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(54) **A valve control system for a variable-timing internal combustion engine, particularly for an engine with several valves per cylinder**

Variable Ventilsteuervorrichtung für eine Brennkraftmaschine, insbesondere eine Brennkraftmaschine mit mehreren Ventilen je Zylinder

Système de commande de soupape pour moteur à combustion interne à calage variable, en particulier pour moteur à plusieurs soupapes par cylindre

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(56) References cited:
EP-A- 0 263 794 **GB-A- 2 179 700**

- **PATENT ABSTRACTS OF JAPAN vol. 8, no. 220 (M-330) 6 October 1984 & JP-A-59 103 907 (HONDA GIKEN KOGYO KK) 15 June 1984**

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Description

The present invention relates to a valve control system for a variable-timing internal combustion engine, particularly for an engine having several valves per cylinder.

Valve control systems for internal combustion engines are known e.g. from EP-A-0 263 794 and JP-A-59 103 907, which enable the lift of the valves to be adjusted in dependence on the running condition of the engine (variable timing systems) and/or to control more than one valve with the same cam.

For example, the camshaft may have conical cams with linear profiles which vary along the axis of the camshaft; an axial movement of the camshaft, by means of a power-assisted control system, alters the cam-profile in contact with the valve stem, thereby altering the lift pattern of the valve.

Although they are highly efficient, such control systems have the disadvantage of requiring the insertion of an adaptor element between the cam and the valve stem and its associated tappet so as to compensate for the conical shape of the cam itself. The need for this adaptor element makes the valve-control mechanism more complicated to manufacture, often increases the reciprocating masses thereby making the dynamic response of the valves less rapid and also makes it difficult, if not impossible, to use automatic systems to compensate for any clearances that may form as a result of wear between the cams and tappets.

The object of the present invention is to provide a valve control system for a variable-timing internal combustion engine which is free of the disadvantages described and which, in particular, enables the reciprocating masses involved in the opening and closing movements of the valves to be minimized, enables the number of control members to be reduced relative to the total number of valves to be controlled and enables automatic clearance-compensation systems to be fitted easily.

On this basis, the present invention provides a valve control system for a variable-timing internal combustion engine, particularly for an engine with several valves per cylinder, of the type disclosed in Claim 1.

In order better to understand the invention, there follows a non-limitative description of one embodiment, with reference to the appended drawings, in which:

Figure 1 is a sectioned side elevation of a valve control system for a variable-timing internal combustion engine constructed according to the present invention;

Figure 2 is a partial front elevation of the valve-control system illustrated in Figure 1; and

Figure 3 is a plan of a detail of the valve-control system illustrated in Figure 2.

With reference to Figures 1 to 3, a system is indicated 1 for the control of the valves 2 of a variable-timing internal combustion engine, of which only one head 11 is illustrated for the sake of simplicity.

The control system 1 is made up substantially of a camshaft 3 having at least one cam 4 with a profile which varies along the axis of the camshaft 3 itself, and of a control device 5 interposed between the cam 4 and a duty valve 2 of a cylinder 6 of the engine, each of the valves 2 being arranged in a respective valve seat 7 in direct communication with the cylinder 6 and being provided with a return spring 8 packed between the head 11 of the engine and a washer 12 securely fixed to the valve 2 itself by respective clamping cotters 13.

The control device 5 includes in turn a cam follower 14 which cooperates with a peripheral surface 15 of the cam 4 and with a support saddle 16 for the cam follower 14.

According to the present invention, the control device 5 is constituted essentially by a substantially T-shaped rocker 18 which includes a central portion 21 on the upper surface of which is formed the support saddle 16 for the cam follower 14 and on the underside of which is a seat 22, constituted by a hemispherical recess 23 formed at one end 24 of the central portion 21, for fixing to a fulcrum 25 defined by a ball-headed pin 26 engaging the seat 22 and carried by the head 11 of the engine; also at the end 24, the rocker 18 has an axially-projecting rudder element 27 engaged in a cooperating guide element 28 formed on the head 11 of the engine.

As well as the central portion 21, the rocker 18 includes a pair of side arms 31 which project in opposite directions from an end 32 of the central portion 21 opposite the end 24 and the connection seat 22; each arm 31 bears against an upper end 33 of a stem 34 of a respective homologous valve of the cylinder 6.

According to the invention, the support saddle 16 extends along the entire length of the central portion 21 and is defined by a substantially semi-cylindrical recess 35 having an axis of symmetry A parallel to and coincident with a longitudinal axis of the central portion 21 of the rocker 18.

