



(19) **United States**
(12) **Patent Application Publication**
Hurst

(10) **Pub. No.: US 2013/0052046 A1**
(43) **Pub. Date: Feb. 28, 2013**

(54) **CONTROLLABLE COOLANT PUMP WITH AN ACTUATOR THAT CAN BE ACTIVATED HYDRAULICALLY**

(52) **U.S. Cl. 417/199.1**

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(57) **ABSTRACT**

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A coolant pump for an engine with a controllable coolant flow, including a pump housing in which a hollow pump shaft is rotatably supported with an associated impeller. A volume flow of the pump is influenced by a guide plate allocated to the impeller. The guide plate is rotationally locked to a push rod guided in the pump shaft and continuously variable between two axial end positions via an actuator, provided as a radial piston pump integrated within the coolant pump that is adjustable by a cam and includes, for generating pressure, a piston that is enclosed on the outside by the cam and guided in the radial direction in a bore of the pump shaft and allocated to a pressure space. The pressure space is connected indirectly to a high pressure space in which a high pressure piston applying a force on the push rod is displaceably guided.

(21) **Appl. No.: 13/596,537**

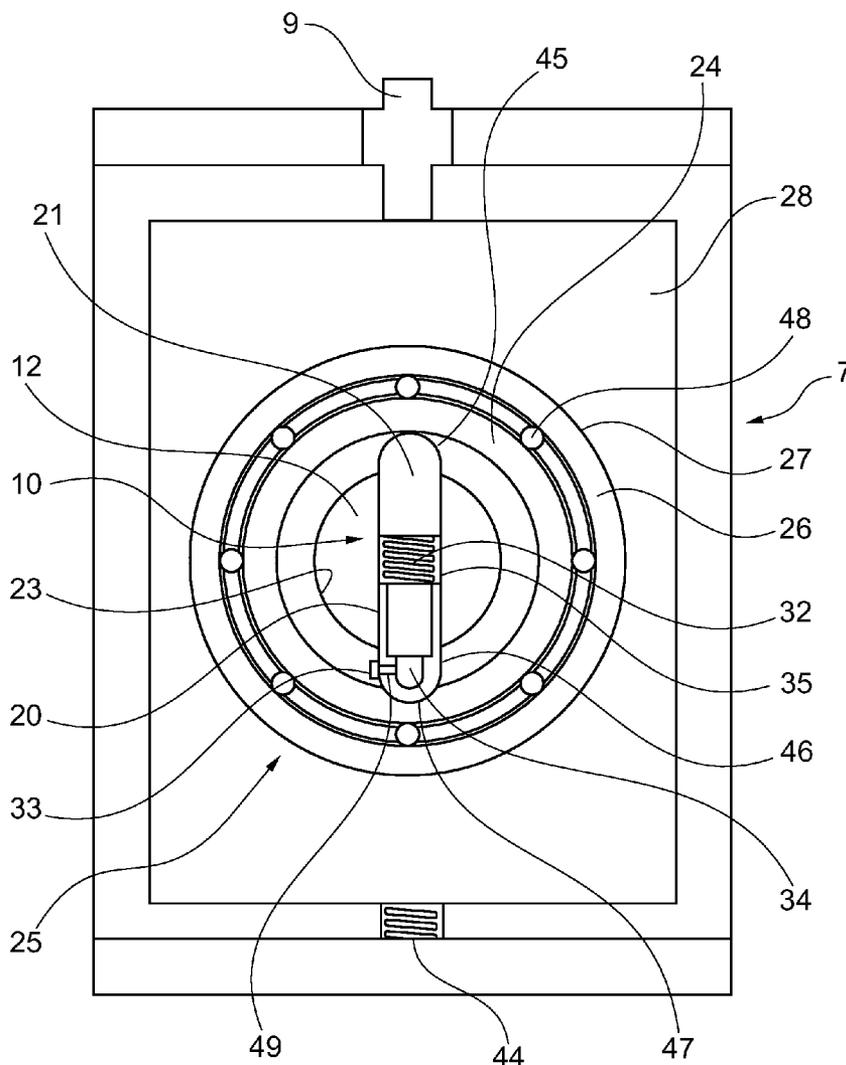
(22) **Filed: Aug. 28, 2012**

(30) **Foreign Application Priority Data**

Aug. 31, 2011 (DE) 102011081875.8

Publication Classification

(51) **Int. Cl. F04B 23/10 (2006.01)**



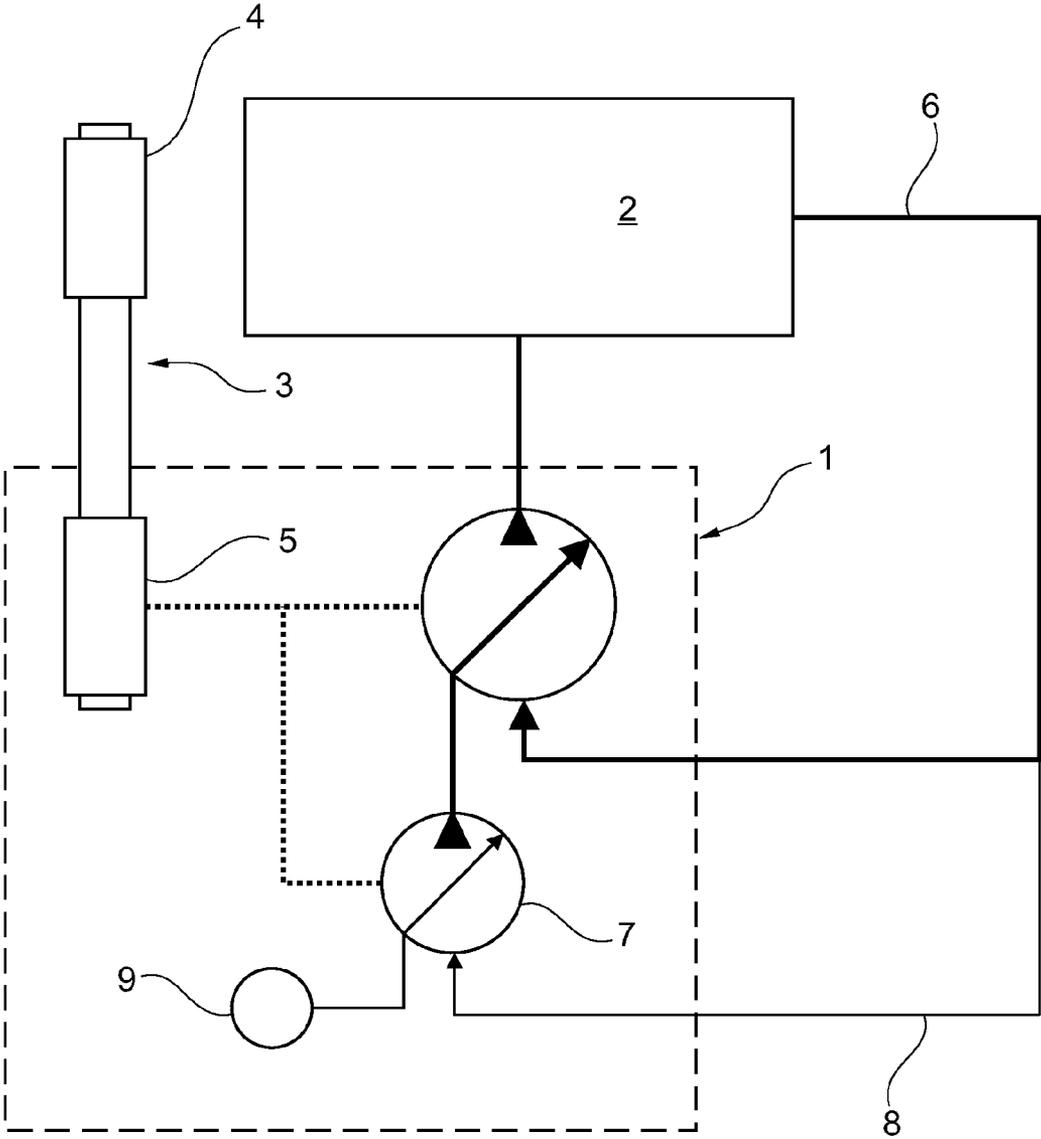


Fig. 1

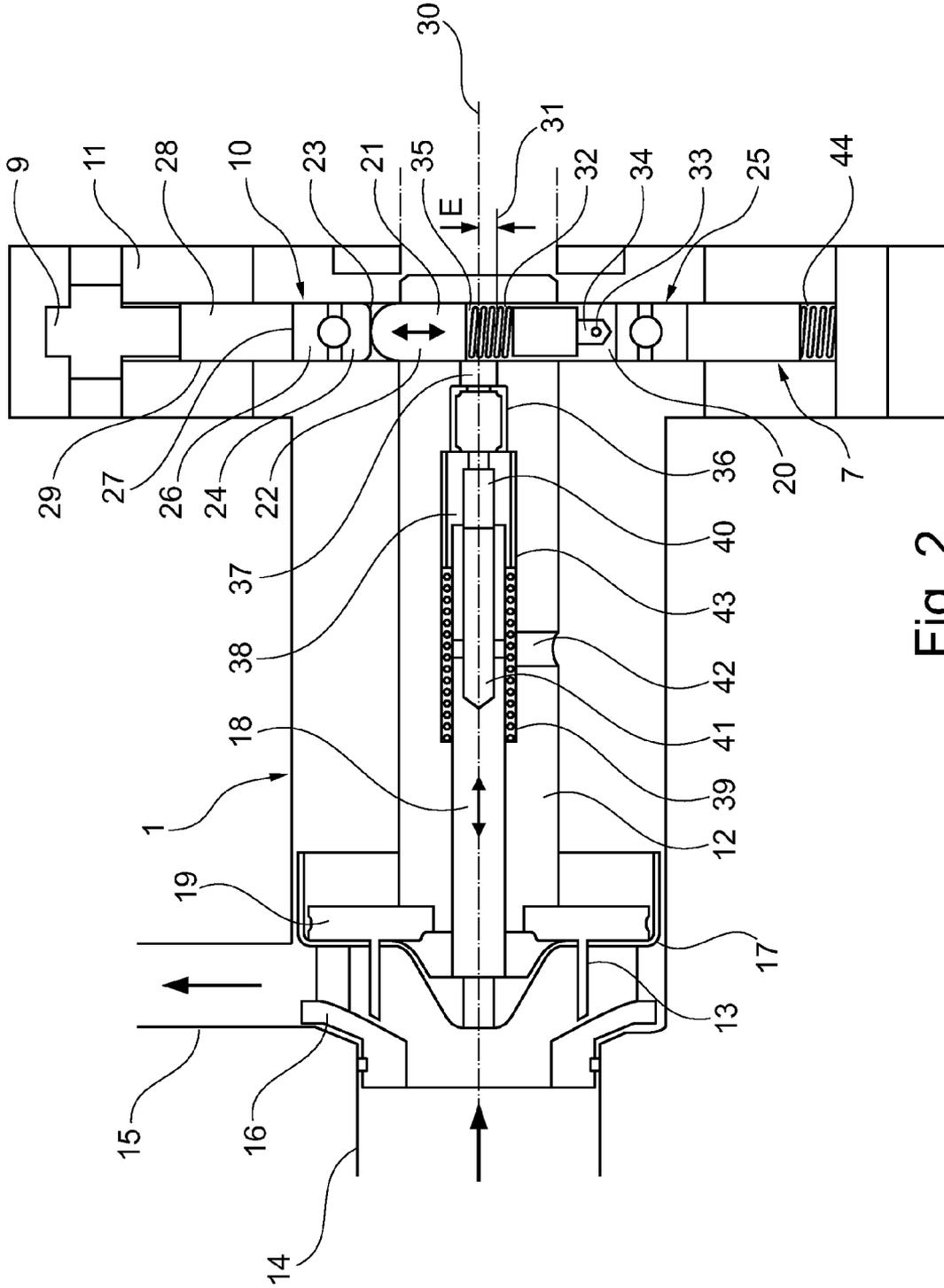


Fig. 2

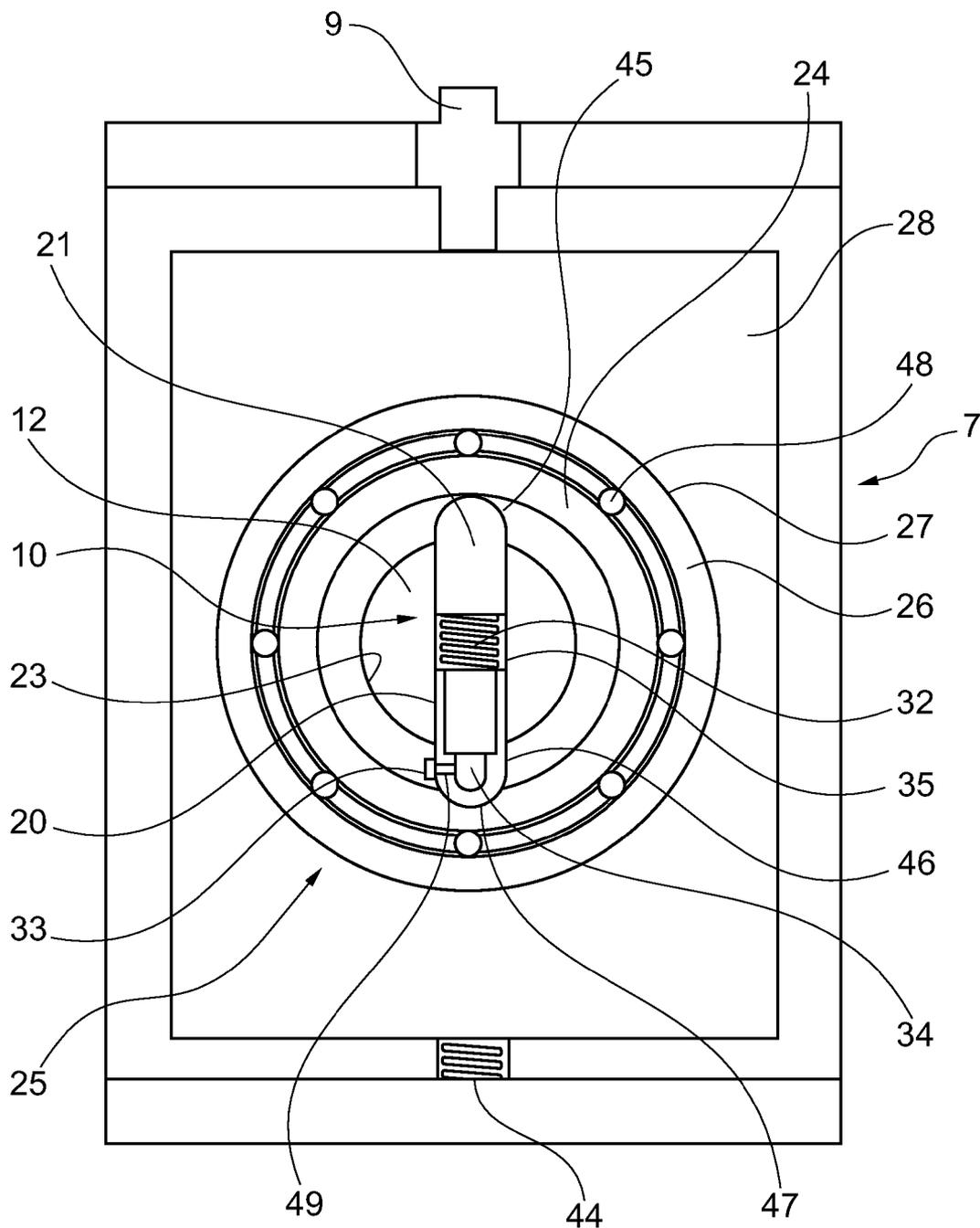


Fig. 3

**CONTROLLABLE COOLANT PUMP WITH
AN ACTUATOR THAT CAN BE ACTIVATED
HYDRAULICALLY**

CROSS-REFERENCE TO RELATED
APPLICATIONS

[0001] This application claims the benefit of German Patent Application No. 102011081875.8, filed Aug. 31, 2011, which is incorporated herein by reference as if fully set forth.

