of the transmission ratio of rocker; to definitive rocker and drive cam, the transmission ratio of rocker and valve lift is confined by the geometric parameters of components and then adjustable range is also confined; because of these reasons, such as, larger force of accessory components, larger motion-resistance force, and more excessive drive segments, dynamical response characteristic is influenced by all these reasons.

[0006] The NO.US5254692 American patent of Hara. S, "porting time modifier"; the NO.DE4404145 German patent of Hass M, "porting time modifier" and the NO.

US5431133 American patent of Spath MJ, "valve lift modifier". The common characteristic of these patents is structuring two or three cams for driving each valve in cam shift, and these cams correspond to the different porting requirement of high speed, intermediate speed and low speed of an engine; in experience this mechanism can achieve a part of requirements and have good results. However, because the control response is cross-sectional, so that the adaptability of this mechanism is confined and it cannot achieve the optimal performance in all working conditions, meanwhile it is needed that adding the relative transition mechanism from one cam to other and rocker compensating gears for the add of moving links, and the discontinuity of input quantity will influence the output data.

[0007] Another realized way of valve control device of continuously variation is seeking the optimal control strategy through hydraulic pressure system. In this way, push rod of cam make airtight hydraulic oil flow out through a fixed little hole or through a controlled little hole. To passive system, the result is that the opening extent or the opening time of valve is not sufficient in low speed, and the effluent liquid cannot make that the motion of valve is differ from the normal system in high speed. The positive control mode can accurately control the lift and working time, then only through the valve movement the intake process can be controlled, and the normal throttling will be abolished. This system is described in the NO.930820 paper (Urata et.) of SAE (Society of American Engineer). The shortage of this system is that, opening operational reliability of valve is inferior, oil viscosity variation following the temperature will lead to fluctuation of mechanical movement and this system is too complexity. Although the engine which is installed this system can appear the apparent improvement of angular force and the car installed this system can reduce 7% fuel consumption, the advantage that mechanical system require to a serial of requirement is conspicuous.

[0008] The figure 1 is the structure sketch of intake and exhaust system of internal combustion engine which is currently general used in engine. This system is mainly composed of valve actuating mechanism 2, valve spring seat 3, valve locker 4, valve spring 5, valve guide 6, cylinder head 7, valve 9, fluid flow passage 11 and valve seat 12. The force from valve actuating mechanism 2 acts on the head of valve 9, compress the valve spring 5 through the valve spring seat 3 and open the valve 9. For the differential pressure, liquor is confined in the fluid flow passage 11 of cylinder head 7 and accomplishes intake or exhaust process; with the gradually decreasing of the force from valve actuating mechanism 2, until canceling all force, the valve 9 will be gradually closed in the acting force from valve spring 5. Because the geometric parameters of valve actuating mechanism 2 and other mechanisms have been defined, as well as the opening and closing time, valve effective phase and valve lift of valve 9 are fixed; the design can only response the eclectic scheme of some special working condition and aggregative indicator of an engine.

[0009] The common ground of variable valve time mechanism in the patents and papers have been mentioned above is that: valve lift is absolute change; the force begetting the largest lift still directly acts on the head of valve rod and this force is large, then the valve rod is easily abraded; because the added pair will beget the change of valve clearance and the performance of engine will be influenced, so it is needed adding the clearance compensator and this mechanism is too complexity and the cost is too high.

INVENTIVE CONTENTS

[0010] The invention is aimed at offering one continuously variable timed and cross-sectional control device which can flexibly control the phase on opening or closing the valve, working time, lift and the fluid vortex strength. The results show that it can improve start performance of internal combustion engine in lower temperature, reduce the fuel consumption, make pollutants emission less, boost the power and the torque, and reduce the noise and the vibration. Thus it makes the internal combustion engine have excellent performances in the working range of all velocities and loads.

[0011] We can adopt the following technical projects to solve its main technology problems of the invention.

[0012] The continuously variable timed and cross-sectional control device includes the intake and exhaust system which makes up of valve drive mechanism, valve spring seat, valve locker, valve spring, valve guide, cylinder head, valve, fluid flow passage, and valve seat, etc. The characteristics of the intake and exhaust system are as follow: (1) increasing the throttle control valve, the throttle control valve components, and the throttle control valve drive equipment at the base of the intake and exhaust system mentioned above;(2) fixing the throttle control valve in the clearance forming of the fluid flow passage of the cylinder head, valve seat, and valve ;(3) Paralleling or having a common axis with the valve guide axis and the valve movement axis;(4) the throttle control valve moving up and down relatively to the valve;(5) the throttle control valve drive device joining the throttle control valve components to control the throttle control valve.

[0013] To solve the technical problems of the invention, we also can adopt the following technical measures.

[0014] In regard to the before-mentioned continuously variable timed and cross-sectional control device:

(1) There is one eccentric hole paralleling with valve locker axes on the valve spring seat. By the valve guide up to cylindrical head there is an eccentric hole paralleling with valve guide axes. The throttle control valve drive device can go through the two

eccentric holes by itself or at the same time.

(2)The external circle of the throttle control valve matches with the inner wall of the fluid flow passage and internal hole clearance of the valve seat and its bottom is coupled with the mushroom valve skirt.

(3) The external circle of the throttle control valve has an annular cylindrical shape. Above the inside circle of the throttle control valve there is a projecting solid part joining the throttle control valve components.

(4) partial external circle of the throttle control valve has an annular cylindrical shape, and at the external circle circumference there is a protrusion joining the throttle control valve components.

(5) All external circle of the throttle control valve has an annular cylindrical shape, and the throttle control valve components joins in the internal circle of the throttle control valve.

(6)The elements of the throttle control valve is baculiform. The throttle control valve and the throttle control valve and the element of throttle control valve can be made as a single component, or assembled by two different components.