The cam follower 14 is defined essentially by a pad 36 having a flat upper surface 37 which cooperates with the conical peripheral surface 15 of the cam 4, while a convex lower surface 38, which is substantially semi-cylindrical, cylindrical, has a profile which matches the recess 35 of the support saddle 16.

According to the present invention, the ball-headed pin 26 is fixed securely to a hydraulic tappet 41 mounted in a seat 42 in the head 11, and having an axis of symmetry B which is substantially parallel to a corresponding axis of symmetry C of one of the stems 34 of the valves 2.

An hydraulically-sealed supply duct 44 is formed in a portion 43 of the head 11 intermediate the guide element 28 for the rudder element 17 and the hydraulic tappet 41 for supplying lubricating oil under pressure both to the guide element 28 and to the hydraulic tappet 41.

In use, as the hydraulic tappet 41 is fixed in its seat 42 formed in the head 11, it does not contribute its mass to the overall mass in reciprocating motion, but acts exclusively as a self-adjusting support for the ball-headed pin 26 onto which the rocker 18 for operating the valves 2 is fixed by means of the seat 22.

The advantages provided by the present invention are apparent from the above description: besides providing automatic compensation for any clearance created through wear, thanks to the presence of the hydraulic tappet, such a valve control system for a variable-timing internal-combustion engine takes up less space and the masses in reciprocating motion are greatly reduced.

The hydraulic tappet is in fact fixed in a suitable seat in the engine head instead of being fixed securely to a valve stem; this leads to a considerable reduction in the masses in reciprocating motion with the result that the valves accelerate faster making it possible to employ a cam with a highly defined profile, and thereby improve the filling of the cylinder with the air and fuel mixture and, as an end result, the performance of the engine itself.

Claims

1. A control system (1) for the valves (2) of a variable-timing internal combustion engine, particularly for an engine with several valves (2) per cylinder (6), of the type which includes a camshaft (3) with at least one cam (4) having a profile which varies along the axis of the camshaft (3), and a control device (5) interposed between the cam (4) and at least one duty valve (2) of a cylinder (6) of the engine, the control device (5) including in turn a cam follower (14) which cooperates with a peripheral surface (15) of the cam and a support saddle (16) for the cam follower (14), the control device (5) including a central portion (21) having the support saddle (16) for the cam follower (14) on its upper surface and a pair of side arms (31) projecting in opposite directions from the central portion (21), each of the arms (31) bearing against an upper end (33) of a stem (34) of a respective homologous valve (2) of the cylinder (6) whereby an end (24) of the central portion (21) of the control device (5) has an axially-projecting rudder element (27) engaged in a corresponding guide element (28) formed in the engine head (11) of the engine characterised in that the control device (5) consists of a rocker (18) which is substantially T-shaped, the pair of side arms (31) projecting in opposite directions from a first end (32) of the central portion (21), the central portion (21) has a seat (22) beneath it for fixing to a fulcrum (25) for the rocker (18) carried by a head (11) of the engine, this seat (22) being located in a second end (24) of the central portion opposite the first end (32), the rudder element (27) is located at said second end (24) of the central portion (21) of the rocker arm (18) in correspondence with the fulcrum (25).

2. A control system (1) for valves (2) according to Claim 1, characterized in that the fixing seat (22) consists of a hemispherical recess (23) formed in said second end (24) of the central portion (21) of the rocker (18), the fulcrum (25) being defined by a ball-headed pin (26) engaged in the seat (22).

3. A control system (1) for valves (2) according to Claim 2, characterised in that the support saddle (16) extends along the entire length of the central portion (21) and is defined by a semi-cylindrical recess (35) having an axis of symmetry (A) parallel to and coincident with the longitudinal axis of the central portion (21) of the rocker (18); the cam follower (14) being defined by a pad (36) having a flat upper surface (37) cooperating with a conical peripheral surface (15) of the cam (4) and a convex lower surface (38) which is substantially semi-cylindrical and has a profile which matches the semi-cylindrical recess (35) of the saddle (16).

4. A control system (1) for valves (2) according to any one of Claims 2 and 3, characterised in that the ball-headed pin (26) is fixed securely to a hydraulic tappet (41) mounted in a seat (42) in the head (11), the said seat (42) having an axis (B) parallel to a corresponding axis of symmetry (C) of the stems (24) of the valves (2).

5. A control system (1) for valves (2), according to Claim 4, characterised in that the engine head (11) of the said engine has a supply duct (44) for pressurised lubricating oil, the duct (44) being formed in a portion (43) intermediate the guide element (28) and the hydraulic tappet (41) and being hydraulically connected to both the latter.