BACKGROUND

[0002] The invention relates to a coolant pump of an internal combustion engine with a controllable coolant flow, comprising a pump housing in which a pump shaft constructed as a hollow shaft is supported so that it can rotate with an associated impeller. The coolant is fed by means of the impeller from a suction connection into a pressure channel of the coolant pump, wherein a volume flow or a displacement volume of the coolant pump can be influenced by a guide plate allocated to the impeller via an actuator. The guide plate is connected rotationally locked to a push rod guided in the pump shaft and continuously variable between two end positions in the axial direction.

[0003] In liquid-cooled, in particular, water-cooled internal combustion engines, the cooling water is led in a closed circuit through cooling channels of the crankcase and the cylinder head and then re-cooled in an air-water heat exchanger or radiator. For supporting the circulation of the coolant, in particular, a coolant pump driven directly by a belt drive is used. Through a direct coupling between the coolant pump and the crankshaft, a dependency of the pump speed on the rotational speed of the internal combustion engine is set. Consequently, for a cold start of the internal combustion engine, the coolant is circulated, delaying a desired quick heating of the internal combustion engine and an associated optimum operating temperature. In the course of the constant optimization of internal combustion engines with respect to emissions and fuel consumption, it is important to bring the engine as quickly as possible to the operating temperature after a cold start. This reduces both the friction losses and also the emission values and also reduces fuel consumption. To achieve this effect, controllable coolant pumps are used, whose feed volume flow can be tuned to the cooling requirements of the internal combustion engine. A coolant flow of $\leq 0.1/h$ designated as “zero leakage flow” is required by vehicle manufacturers for internal combustion engines in the cold running phase.