(7) At the bottom of annular cylindrical wall of the throttle control valve there are one or more throttling passages which look like hole or hatch.

(8) At the bottom of the annular cylindrical wall of the throttle control valve 10 there isn't any hole or hatch. The bottom of the throttle control valve matching with the mushroom valve skirt has the sealing function.

[0015] This invention of continuously variable timed and cross-sectional control device is adding the throttle control valve and the corresponding components to the intake and exhaust valve (throttle valve) as well as the valve seat of the regular engine. There is a coaxial line among the throttle control valve, the intake and exhaust valve and the valve seat. The intake and exhaust valve can move up and down along this coaxial line (the so-called up direction is the movement to close the valve, and the down direction is the movement to open the valve), and the throttle control valve can also move up and down along this coaxial line. There is relative and independent movement between the intake or exhaust valve and the throttle control valve, because of the particularity of their relative position, it results in a flexible timed and cross-sectional control for whole course (In regard to valve-type IC engine, $\Omega = \int f dt = \frac{1}{6n} \int f d\varphi$, here, f - cross-section area of fluid flow passage; n - rotation speed; dt - the differential of time; $d\varphi$ - differential of the crank angle). Therefore, the continuous optimum control of the valve availability phase of the intake and exhaust, working time, and swirl intensity of fluid movement during the whole course can be achieved, from which the engine performance will be improved on a large extent In comparison to the existing technology, the invention has obvious merits and availability effects. As these technical projects mentioned above, the invention has the following merits:

1) It is convenient to the throttle control, thus making the driving consume power less;
2) It can flexibly adjust the valve opening and closing timing phase;
3) It can continue to adjust the valve availability lifts.
4) It can flexibly adjust the valve opening and closing time;
5) It can flexibly adjust the flow turbulence intension;
6) It will be convenient to programming in the real-time control.

[0016] The invention is according the relatively independent movement means between the intake and exhaust valve and the throttle control valve to change the valve phase-working time-lift, and the vortex intensity of fluid movement. The valve and its drive gear keep original mode, and adding the throttle control valve and the corresponding control gear. The working principle is far from the existing working principle. To the engine having valve, it can realize flexible gas exchange in the range of all conditions. The invention has the following characteristics:

1) The design project is fit for the valve drive engine such as the traditional jib style, up-setting cam shaft style, and other valve driving means;
2) The design project is fit for single intake and exhaust valve or multi-intake and exhaust valves of every cylinder;
3) The structure of the mechanism is simple and needn't adding more accessories;
4) The control process of the hardware and software be realized dynamically under the engine movement, and can be controlled in all ranges;
5) The relativity independent movements between the throttle and throttle controllable valve can flexibly change the valve effective phase, working time, the effective lifts, and the vortex intensity of fluid movement. At the same time it can make the best use of the advantage of the software control, make the working mode variety and selectivity, and make the driving consume power less;
6) It will obviously improve the low temperature start performance, realize start in turn, and reduce largely start power. The corresponding performance has greatly improved because the key technology of the low temperature start is broken through;
7) It will improve obviously the noise and the vibra-

tion;
8) It will reduce the exhaust emissions and is convenient to the EGR control;
9) It has excellent economic performance under the part and full load conditions;
10) It may call off the butterfly valve and improve the power and the torque of the internal combustion engine;
11) It can improve the acceleration performance of the engine, lower its idle velocity, and having excellent stability.

[0017] The invention is fit for the other design projects using differ means making the throttle control valve working time and cross-section and vortex intensity of fluid movement flexible change.

[0018] The specific implement way of the present invention is given by the following implement examples and their attached drawings.

BRIEF DESCRIPTION OF THE FIGURES

[0019]

FIG.1 is a structural diagrammatic view showing the intake and exhaust system of the ICE which is in general use.

FIG.2 is a structural diagrammatic view showing the intake and exhaust system of the ICE when they are closed according to the present invention.

FIG.3 is a structural diagrammatic view showing the intake valve and the exhaust valve during the process of the ICE' s starting on cold temperature according to the present invention.

FIG.4 is a structural diagrammatic view showing the intake valve and the exhaust valve during the process of the ICE' s operation.

FIG.5 is a structural diagrammatic view showing the first implement example of the throttle valve according to the present invention.

FIG.6 is the vertical view of FIG.5.

FIG.7 is a structural diagrammatic view showing the second implement example of the throttle valve according to the present invention.

FIG.8 is the vertical view of FIG.7.

FIG.9 is a structural diagrammatic view showing the third implement example of the throttle valve according to the present invention.

FIG.10 is the vertical view of FIG.9.

FIG.11 is a graph when the valve's effective lift ΔH = valve's actual lift H1 according to the present invention.

FIG.12 is a graph when the valve's effective lift ΔH = 0 according to the present invention.

FIG.13 is a graph when the valve's effective lift ΔH = valve's actual lift H1 - throttle valve's lift H2 according to the present invention.

SPECIFIC IMPLEMENT WAY

[0020] Referring now to the specific implement way, structure, character and efficiency of the continuously variable timed and cross-sectional control device according to the present invention, the detailed description is given as follows by combining attached drawings and better implement examples.

