In a camshaft adjuster for an internal combustion engine, having a hydraulic control piston for controlling an adjusting unit for the angular adjustment of a camshaft relative to a crankshaft, the control piston is supported in a separate guide sleeve received in an opening in the camshaft by a press-fit.
CAMSHAFT ADJUSTER FOR AN INTERNAL COMBUSTION ENGINE

[0001] This is a Continuation-In-Part application of international application PCT/EP03/01772 filed Feb. 21, 2003 and claiming the priority of German application 102 11 468.4 filed Mar. 15, 2002.

BACKGROUND OF THE INVENTION

[0002] The invention relates to a camshaft adjuster for an internal combustion engine with a hydraulic operating arrangement.

[0003] A camshaft adjuster for an internal combustion engine having a hydraulic valve with a control piston is known for example from DE 198 17 319 A1. It is possible to control an adjusting unit for the angular adjustment of a camshaft using the control piston, the adjusting unit having an inner body which is connected fixedly to the camshaft so as to rotate with it and including a rotary swing piston received in an outer body which is rotatably mounted with respect to the camshaft, and includes a chain sprocket via which there is a drive connection from the crankshaft to the camshaft. The control piston is disposed displaceably in an axial opening of a central clamping screw. The inner body is clamped axially against the camshaft by means of the central clamping screw.

[0004] It is the object of the invention to provide a generic camshaft adjuster for an internal combustion engine, having low tolerances and at the same time relatively low manufacturing costs.

SUMMARY OF THE INVENTION

[0005] In a camshaft adjuster for an internal combustion engine, having a hydraulic control piston for controlling an adjusting unit for the angular adjustment of a camshaft relative to a crankshaft, the control piston is supported in a separate guide sleeve received in an axial opening in the camshaft by a press-fit.

[0006] The invention proceeds from a camshaft adjuster for an internal combustion engine, having a hydraulic control piston with which it is possible to control an adjusting unit for the angular position adjustment of a camshaft.

[0007] The guide sleeve can be designed for its function in a targeted manner and disturbances caused by other functions can be avoided. Control edges can be formed on the guide sleeve in a structurally simple manner, inexpensively and particularly accurately, as a result of which tolerances overall can be reduced and costs can be saved. It is possible to decouple the functions, and this functional decoupling can be used to attain modularization and standardization; for example, the same guide sleeves can be used for different internal combustion engines.

[0008] If the guide sleeve is arranged in the camshaft, simple oil routing can be attained and, in particular, existing oil ducts can be used in substantially unchanged form. Furthermore, arranging the guide sleeve in the camshaft makes it possible to achieve an advantageous precise positional assignment of the control piston with respect to the camshaft. However, the guide sleeve can also be arranged in a central clamping screw or another component which appears sensible to the person skilled in the art.

[0009] In accordance with the invention, the guide sleeve is pressed in, as a result of which it can be designed and installed in a particularly simple and inexpensive manner. If the guide sleeve is pressed in or the guide sleeve is held by a press joint, the guide sleeve is fastened inexpensively and, in particular, the fastening process can be integrated advantageously into existing installation processes of internal combustion engines. The press joint is particularly advantageously produced using a thermal shrinking process.

[0010] If at least one channel is made in the longitudinal and/or in the circumferential direction of the guide sleeve at least one interface between the guide sleeve and a component which accommodates the guide sleeve, additional channels which would have to be produced expensively in other functional components, such as in particular in the camshaft, can be avoided and costs can be saved, to be precise in particular when the channel is formed by a groove formed into the guide sleeve. Pressure and/or control fluids are distributed via the channel.

[0011] The control piston may be held captively in the guide sleeve via a securing element. The guide sleeve and the control piston can advantageously be preassembled as one unit, checked in terms of their function, shipped and installed.

[0012] Furthermore, a spring which acts on the control piston may be arranged in the guide sleeve, as a result of which the control piston can be activated simply by an actuator which produces only tensile forces or only compressive forces.