[0004] From DE 199 01 123 A1, a measure for influencing the displacement volume of a coolant pump is known in which the impeller is allocated to a slide with which the effective vane width of the impeller can be changed and can be continuously adjusted moveable in the axial direction. The slider is here adjusted by the rotation of a thread-like guide. DE 10 2005 004 315 A1 and DE 10 2005 062 200 A1 disclose controllable coolant pumps in which a valve slide that can move in the direction of the pump shaft axis is used for influencing the displacement quantity within the pump housing. The annular valve slide forms an outer cylinder variably covering the outflow area of the impeller. According to DE 10 2005 004 315 A1, the valve slide that is also called a guide disk is adjusted electromagnetically with a magnetic coil arranged in the pump housing. As an alternative, for adjusting the valve slide according to DE 10 2005 062 200 A1, a

pneumatically or hydraulically activated actuator is provided that includes piston rods guided in the pump housing for adjusting the valve slide.

SUMMARY

[0005] The objective of the present invention is to provide a controllable coolant pump with which a volume flow can be adjusted as needed and includes an installation space-optimized actuator that can be integrated within conventional coolant pumps.

[0006] This objective is met through the use of one or more features of the invention. According to the invention, the hydraulic actuator integrated within the coolant pump offers the advantage of adjusting the guide plate, in order to actively influence the displacement volume of the coolant pump, so that a constantly increasing displacement flow characteristic curve can be produced. For generating pressure, the actuator has a hydrostatic radial piston