Patentansprüche

1. Steuersystem (1) für die Ventile (2) eines Verbrennungsmotors mit variabler Steuerung, insbesondere für einen Motor mit mehreren Ventilen (2) je Zylinder (6), der Art, die aufweist: eine Nockenwelle (3) mit mindestens einer Nocke (4) mit einem Profil, das sich längs der Achse der Nockenwelle (3) ändert, und eine Steuervorrichtung (5), die zwischen die Nocke (4) und mindestens ein Arbeitsventil (2) eines Zylinders (6) des Motors eingefügt ist, wobei die Steuervorrichtung (5) ihrerseits einen Schlepphebel (14) aufweist, der mit einer Umfangsfläche (15) der Nocke und einem Stützsattel (16) für den Schlepphebel (14) zusammenwirkt, die Steuervorrichtung (5) einen Mittelabschnitt (21) mit dem Stützsattel (16) für den Schlepphebel (14) auf seiner Oberseite und ein Paar Seitenarme (31) auf-

weist, die in entgegengesetzte Richtungen von dem Mittelabschnitt (21) vorspringen, jeder der Arme (31) an einem oberen Ende (33) eines Schafts (34) eines jeweiligen gleichliegenden Ventils (2) des Zylinders (6) anliegt, wodurch ein Ende (24) des Mittelabschnitts (21) der Steuervorrichtung (5) ein axial vorspringendes Ruderelement (27) hat, das in ein entsprechendes Führungselement (28) eingreift, das in dem Motorkopf (11) des Motors geformt ist, dadurch gekennzeichnet, daß die Steuervorrichtung (5) einen Kipphebel (18) aufweist, der im wesentlichen T-förmig ist, wobei das Paar Seitenarme (31) in entgegengesetzte Richtungen von einem ersten Ende (32) des Mittelabschnitts (21) vorspringt, der Mittelabschnitt (21) einen Sitz (22) unter sich zum Befestigen an einer Hebelstütze (25) für den Kipphebel (18) hat, der durch einen Kopf (11) des Motors getragen wird, wobei dieser Sitz (22) in einem zweiten Ende (24) des Mittelabschnitts gegenüber dem ersten Ende (32) angeordnet ist, und das Ruderelement (27) an dem zweiten Ende (24) des Mittelabschnitts (21) des Kipphebels (18) entsprechend der Hebelstütze (25) angeordnet ist.

2. Steuersystem (1) für Ventile (2) nach Anspruch 1, dadurch gekennzeichnet, daß der Befestigungssitz (22) aus einer halbkugelförmigen Aussparung (23) besteht, die in dem zweiten Ende (24) des Mittelabschnitts (21) des Kipphebels (18) geformt ist, wobei die Hebelstütze (25) durch einen Kugelkopf stift (26) gebildet ist, der in den Sitz (22) eingreift.

3. Steuersystem (1) für Ventile (2) nach Anspruch 2, dadurch gekennzeichnet, daß sich der Stützsattel (16) längs der gesamten Länge des Mittelabschnitts (21) erstreckt und durch eine halbzylindrische Aussparung (35) mit einer Symmetrieachse (A) gebildet ist, die parallel zu der Längsachse des Mittelabschnitts (21) des Kipphebels (18) und dekkungsgleich mit ihr ist; wobei der Schlepphebel (14) durch eine Unterlage (36) mit einer flachen Oberseite (37), die mit einer konischen Umfangsfläche (15) der Nocke (4) zusammenwirkt, und eine konvexe Unterseite (38) gebildet ist, die im wesentlichen halbzylindrisch ist und ein Profil hat, das der halbzylindrischen Aussparung (35) des Sattels (16) entspricht.

4. Steuersystem (1) für Ventile (2) nach einem der Ansprüche 2 und 3, dadurch gekennzeichnet, daß der Kugelkopfstift (26) sicher an einem hydraulischen Stößel (41) befestigt ist, der in einem Sitz (42) in dem Kopf (11) angebracht ist, wobei der Sitz (42) eine Achse (B) hat, die parallel zu einer entsprechenden Symmetrieachse (C) der Schäfte (24) der Ventile (2) ist.

5. Steuersystem (1) für Ventile (2) nach Anspruch 4, dadurch gekennzeichnet, daß der Motorkopf (11) des Motors einen Zufuhrkanal für unter Druck gesetztes Schmieröl hat, wobei der Kanal (44) in einem Abschnitt (43) zwischen dem Führungselement (28) und dem hydraulischen Stößel (41) geformt und mit den beiden letztgenannten hydraulisch verbunden ist.