[0021] FIG.2 is a structural diagrammatic view showing the intake and exhaust system of the IC engine when they are closed according to the present invention. Hence, the present invention includes the IC engine's intake and exhaust system which are composed of throttle valve drive mechanism 1 valve drive mechanism 2, valve spring seat 3 valve locker 4, valve spring 5, valve guide 6, cylinder head 7 throttle valve component 8, valve 9, throttle valve 10, fluid flow passage 11, valve seat 12, and so on. The present invention adds throttle valve and the corresponding control device to the ICE which is in general use ; valve guide 6, valve 9, throttle valve 10 and valve seat 12 are fixed on the same axis (common axis); the bottom of throttle valve 10 matches the skirt of valve 9, the external circle of throttle valve 10 and the inner wall of fluid flow passage 11 match the internal pore of valve seat 12; paralleling to the axis of valve guide 6 (common axis), there is an eccentric pore h_2 nearby the valve guide 6 which is on cylinder head 7; paralleling to the pore axis of valve locker 4, there is an eccentric pore h_1 on valve spring seat 3; throttle valve component 8 can go through the eccentric pore h_2 and the eccentric pore h_1 separately or at the same time; valve drive mechanism 1 controls throttle valve 10 through throttle valve component 8; under the action of force from throttle valve drive mechanism 1, throttle valve 10 can make up-and-down movement alone the axis in the inner wall of fluid flow passage 11 and the valve seat 12, throttle valve 10 can also make up-and-down movement under the action of force from valve 9; valve 9 can move up-and-down (open and close) along the axis of valve guide 6 under the action of force from valve drive mechanism 2 and valve spring 5; being relative to valve guide 6, fluid flow passage 11 and the internal pore of valve seat 12, valve 9 and throttle valve 10 can make independent relative movement, and the relative movement composes the flexible time-cross-section; during the process of valve 9's movement, the up-and-down movement of throttle valve 10 can control

the effective phase, working time, effective lift and the vortex intensity of fluid movement of valve 9 when it is open or close, the manual and automatic implement modes can be mechanical mode, hydraulic or pneumatic control mode, electric power and electromagnetism control mode or other modes.

[0022] FIG.3 is a structural diagrammatic view showing the intake valve and the exhaust valve during the process of the IC engine's start on lower temperature according to the present invention. The force from valve drive mechanism 2 acts on the top of valve 9 directly, it presses valve spring 5 and valve 9 to move downward (open valve) along axis through valve locker 4 and valve spring seat 3, the force from throttle valve drive mechanism 1 acts on throttle valve 10 through throttle valve component 8, throttle valve 10 can move up-and-down along the common axis following valve 9, the position of throttle valve 10 is controlled by throttle valve drive mechanism 1, there is throttle channel 13 on the circular barrel which is at the bottom of throttle valve 10, we can get its position and cross-sectional area through optimization; for the existence of draught head between the inner of cylinder and exterior, the liquid is forced to move in the fluid flow passage 11 which is in cylinder head 7, it enters and discharges from cylinder through throttle channel 13 so as to complete gas exchange; when the force from valve drive mechanism 2 reduces gradually and withdraws finally, valve 9 closes gradually under the action of the force from valve spring 5; during the process of close, the circular barrel's bottom of throttle valve 10 resets to the original position under the action of the force from valve 9's skirt moving upward, throttle valve 10 can also reset under the control of throttle valve drive mechanism 1. During the process of start, throttle valve 10's moving position at valve 9 should increase the intake resistance and exhaust resistance as big as possible so as to remain a certain amount of unburned or burned mixture of proximal cycle in the cylinder and improve the ignition environment till the ICE can start smoothly.

[0023] For multi-cylinder engine, on a certain amount of throttle valve 10's circular barrels have throttle channel 13, while the rest have no throttle channel 13; by doing so, the cylinders without throttle channel 13 of throttle valve 10 have seldom ventilation volume during the process of start, while the cylinders having throttle channel 13 of throttle valve 10 can ignite continuously; the corresponding purpose can also be realized by controlling the moving position of throttle valve 10 without throttle channel so as to get different effective time-cross-section area, because the reduction of the compressed waste work results in the reduction of start moment of resistance, its start becomes much easier and it can realize hardware program or control the sequence of ignition using software.

[0024] The present invention can be realized at low cost when it is only used to improve the start in lower temperature. During the process of start, we set the throttle valve 10 which is in the intake and exhaust mechanism to the proper position according to the environment parameter so as to get the optimal effect and make the ICE start smoothly, after the start ends, throttle valve 10 will be set to the inactive status (position), at this time this device seems not exist.

[0025] The present invention breaks through the technical bottleneck of the IC engine's start in lower temperature, so it improves the other performance index (such as specific fuel consumption-emission-noise-vibration and so on) greatly. FIG.4 is a structural diagrammatic view showing the intake valve and the exhaust valve during the process of the IC engine's operation. Moving status of the throttle valve is controlled manually or automatically through throttle valve drive mechanism 1 according to the IC engine's status parameters (including number of revolution, load, temperature, environment parameter, and so on), throttle valve 10's up-and-down movement can control the effective phase, working time, effective lift and the vortex intensity of fluid movement of valve 9 when it is open; when the IC engine operates at rated load and excess load, the bottom of throttle valve 10 doesn't contact the skirt of valve 9 and it has no choking effect; when the ICE operates at underrated load, throttle valve 10 can move along the axis to control the effective time-cross-section of valve 9 when it is open, so the ventilation volume is controlled correspondingly. Effective time-cross-section is large when load is heavy, otherwise it is small; when the IC engine operates at dynamic load, throttle valve 10's moving position can be controlled manually in steps or through other ways so as to seek the optimum working status, it has a very big flexibility and it can realize multi-mode operation (starting mode, economical mode, low-exhaust mode, overload mode, and so on). For the IC engine with multiple intake valves and exhaust valves, every throttle valve 10's movement can be controlled according to different vortex intensity of fluid movement and the demand of ventilation volume in the same cylinder.

[0026] In multi-cylinder engine, throttle channel 13 are set on annulations of a certain quantity of throttle control valve 10, and there are no throttle channel 13 on other throttle control valve 10; So the quantities of gas exchange in the cylinder that have no throttle channel 13 on throttle control valve 10 are very few during starting course, and the cylinder set throttle channel 13 on throttle control valve 10 can inflame continuously; We can also reach corresponding purpose by acquiring different effective time and cross-section valves by controlling the motion location of throttle control valve 10 which have no throttle channel. In this way, because of compression work decreasing, engines can shutdown a certain quantity of working cylinder when it work in lower load. It has obvious advantages applying the project to multi-cylinder engines with electronic fuel injection system.