pump integrated within the coolant pump with a cam adjustment with at least one suction piston that is guided in the radial direction in a passage bore forming a pressure space in the rotating pump shaft. Due to a cam that encloses the suction piston on the outside and interacts with this piston, the piston performs an oscillating movement. The pressure space limited on one side by the suction piston is connected indirectly to a high pressure space in which a high pressure piston loading the push rod is guided in a moveable manner. Through the use of the radial piston pump, the cooling medium is suctioned from the cooling circuit or the coolant pump, compressed, and transferred to a high pressure space in the coolant pump shaft on a high pressure piston. A control pressure can be generated with the radial piston pump in connection with a variable eccentricity, in order to adjust the piston between an idle or no-load run and a fixed or variable stroke. Furthermore, the speed of the pressure build-up and thus the position of the guide plate relative to the impeller can be continuously controlled, in order to achieve after a cold start a quick heating of the internal combustion engine or to selectively influence the engine temperature. In contrast to known solutions in which, for example, an oil hydraulic system of the internal combustion engine adjusts the guide disk, according to the invention the cooling medium is compressed by the radial piston pump integrated into the coolant pump for the actuation or for generating the hydraulic pressure, and thus the hydraulic pressure is generated autonomously. This less critical actuation energy advantageously requires no additional hydraulic connections, for example, between the internal combustion engine and the pump housing, as well as no increased sealing expense, in order to effectively prevent oil from penetrating into the cooling medium of the internal combustion engine.