[0013] The invention will become more readily apparent from the following description of an exemplary embodiment thereof shown in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The sole FIGURE is a cross-sectional view of a camshaft adjuster according to the invention.

DESCRIPTION OF A PREFERRED EMBODIMENT

[0015] FIG. 1 shows a detail of an internal combustion engine 20 of a motor vehicle (not shown), having a camshaft adjuster according to the invention. The camshaft adjuster has a hydraulic control piston 10 with which it is possible to control an adjusting unit for the angular adjustment of a camshaft 16.

[0016] The control piston 10 is supported in a separate guide sleeve 11 which has control edges which are formed by four radial holes 12, 13, 14, 15, the radial holes 12, 15 being arranged offset in the circumferential direction with respect to the radial holes 13, 14.

[0017] The guide sleeve 11 is pressed into a central opening 21 which extends in the axial direction from one end of the camshaft 16. Before the guide sleeve 11 is installed into the opening 21, the camshaft 16 is heated, in which case the camshaft 16 and thus the opening 21 expand. The guide sleeve 11 is installed in the opening 21 in the heated state, so that its end side facing the camshaft 16 comes into contact with the base of the opening 21. The opening 21 becomes narrower when the camshaft 16 cools down, and the guide sleeve 11 is pressed into the opening 21.

[0018] The camshaft 16 is mounted on a cylinder head 23 of the internal combustion engine 20 via a main bearing 22 and is fixed in the axial direction with respect to the control piston 10 via a cover 24 which is screwed to the cylinder head 23. Starting from the main bearing 22, pressure fluid is fed to radial passages 27, 28 in the guide sleeve 11 via
passages 25 and 26 in the camshaft 16 and via interface areas 17, 55 between the guide sleeve 11 and the camshaft 16, to be precise via a channel, which is not shown but extends in the axial direction and via an annular groove 47, and radial bores 27, 28 through which the pressure fluid flows into an annular space formed between an annular groove 29 of the control piston 10 and the guide sleeve 11. The channel (not shown in greater detail) and the annular groove 47 are formed by recesses formed into the guide sleeve 11.

[0019] A compression coil spring 19 acting on the control piston 10 is arranged on a side of the control piston 10 facing the camshaft 16, the end of the compression coil spring 19 remote from the control piston 10 being supported on a base of the guide sleeve 11 which is closed toward the camshaft 16, and the end of the compression coil spring 19 which faces the control piston 10 acting on the control piston 10.

[0020] An actuator magnet 30 formed by a repelling magnet is arranged in a casing 36 installed in a fixed position with respect to the cylinder head 23 on the side of the control piston 10 which is remote from the camshaft 16, via which actuator magnet 30 it is possible to adjust the control piston 10 against the force of the compression coil spring 19. For this purpose, there is a contact point (not shown in greater detail) between the plunger of the repelling magnet and an end of the control piston 10 remote from the compression coil spring 19, which contact point transmits the adjusting forces of the repelling magnet to the control piston 10 in a known manner. In order for it to be possible to preassemble the guide sleeve 11 with the compression coil spring 19 and the control piston 10 independently of the actuator magnet 30, the control piston 10 is secured in the guide sleeve 11 in the direction away from the compression coil spring 19 via a securing ring 18.

[0021] The adjusting unit which can be controlled by the actuator magnet 30 via the control piston 10 has a sleeve-shaped casing 31 which encloses the end of the camshaft 16. A disk-shaped cover 32 with a central recess for the guide sleeve 11 is arranged on the side of the casing 31 facing the actuator magnet 30, and a chain sprocket 33 which is rotatably mounted on the camshaft 16 is arranged on the side of the casing 31 remote from the actuator magnet 30, via which chain sprocket 33 the camshaft 16 has a drive connection to a crankshaft of the engine. The cover 32, the casing 31 and the chain sprocket 33 are clamped by clamping screws 34 extending in the axial direction and form a unit which is rotatably mounted on the camshaft 16.