[0027] The application of throttle control valve 10 can cancel the throttle shutter (Butterfly shape valve) in in-

take pipe on carburetor engine, electronic fuel injection engine or other fuels engine. Under equal condition, throttling loss reduces largely and increases the pressure of each air inlet valve, therefore improving air inlet quality, raising power and improving economy and power capability etc., at the same time acquiring low idle speed and good stability etc.. The effect is obvious applying the project to turbo-supercharge engines.

[0028] When applying the invention to exhaust valve, the location during exhaust process of throttle control valve 10 influence exhaust resistance directly. By controlling the quantity of the remaining waste gas in cylinder and improving exhaust quality, the direct inner EGR control can be realized. During low temperature starting, by controlling throttle control the effective time and cross-section of valve 10 and valve 9, a certain quantity unburned or burned mixed air during former cycle can be kept in cylinder forcedly, so that raise the compressed temperature of next cycle to make it reach the condition of firing continuous and realize starting smoothly.

[0029] Fig.5 - 10 is the 3 kinds of structural sketches of throttle control valve 10. Part of or all of throttle control valve 10 are designed to cylinder, it's placed in the room formed by fluid passageway 11 and valve seat 12 in valve 9 and cylinder head 7. Throttle control valve 10, valve 9 have independent relative motion relative to valve guide bush 6 and fluid passageway 11 and inner hole of valve seat 12, the relative motion forms effective flexible time and cross-section; the up and down motion of throttle control valve 10 can control the effective phase, working time, effective lift and the vortex strength of fluid movement when intake valve and exhaust valve 9 is open or close.

[0030] Fig.5 is the first implement illustration structural sketches of throttle control valve, Fig.6 is the vertical view of Fig.5. As Fig.5, 6 show, the outer surface of throttle control valve 10 is annular cylinder, and inner circle surface have an extrusive entity. It is used to connect with throttle control valve's component 8. The bottom of throttle control valve 10 cooperates with skirt department of valve 9, and the outer circle surface cooperates with fluid flow passage 11 and the inner hole of valve seat 12. Throttle channel 13 are designed on the nether annular cylinder of throttle control valve 10, throttle passageway 13 is closing or opening type; we can also do not set throttle channel 13 on the nether annular cylinder of throttle control valve 10. It is feasible to make throttle control valve 10 and throttle control valve's component 8 into integration, or make the two components respectively, and then assemble them together.

[0031] Fig.7 is the second implement illustration structural sketches of throttle control valve, Fig.8 is the vertical view of Fig.7. As Fig.7, 8 show, the outer surface of throttle control valve 10 is annular cylinder, and external circle surface have a extrusive entity, it is used to connect with throttle control valve's component 8. The extrusive entity of external circle surface can be assembled in the eccentric hole of cylinder head 7, and the bottom of throttle control valve 10 cooperate with skirt department of valve 9, and the outer circle surface cooperate with fluid flow passage 11 and the inner hole of valve seat 12. Throttle channel 13 are designed on the nether annular cylinder of throttle control valve 10. Throttle channel 13 is closing or opening type and the shape of throttle channel 13 may be hole or opening shape; we can also do not set throttle channel 13 on the nether annular cylinder of throttle control valve 10. It is feasible to make throttle control valve 10 and throttle control valve's component 8 into integration, or make the two components respectively, and then assemble them together.

[0032] Fig.9 is the third implement illustration structural sketches of throttle control valve, Fig. 10 is the vertical view of Fig.9. As Fig.9, 10 show, the outer surface of throttle control valve 10 is annular cylinder, throttle control valve's component 8 is connected with the circle surface throttle control valve 10, and the axes of throttle control valve's component 8 is parallel with the axes of throttle control valve 10; the bottom of throttle control valve 10 cooperate with skirt department of valve 9, and the outer circle surface cooperate with fluid flow passage 11 and the inner hole of valve seat 12. Throttle channel 13 are designed on the nether annular cylinder of throttle control valve 10.Throttle channel 13 is closing or opening type; we can also do not set throttle channel 13 on the nether annular cylinder of throttle control valve 10. It is feasible to make throttle control valve 10 and throttle control valve's component 8 into integration, or make the two components respectively, and then assemble them together.

[0033] A curve fit of the relationship between effective lift of valve and crankshaft angle is shown in Fig.11-13. The controlling range of effective phase is : Ø E(0, θ), where θ is opening or closing angles; The controlling range of time is : tE(0, θ/6n); The effective lift = actual lift of valve H1-lift of throttle control valve H2, The controlling range of effective lift is :Δ*H*E (0, H_{max}), where, H_{max} is the maximal actual lift of valve 9.

[0034] Fig.11 is a curve fit of the relationship between effective lift of valve and crankshaft angle when effective lift of valve Δ*H*=actual lift of valve H1. At this time, lift of throttle control valve 10=0, and also flexible time and cross-section area=0, and engine works under high load or overload state. Here throttle control valve 10 does not work for effective phase, working time and effective lift, but it can control strength of fluid vortex.

[0035] Fig.12 is a curve fit of the relationship between effective lift of valve and crankshaft angle when effective lift of valve Δ*H*=0. At this time, lift of throttle control valve 10 H2-actual lift H1 of valve 9, and whole area is the flexible time and cross-section area, and engine works under lowing load or low temperature starting state. Here throttle control valve 10 does work for effective phase, working time and effective lift, and it can control strength of fluid vortex.