[0007] Compared with complex and expensive electromagnetic or electromotive constructions for realizing a controllable coolant pump, the invention advantageously provides an installation space-neutral, installation-friendly, and cost-effective concept. Advantageously, the actuator according to the invention is installation space-neutral at least in the axial direction and does not negatively affect the installation space defined in front of the drive or belt plane of the coolant pump. The actuator thus can be realized within the axial packaging limits of a conventional pump including the belt pulleys, bearings, sliding ring seals, and impeller. The concept according to the invention guarantees good controllability of the guide plate and fulfills all criteria from the customer's point of view can also be built from standard components.

[0008] In addition, the radial piston pump according to the invention that can be adjusted by a cam can also be used alternatively for switching or activating other auxiliary units of an internal combustion engine. A hydraulic pressure explained as before and generated within the coolant pump can be led out from the pump shaft by a pressure line and fed to an adjacent unit. Preferably a positive displacement pump is provided as an actuator that is used alternatively for coupling with the rotating pump shaft in a stationary housing of the coolant pump and is driven by a pump shaft cam. The generated hydraulic pressure can also be used to generate a "movement distance" with which, for example, the coupling of an air conditioner compressor, generator, or a steering booster pump can be switched.

[0009] According to a preferred improvement of the invention, it is provided that a cam carriage, sled, or slide that can move continuously in the radial direction in the pump housing via a linear guide is used as the cam. A cylindrical sleeve is fixed in position in a receptacle of the cam carriage. At least one piston of the radial piston pump is supported and guided on the inside of this sleeve. By the radial adjustment of the linear sliding or rolling supported cam carriage, the stroke of the piston and thus the pump pressure or the displacement volume of the radial piston pump can be changed. As the sleeve, in particular, a steel sleeve is suitable, wherein especially its inside is hardened. In terms of a sufficient service life of the sleeve and the piston contact surface, for optimizing or achieving the most cost-effective and wear-resistant solution, a suitable material combination and/or a corresponding hardening method is provided, as well as a hydrodynamic lubrication, in order to withstand the surface pressure on a sustained basis. A roller bearing, in particular, a grooved ball bearing without a seal and without a separate lubricant provides an alternative construction of the cam carriage instead of the steel sleeve. In this more wear-resistant variant, the outer ring is pressed in a fixed position into the receptacle of the cam carriage and the piston supports the radial piston pump on the rotating inner ring of the roller bearing.

[0010] According to the invention, a radial piston pump is used preferably with two pistons offset relative to each other by 180° piston angle, which represents an optimum in terms of expense and function and produces an advantageous kinematic system for the piston through its setup. In contrast to a radial piston pump with a piston in which the stroke is adjustable by a cam, in the double piston variant, for each revolution of the coolant pump shaft, two work strokes are produced, wherein the stroke can also be influenced throughout the piston angle. The stroke level can further be reduced compared with the single-piston variant. For example, for a guide radius of 15 mm and a set eccentricity of 1 mm, a stroke of 0.07 mm can be realized in a two-piston variant in contrast to a stroke of 2 mm for otherwise equal parameters in the single-piston variant. In addition, the radial piston pump containing two pistons distinguishes itself by a uniform pressure generation with low pulsation, with which an approximately constant pressure level can be achieved. The two-piston variant also allows a desirable starting basis, an optimal control path/stroke ratio, in order to adjust the parameters of pump pressure or guide plate position for a continuously controllable operation detected by a position sensor with a sufficiently low sensitivity. As the radial piston pump, a double-piston variant could also be used that has a counter piston that applies a force on the inner ring and has neither a suction valve nor a corresponding suction or displacement opening. The piston used

for mass regulation or for radial mass distribution relative to the suction piston avoids a disadvantageous imbalance of the radial piston pump. For radial piston pumps with more than two pistons, for example, for three-piston or four-piston variants, an asymmetric peripheral arrangement of the pistons leads to an increase in the stroke. Because a uniform distribution of the pistons can lead to a zero stroke, a low asymmetric piston arrangement is preferably provided. A desired doubling of the working frequency can be achieved in the four-piston variant, just like the two-piston variant.

[0011] In order to guarantee a contact of the pistons on the steel sleeve or the inner ring of the roller bearing in all of the operating states, wherein this contact is required for the functioning of the radial piston pump, each piston is loaded by a spring element. For a radial piston pump with two pistons, a compression spring is suitable that guarantees a centrifugal force supporting an active contact of both pistons on the guide element of the cam carriage, which is required especially in the suction phase.