[0022] The cover 32, the casing 31 and the chain sprocket 33 enclose an annular space in which a blade wheel 35 is arranged. The blade wheel 35 is pressed fixedly onto the camshaft 16 so as to rotate with it and has blades (not shown in greater detail) which extend outwardly in the radial direction. The blades of the blade wheel 35 form pressure spaces together with radially inwardly extending blades (not shown in greater detail) integrated on the casing 31.

[0023] If the actuator magnet 30 is deactivated, the control piston 10 is displaced by the compression coil spring 19 into its first end position which is remote from the camshaft 16. The annular groove 29 of the control piston 10 is situated radially within the radial bores 12, 15. First pressure spaces are acted on by a pressure fluid via the radial bores 12, 15, via an interface passage 54 between the guide sleeve 11 and the camshaft 16, and, via an annular groove 48 formed in the outer circumference of the guide sleeve 11 and via radial bores 37, 38 in the camshaft 16 and radial bores 49, 50 formed in an inner ring of the blade wheel 35, with the result that the chain sprocket 33 is fixed in a first rotational position relative to the camshaft 16.

[0024] If the actuator magnet 30 is activated and the control piston 10 is displaced against the force of the compression coil spring 19 in the direction of the camshaft 16 into its second end position which faces the camshaft 16, the annular groove 29 of the control piston 10 comes to rest radially within the radial bores 12, 15. Here, further pressure spaces are acted on by the pressure fluid via the radial bores 12, 15, via an interface passage 56 between the guide sleeve 11 and the camshaft 16, and via an annular groove 53 formed in the outer circumference of the guide sleeve 11, via radial bores 39, 40 in the camshaft 16 and via radial bores 51, 52 in the inner ring of the blade wheel 35. At the same time, an annular groove 41 of the control piston 10 comes to rest radially within the radial bores 12, 15, while the first pressure spaces are relieved of pressure via the annular groove 41 and via channels 42, 43 in the control piston 10, with the result that the chain sprocket 33 is rotated into its second rotational position relative to the camshaft 16.

[0025] When the actuator magnet 30 is deactivated and the control piston 10 is displaced by the force of the compression coil spring 19 in the direction away from the camshaft 16, until the annular groove 29 of the control piston 10 comes to rest radially within the radial bores 12, 15, the first pressure spaces are acted on by pressure medium via the radial bores 12, 15, via the annular groove 48 formed in the guide sleeve 11, the radial bores 37, 38 in the camshaft 16 and via the radial bores 49, 50 in the inner ring of the blade wheel 35. At the same time, an annular groove 44 of the control piston 10 comes to rest radially within the radial bores 13, 14, the further pressure spaces being relieved of pressure via the annular groove 44 and via channels 45, 46 in the control piston 10, with the result that the chain sprocket 33 is rotated into its first rotational position relative to the camshaft 16.

What is claimed is:

1. A camshaft adjuster for an internal combustion engine, having a hydraulic valve with a control piston (10) for controlling an adjusting unit for the angular adjustment of the camshaft (16), said control piston (10) being supported in a separate guide sleeve, said guide sleeve (11) being pressed into a cylindrical axial opening of said camshaft (16).

2. A camshaft adjuster as claimed in claim 1, wherein the guide sleeve (11) has control edges which are formed by openings (12, 13, 14, 15) in the guide sleeve (11).

3. A camshaft adjuster as claimed in claim 1, wherein at least one channel (47, 48, 53) is formed in the guide sleeve (11) at at least one interface (17, 54, 55, 56) between the guide sleeve (11) and the camshaft (16).

4. A camshaft adjuster as claimed in claim 1, wherein the control piston (10) is held captive in the guide sleeve (11) via a securing element (18).

5. A camshaft adjuster as claimed in claim 4, wherein a spring (19) which acts on the control piston (10) is arranged in the guide sleeve (11).

6. A camshaft adjuster as claimed in claim 5, wherein the position of the control piston (10) is determined by the equilibrium of forces between the force of the spring (19) and the counteracting magnetic force.

7. The camshaft adjuster as claimed in claim 1, wherein the guide sleeve (11) is held by means of a press joint produced by a thermal shrinking process.