[0036] Fig.13 is a curve fit of the relationship between effective lift of valve and crankshaft angle when effective lift of valve ΔH= actual lift of valve H1-lift of throttle control valve H2. At this time, ΔH>0.Upper cross-section is the effective cross-section area under the condition of$\theta_1 \leq \theta \leq \theta_2$, and the others are flexible time and cross-section area. Lift of throttle control valve H2 is controlled by driving device 1 of throttle control valve, and engine works under lowing load or low temperature starting state. Here throttle control valve 10 does work for effective phase, working time and effective lift, and it can control strength of fluid vortex.

[0037] The expatiation above is only better implement illustration structural, and do not mean the invention is restricted by any form. So any simple modifications, the same varieties and decorations depending on the technique theory of the invention belong to the scope of technical scheme of the invention.

Claims

1. A continuously variable timed and cross-sectional control device for an intake and exhaust system of an engine, comprising in combination: valve actuating mechanism (2), valve spring seat (3), valve locker (4), valve spring (5), valve guide (6), cylinder head (7), valve (9), fluid flow passage (11), valve seat (12), and a throttle control valve (10), including an element (8) of throttle control valve and a relative drive mechanism (1).

2. Control device of claim 1, in that a throttle control valve (10) is fixed in the cavity which is composed of the fluid flow passage (11) in the cylinder head (7), the valve seat (12) and the valve (9).

3. Control system of claim 1 or 2 in that the throttle control valve (10) is cylindrical, and its axis of motion is just the same as that of the valve guide and valve (9) or is parallel with it.

4. Control system of claim 3 in that there is a relative up-and-down movement between the throttle control valve (10) and the valve (9).

5. Control system of at least one of claims 1 to 4, in that the drive mechanism of throttle control valve (1) can control the throttle control valve (10) through the element (8) of throttle control valve which is connected with it.

6. Control device of at least one of claims 1 to 5 wherein said comprise:

   An eccentric hole (h2) near the said valve guide (6) in the cylinder head (7)., the axis of the hole is parallel with that of valve guide (6), and the element (8) of throttle control valve runs across this hole.

7. Control device of at least one of claims 1 to 5 including:

   An eccentric hole (h1) in the said valve spring seat (3) with which the axis of valve locker (4) is parallel, and the element (8) of throttle control valve runs across this hole.

8. Control device of at least one of claims 1 to 5 wherein said comprises:

   Two holes, one is an eccentric hole (h2) which is near the said valve guide (6) in the cylinder head (7) and its axis is parallel with that of valve guide (6), the other is an eccentric hole (h1) which is in the said valve spring seat (3) and its axis is parallel with that of valve locker (4), the element (8) of throttle control valve runs across these two holes.

9. Control deviceof at least one of claims 1 to 8, **characterized by** a gap assembling between the external circle of said throttle control valve (10), an internal wall of fluid flow passage (11), and an internal hole of valve seat (12); and the bottom of this device is matched with the mushroom valve (9).

10. Control devices of at least one of claims 1 to 9 wherein said comprises:

    That all external circle of said throttle control valve (10) is cylindrical and there is an inward projecting part at the upper portion of the inner circumference and this projecting part is connected with the element (8) of throttle control valve.

11. Control device of at least one of claims 1 to 10 including:

    That partial external circle of said throttle control valve (10) is cylindrical and there is an outward projecting part at the upper portion of the surface of circumference and this projecting part is connected with the element (8) of throttle control valve.

12. Control device of at least one of claims 1 to 11 wherein said comprises:

    That all external circle of said throttle control valve (10) is cylindrical, and the element (8) of throttle control valve is connected with the inner circumference of the throttle control valve (10).

13. Control system of at least one of claims 1 to 12 including:

That the element (8) of throttle control valve is baculiform and the throttle control valve (10) and the element (8) of throttle control valve can be made as a single component, or assembled by two different components.

14. Control device of at least one of claims 1 to 13 wherein said comprises:

That there are one or more throttle pathways (13) which look like hole or hatch at the bottom of annular cylinder of the throttle control valve (10).