[0012] For the purpose of achieving rotational entrainment and rolling support of the roller bearing inner ring, at least one suction piston that is also called a guide piston and can move in the pump shaft is positioned on the roller bearing inner ring. This arrangement differs from a steel sleeve that is pressed fixed in position in the cam carriage and on which the pistons are supported in a sliding manner. For the rotational coupling, the guide piston or its piston head forms, on one end, a half cylinder whose axis runs parallel to the coolant pump axis, wherein the piston is guided with a certain contact in the complementary recess in the inner ring of the roller bearing, in order to be able to perform a tilting movement that can be based on the kinematics of the radial piston pump including multiple pistons. Furthermore, this head geometry prevents rotation of the piston in the associated bore, wherein a position-oriented installation position is set that guarantees a defined allocation of a suction bore to the suction piston. Alternatively, the piston or the piston head can be constructed with preferably convex contours on the end, which engage with a positive-fit connection in a complementary concave receptacle of the inner ring. All of the other pistons of the radial piston pump are supported without a positive-fit connection on the inner ring, thus allowing unimpaired piston kinematics of the eccentrically adjustable radial piston pump. All of the pistons perform an oscillating, sliding motion in sync, wherein, as a measure for reducing the wear in the area of the contact surfaces to the roller bearing inner ring, a corresponding construction of the pistons and/or a special selection of materials is provided.

[0013] According to the invention, in the operating state of the radial piston pump, the coolant flows via a suction valve constructed as a one-way valve into the pressure space in the suction phase, as a function of a position of the suction piston. The suction piston with an opening direction toward the pressure space is preferably connected to the pressure channel of the coolant pump. Therefore, the back pressure rising at the suction opening of the suction valve supports the opening at the beginning of the suction phase of the piston.

[0014] According to one improvement of the invention, it is provided that a closing valve is inserted between the high pressure space and the pressure space, wherein this valve transfers the compression pressure generated by the piston into the high pressure space as soon as the counter pressure prevailing in the high pressure space is exceeded. The closing valve constructed as a one-way valve simultaneously effec-

tively prevents a back flow of the coolant from the high pressure space into the pressure space and thus a pressure drop in the high pressure space after the end of the compression phase of the suction piston. The pressure or the volume established in the high pressure space moves the high pressure piston with the associated push rod and the guide plate against the fluid forces into the closed position. Here, the high pressure space empties out at least partially between the compression strokes, because a defined leakage gap is provided between the piston shoulder or the piston outer contours and the bore wall of the high pressure space. The leakage gap also allows passive venting that is required for resetting the guide plate into a maximum opening for a deactivated or failure of the radial piston pump. Resetting the guide plate, in which the coolant in the high pressure space is simultaneously displaced via the leakage gap, is realized with the support of a previously compressed spring, in particular, a compression spring.

[0015] To counteract an uncontrolled pressure increase in the high pressure space, which could lead to destruction of the impeller cover forming an end stop for the guide plate or to destruction of the guide plate, an overpressure valve is used in the high pressure piston. When a permissible pressure is exceeded, the overpressure valve opens and causes an outflow of coolant from the high pressure space via a drainage channel of the push rod in an outflow opening of the pump shaft. The discharged coolant can advantageously be guided together with the leakage flow of the piston into a suction area of the coolant pump. For reducing an axial length it is possible to integrate the overload valve on the inside into a counter piston of the radial piston pump interacting with a suction piston. As an alternative to an outer end stop of the guide plate in the form of an impeller cover, it is possible to use a block length of the pressure spring provided for resetting the guide plate as an inner stop. This concept makes it possible to eliminate overload protection in the form of an overpressure valve.

[0016] A preferred improvement of the invention provides that the cam carriage, sled, or slide can be adjusted or set continuously by an electronic control element. The control element coupled, in particular, with the engine management can be activated, for example, as a function of parameters of the internal combustion engine, in particular, the water or oil temperature of the internal combustion engine. As the control element, preferably a linear actuator can be used that includes an electric motor with associated coupling and cam drive or an electromagnet, in order to move the cam carriage set in the wet space in the axial direction between the sliding ring seal and the impeller of the coolant pump in the radial direction relative to the pump shaft.

[0017] As safety measures in an emergency, the invention comprises different fail safe devices for the actuator of the cam-controlled radial piston pump. As a first measure, a spring element interacting with the cam carriage of the radial piston pump is provided. This fail safe device has the effect that, when activated, for example, after failure of the hydraulic circuit of the actuator system, the cam carriage is reset to a starting position concentric to the coolant pump axis. This arrangement produces a piston position in which the radial piston pump is not displaced and the largest possible impeller cross section is set, which guarantees a maximum coolant displacement. Furthermore, a compression spring inserted within the pump shaft and supported on a shoulder of the pump shaft and on the pressure piston can be provided as a fail safe device that moves the high pressure piston, in the event of a defect, in the axial direction toward the radial piston pump

and here forces the coolant out from the high pressure space via the leakage gap. Preferably, the coolant pump includes both fail safe devices explained above.