Revendications

1. Système de commande (1) pour les soupapes (2) d'un moteur à combustion interne à distribution variable, en particulier pour un moteur à plusieurs soupapes (2) par cylindre (6), du type qui comprend un arbre à cames (3) comportant au moins une came (4) présentant un profil qui varie suivant l'axe de l'arbre à cames (3), et un dispositif de commande (5) interposé entre la came (4) et au moins une soupape de commande (2) d'un cylindre (6) du moteur, le dispositif de commande (5) comprenant à son tour une contre-came (14) qui collabore avec une surface périphérique (15) de la came et un étrier d'appui (16) de la contre-came (14), le dispositif de commande (5) comprenant une partie centrale (21) comportant l'étrier d'appui (16) destiné à la contre-came (14) sur sa surface supérieure, et une paire de bras latéraux (31) faisant saillie dans des directions opposées à partir de la partie centrale (21), chacun des bras (31) portant sur une extrémité supérieure (33) d'une queue (34) d'une soupape correspondante respective (2) du cylindre (6), une extrémité (24) de la partie centrale (21) du dispositif de commande (5) comprenant un élément de positionnement faisant saillie axialement (27), engagé dans un élément de guidage correspondant (28), formé dans la culasse (11) du moteur, caractérisé en ce que le dispositif de commande (5) est constitué par un culbuteur (18) qui a sensiblement la forme d'un T, la paire de bras latéraux (31) faisant saillie dans des directions opposées à partir d'une première extrémité (32) de la partie centrale (21), la partie centrale (21) comporte un siège (22) au-dessous d'elle permettant d'y placer un point d'appui (25) du culbuteur (18) supporté par la culasse (11) du moteur, ce siège (22) étant situé dans une seconde extrémité (24) de la partie centrale opposée à la première extrémité (32), l'élément de positionnement (27) est situé à ladite seconde extrémité (24) de la partie centrale (21) du culbuteur (18) en correspondance avec le point d'appui (25).

2. Système de commande (1) pour des soupapes (2) selon la revendication 1, caractérisé en ce que le siège de positionnement (22) est composé d'un évidement hémisphérique (23) formé dans ladite seconde extrémité (24) de la partie centrale (21) du culbuteur (18), le point d'appui (25) étant défini par

une broche à tête sphérique (26) engagée dans le siège (22).

3. Système de commande (1) pour des soupapes (2) selon la revendication 2, caractérisé en ce que l'étrier d'appui (16) s'étend tout le long de la partie centrale (21) et est défini par un évidement semi-cylindrique (35) ayant un axe de symétrie (A) parallèle à l'axe longitudinal de la partie centrale (21) du culbuteur (18) et coïncidant avec celui-ci, la contre-came (14) étant définie par un patin (36) comportant une surface supérieure plate (37) collaborant avec la surface périphérique conique (15) de la came (4), et une surface inférieure convexe (38) qui est sensiblement semi-cylindrique et présente un profil qui correspond à l'évidement semi-cylindrique (35) de l'étrier (16).

4. Système de commande (1) pour des soupapes (2) selon l'une quelconque des revendications 2 et 3, caractérisé en ce que la broche à tête sphérique (26) est montée dans un poussoir hydraulique (41) monté dans un siège (42) de la culasse (11), ledit siège (42) ayant un axe (B) parallèle à un axe de symétrie (C) correspondant des tiges (34) des soupapes (2).

5. Système de commande (1) pour des soupapes (2), selon la revendication 4, caractérisé en ce que la culasse (11) dudit moteur comporte un conduit d'alimentation (44) en huile de graissage sous pression, le conduit (44) étant formé dans une partie (43) située entre l'élément de guidage (28) et le poussoir hydraulique (41), et étant relié hydrauliquement à ces deux derniers.