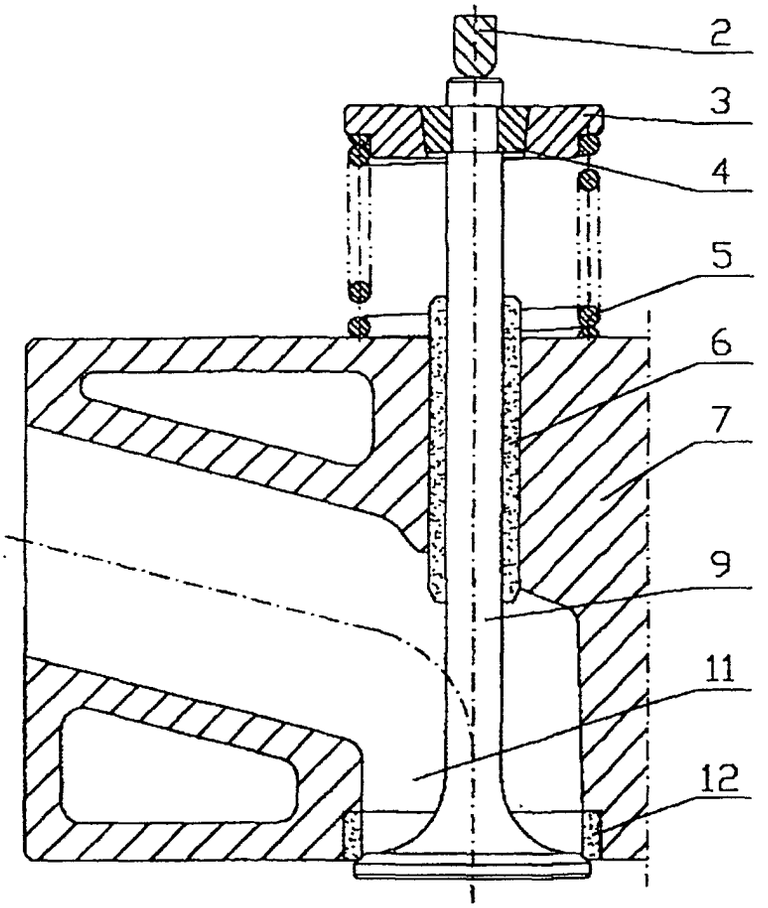

Fig. 1

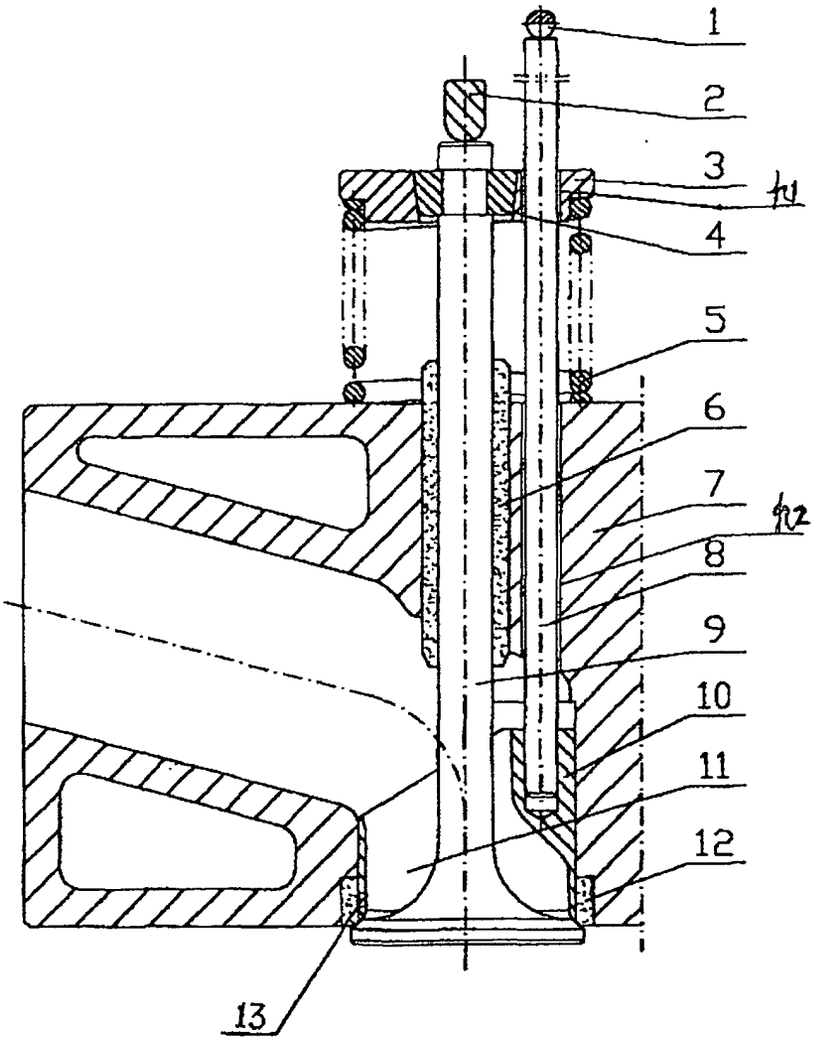

Fig. 2

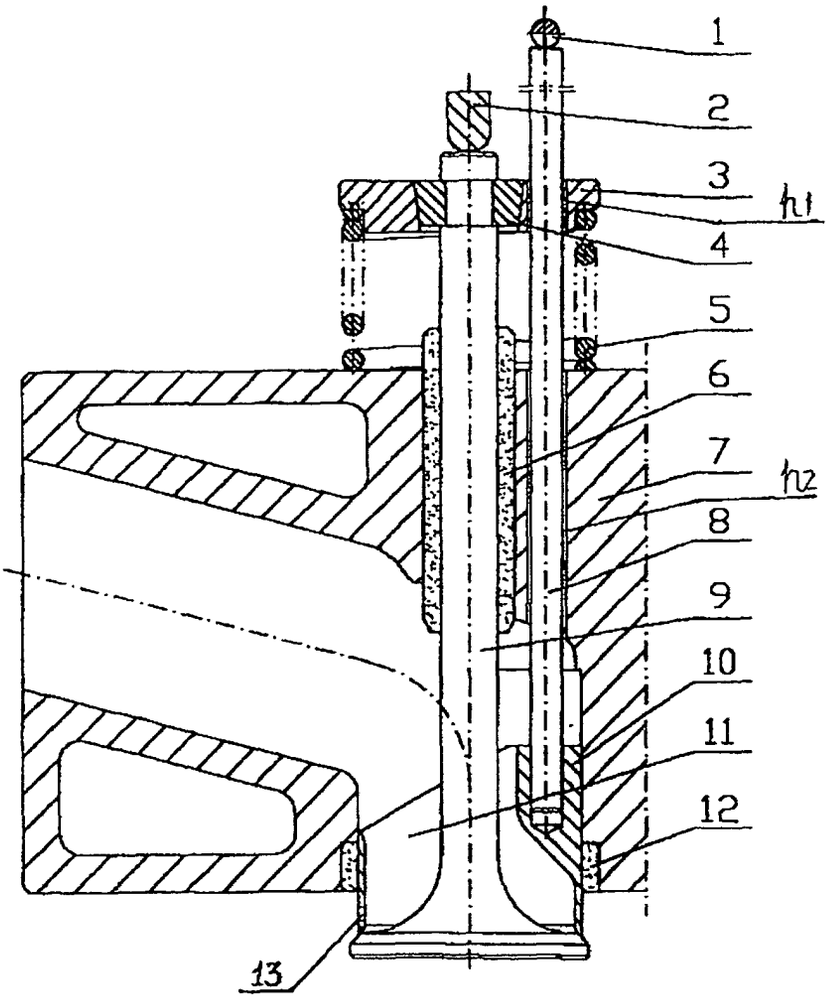

Fig. 3

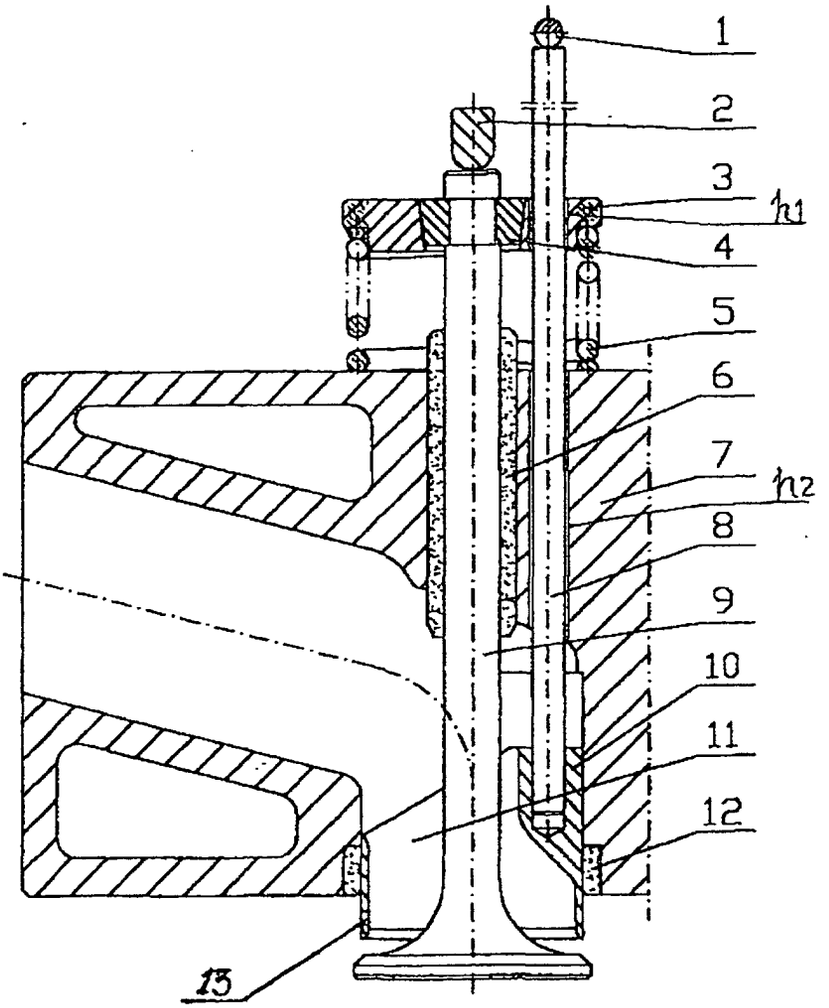

Fig. 4

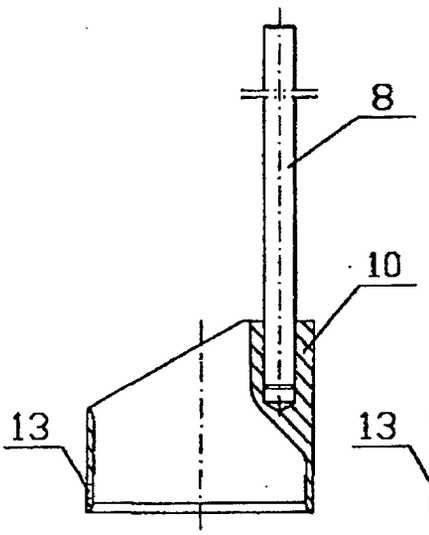

Fig. 5

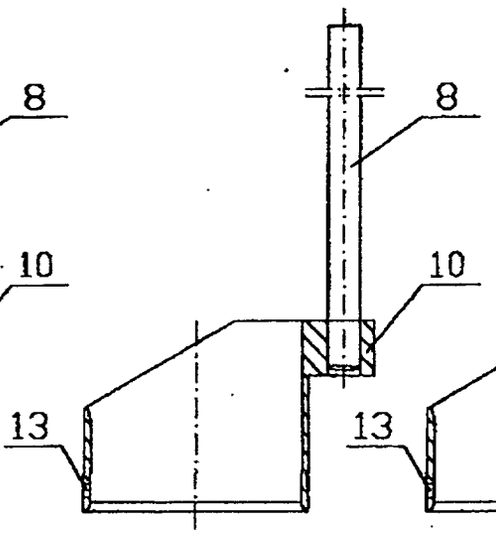

Fig. 6

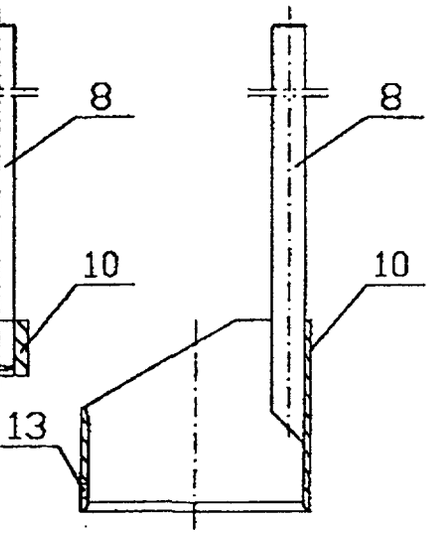

Fig. 7

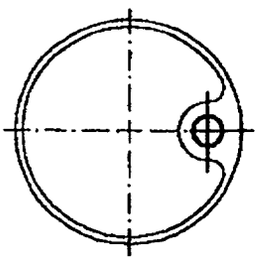

Fig.8

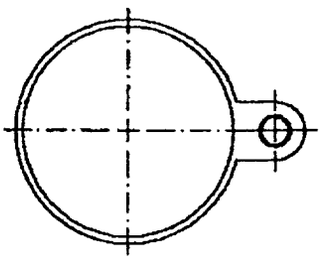

Fig. 9

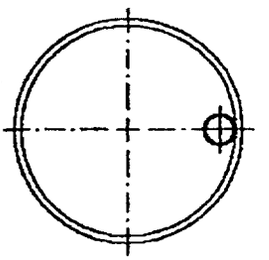

Fig. 10

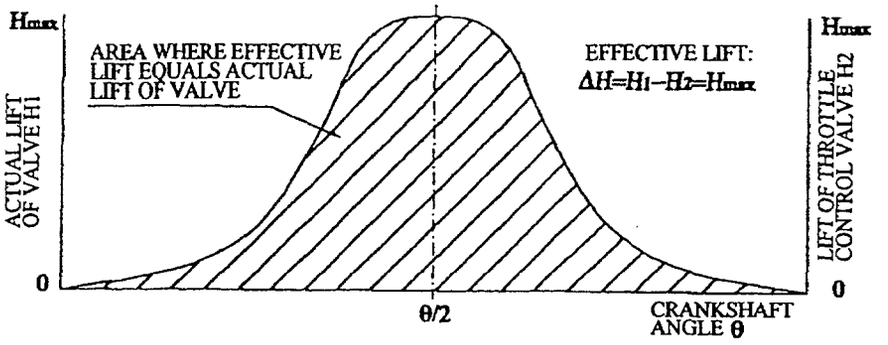

Fig. 11

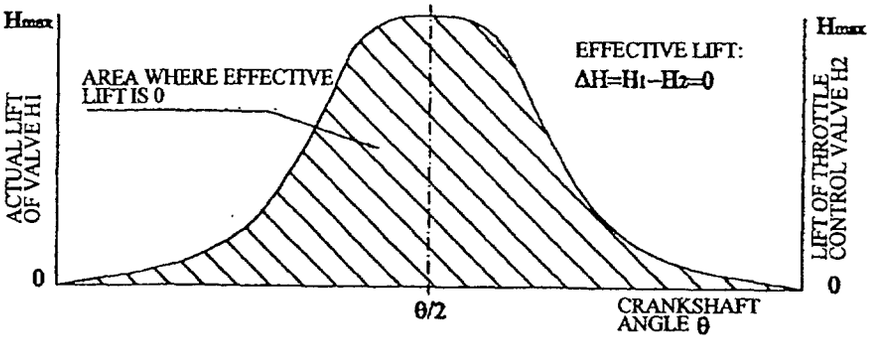

Fig. 12

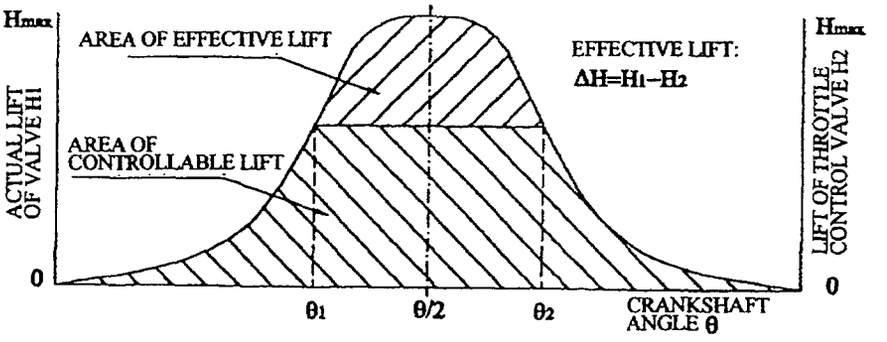

Fig. 13

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN02/00504

A. CLASSIFICATION OF SUBJECT MATTER