[0018] The radial piston pump adjustable by the cam carriage can also be used alternatively for switching or activating other auxiliary units of the internal combustion engine. The hydraulic pressure generated within the coolant pump can be discharged from the pump shaft by means of a pressure line and be fed to an adjacent unit. Preferably a positive displacement pump is provided as the actuator that is used alternatively for coupling with the rotating pump shaft in a stationary housing of the coolant pump and is driven by a pump shaft cam. The generated hydraulic pressure can be used to generate a "movement distance" with which, for example, the coupling of an air conditioner compressor, generator, or steering booster pump can be switched.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] Additional features of the invention can be taken from the following description about the drawings in which a preferred embodiment is illustrated. Shown are:

[0020] FIG. 1 is a schematic representation of the structure of a coolant pump with an integrated actuator constructed according to the invention,

[0021] FIG. 2 is a longitudinal section view of a coolant pump according to the invention,

[0022] FIG. 3 is a front view of the actuator of the coolant pump according to FIG. 2.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0023] FIG. 1 shows, in a schematic representation, all of the components of a coolant pump 1 that is built according to the invention and is designed for cooling an internal combustion engine 2 and is driven by a traction mechanism drive 3. The traction mechanism of the traction mechanism drive 3 constructed as a belt drive connects a first belt pulley 4 connected to a not shown crankshaft of the internal combustion engine 2 to a second belt pulley 5 allocated to the coolant pump 1. The displacement volume of the coolant pump 1 in connection with a coolant circuit 6 is adjustable or controllable by a hydraulic actuator 7 allocated to a hydraulic circuit 8. The actuator 7 is activated by a hydraulically, pneumatically, or electrically drivable control element 9.

[0024] In FIG. 2, the controllable coolant pump 1 is illustrated in a longitudinal section and shows, in particular, the structure of the actuator 7 that includes a radial piston pump 10 adjustable by a cam. The coolant pump 1 comprises a pump housing 11 in which a pump shaft 12 is supported that is constructed as a hollow shaft and is connected rotationally locked to an impeller 13. When the impeller 13 rotates in the operating state of the coolant pump 1, the coolant flows in the axial direction via a suction connection 14 to the impeller 13 and is guided in the radial direction into a pressure channel 15 or spiral channel. Here, a pump cover 16 connected to the impeller 13 forms a transition between the suction connection 14 and the pressure channel 15. For influencing the displacement volume of the coolant pump 1, a guide plate 17 is provided that can move in the axial direction and variably covers an outlet area of the impeller 13 and is rotationally fixed on a push rod 18 that can move in the axial direction relative to the pump shaft 12. Through the use of an actuator 7 that is also called an activating mechanism, the guide plate

17 can be positioned continuously between two end positions defined by the pump cover 16 and a rear wall 19 of the impeller 13. According to FIG. 2, the guide plate 17 is supported on the rear wall 19, wherein a maximum displacement volume of the coolant pump 1 is set. The actuator 7 comprises a positive displacement pump that is integrated within the coolant pump 1 and is constructed as a radial piston pump 10 and can be adjusted eccentrically and includes the two opposing pistons 20, 21 guided in a radially directed passage bore 22 of the pump shaft 12. The pistons 20, 21 are supported on the outside on an inside 23 of an inner ring 24 of the roller bearing 25 that is constructed as a grooved ball bearing and whose outer ring 26 is pressed in a position fixed manner into a receptacle 27 of a cam carriage 28. By the use of a linear guide 29, the cam carriage 28 can move in the radial direction in the pump housing 11 for adjusting an eccentricity E between a longitudinal axis 30 of the coolant pump 1 and a rotational axis 31 of the roller bearing 25. The eccentricity E that is adjustable by the control element 9 of the actuator 7 directly influences a stroke of the pistons 20, 21 and consequently their oscillating movement that is superimposed on a rotation of the pump shaft 11.

[0025] Through the use of a spring element 32 constructed, in particular, as a compression spring, the pistons 20, 21 are supported with a positive-fit connection on the inside 23 of the roller bearing inner ring 24. In the area of greatest eccentricity E, coolant flows via a suction valve 33 interacting with the suction piston 20 and via a displacement opening 34 of the piston 20 into the pressure space 35 of the radial piston pump 10. The suction valve 33 also call a one-way valve with an opening direction toward the pressure space 35 is preferably connected to the pressure channel 15 of the coolant pump 1, wherein, at the beginning of the suction phase of the piston 20, the rising back pressure supports the opening of the suction valve 33. The piston 21 is used for mass regulation or radial mass distribution relative to the suction piston 20 and forms a counter piston that is neither connected to a suction valve nor includes a displacement opening. After the end of the suction and compression phases, a maximum pressure is set in the pressure space 35 in a position of the piston 20 changed by 180°. Through the use of a closing valve 36 also acting as a one-way valve and inserted into a longitudinal bore of the pump shaft 12, the coolant can flow from the pressure space 35 into a high pressure space 37 that is bounded on one side by a high pressure piston 38 fixed directly on the push rod 18. The closing valve 36 opens as soon as a pressure drop is set in which the pressure in the pressure space 35 exceeds the pressure level in the high pressure space 37. An adjustment movement of the push rod 18 and the connected guide plate 17 is performed in the direction of the pump cover 16 as soon as the pressure set in the high pressure space 37 exceeds the spring force of a spring that is also called a fail safe device 39. The spring here locally encloses the push rod 18 and is supported between a shoulder of the pump shaft 12 and the high pressure piston 38. As a measure for counteracting an uncontrolled pressure increase in the high pressure space 37, an overpressure valve 40 is integrated in the high pressure piston 38 and this overpressure valve opens when a permissible pressure is exceeded and allows a discharge of coolant from the high pressure space 37 via a drainage channel 41 of the push rod 18 and an outflow opening 42 of the pump shaft 12. A quick resetting of the guide plate 17 allows a leakage gap 43 that is formed in the outer contours of the high pressure piston 38 and by means of which the coolant can be discharged from