FIG.1

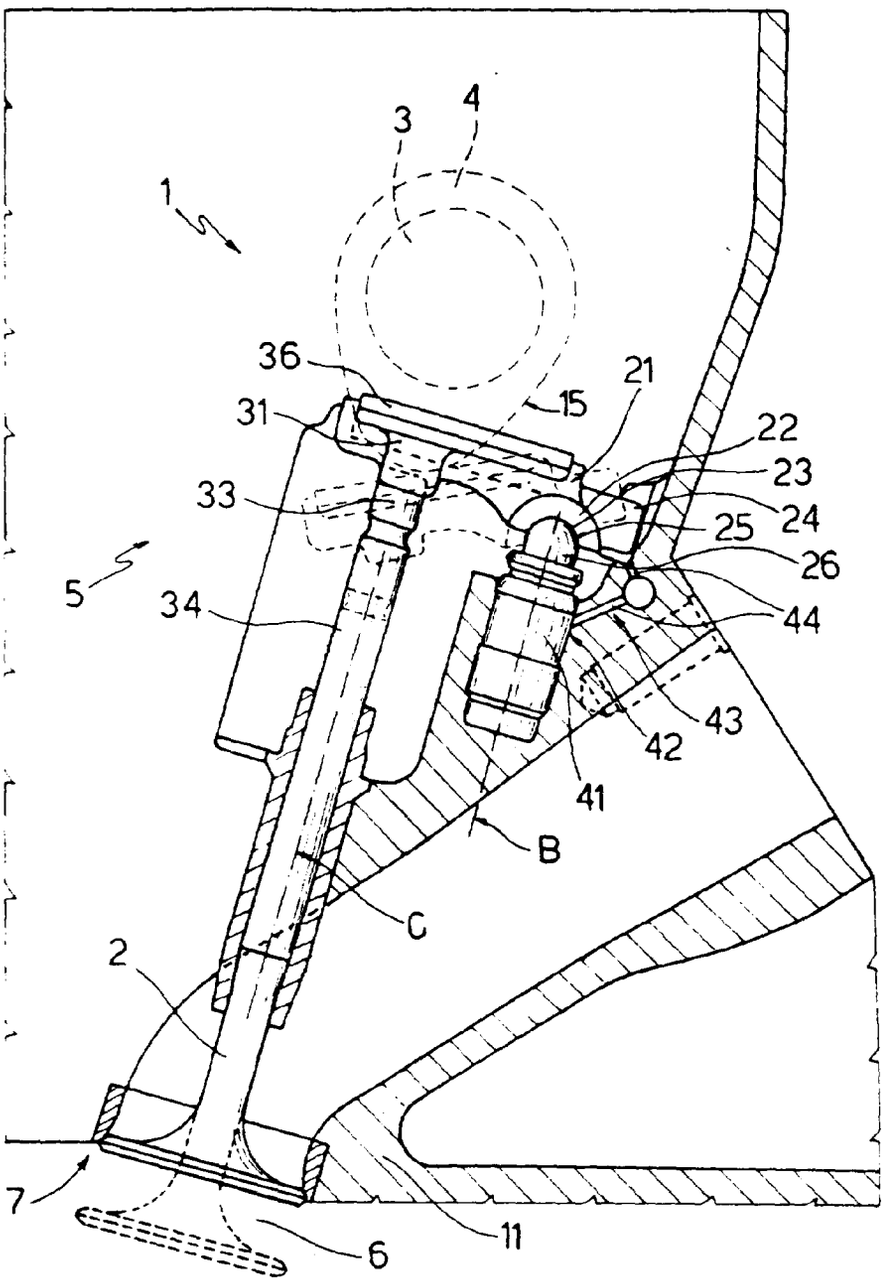

FIG.3

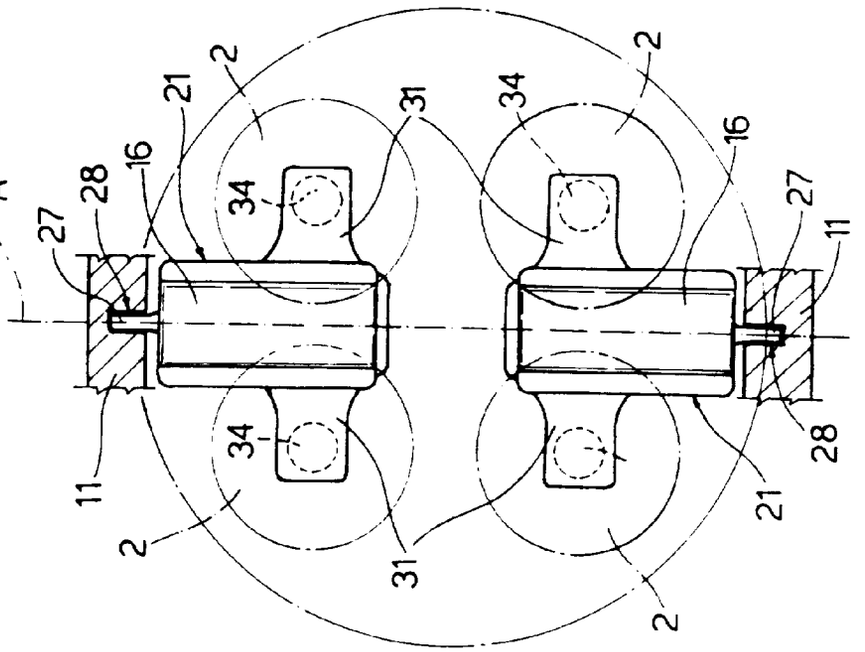

FIG.2