F01L^{7}1/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F01L1/28,1/34,F16K1/16,1/24,F02B29/02,29/08

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

CHINESE INVENTION: 1985-2002, CHINESE UTILITY MODELS: 1985-2002

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC,WPI,PAJ,CNPAT:valve,intake,timing,change,adjusting,engine,flexible,control

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US4836154A(Charles W. Bergeron, USA) 6.Jun.1989(06.06.89) Whole document	1
A	US4094277A(Tokyo Jidosha Kogyo Kabushiki Kaisha,Toyota,Japan) 13.Jun.1978(13.06.78) Whole document	1
A	US6237549B1(Acro-Tech,Inc.Scappoose,OR USA) 29.May.2001(29.05.01) Whole document	1
A	CN1285461A (Deng Guofeng, Hunan,China) 28.Feb.2001(28.02.01) Whole document	1-10

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim (S) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10.Oct.2002 (10.10.02)	24 OCT 2002 (24.10.02)
Name and mailing address of the ISA/CN 6 Xitucheng Rd., Jimen Bridge, Haidian District, 100088 Beijing, China Facsimile No. 86-10-62019451	Authorized officer Xiaoguangting Telephone No. 62093724

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN02/00504

US4836154A	6.Jun.1989(06.06.89)	EP0335924A	11.Oct.1989(11.10.89)
		WO8901565A	23.Feb.1989(23.02.89)
US4094277A	13.Jun.1978(13.06.78)	JP52-001229	7.Jan.1977(07.01.77)
US6237549B1	29.May.2001(29.05.01)	None	
CN1285461A	28.Feb.2001(28.02.01)	None	

Form PCT/ISA/210 (patent family annex) (July 1998)