the high pressure space 37 into an annular space defined for the spring of the fail safe device 39 and then into the outflow opening 42. Another fail safe device 44 similarly including a compression spring is provided for the cam carriage 28 interacting with the radial piston pump 10. For example, if the pressure supply of the actuator 7 fails, the compression spring pushes the cam carriage 28 into an output position concentric to the longitudinal axis 30 of the coolant pump 1 in which a maximum coolant displacement of the coolant pump 1 is set. [0026] FIG. 3 shows, in particular, the installation position of the roller bearing 25 and also the components connected to the roller bearing 25. The two pistons 20, 21 of the radial piston pump 10 are guided differently or supported on the inner ring 24 of the roller bearing 25. The counter piston 21 is supported with a rounded piston peak 45 shaped as a dome or convexly by a centrifugal force and also by the spring element 32 on the inside 23 of the roller bearing inner ring 24. Advantageously, the guide or suction piston 20 forms on one end, for rotational coupling, a piston peak 46 that is shaped as a half cylinder and engages in a complementary shaped receptacle 47 of the roller bearing inner ring 24 with a positive-fit connection. The half cylinder of the piston peak 46 is here oriented with a profile parallel to the longitudinal axis 30 of the pump shaft 12 or the coolant pump 1, in order to be able to perform a defined tilting movement that is set for a radial piston pump with several pistons. For the seal-less roller bearing 25 built as a grooved ball bearing, the roller bodies 48 are loaded directly by the coolant. FIG. 3 further shows the position of the suction valve 33 by which a flow of coolant into the suction piston 20 is enabled when its position is aligned with an inlet channel 49 of the suction piston 20.

LIST OF REFERENCE SYMBOLS

- [0027] 1 Coolant pump
- [0028] 2 Internal combustion engine
- [0029] 3 Traction mechanism drive
- [0030] 4 Belt pulley
- [0031] 5 Belt pulley
- [0032] 6 Coolant circuit
- [0033] 7 Actuator
- [0034] 8 Hydraulic circuit
- [0035] 9 Control element
- [0036] 10 Radial piston pump
- [0037] 11 Pump housing
- [0038] 12 Pump shaft
- [0039] 13 Impeller
- [0040] 14 Suction connection
- [0041] 15 Pressure channel
- [0042] 16 Pump cover
- [0043] 17 Guide plate
- [0044] 18 Push rod
- [0045] 19 Rear wall
- [0046] 20 Piston
- [0047] 21 Piston
- [0048] 22 Passage bore
- [0049] 23 Inside
- [0050] 24 Inner ring
- [0051] 25 Roller bearing
- [0052] 26 Outer ring
- [0053] 27 Receptacle
- [0054] 28 Cam carriage
- [0055] 29 Linear guide
- [0056] 30 Longitudinal axis
- [0057] 31 Rotational axis

- [0058] 32 Spring element
- [0059] 33 Suction valve
- [0060] 34 Displacement opening
- [0061] 35 Pressure space
- [0062] 36 Closing valve
- [0063] 37 High pressure space
- [0064] 38 High pressure piston
- [0065] 39 Fail safe device
- [0066] 40 Overpressure valve
- [0067] 41 Drainage channel
- [0068] 42 Outflow opening
- [0069] 43 Leakage gap
- [0070] 44 Fail safe device
- [0071] 45 Piston peak
- [0072] 46 Piston peak
- [0073] 47 Receptacle
- [0074] 48 Roller body
- [0075] 49 Inlet channel

1. Coolant pump of an internal combustion engine with a controllable coolant flow, comprising a pump housing in which a pump shaft constructed as a hollow shaft is supported so that it can rotate with an associated impeller and feeds a coolant via a suction connection into a pressure channel of the coolant pump, a volume flow or a displacement volume of the coolant pump is influenced by a guide plate allocated to the impeller via an actuator, the guide plate is connected rotationally locked to a push rod guided in the pump shaft and continuously variable between two end positions in an axial direction, the actuator comprises a radial piston pump that is integrated within the coolant pump and is adjustable via a cam and includes, for generating pressure, at least one oscillating piston or suction piston that is enclosed on an outside by the cam and is guided in a radial direction in a passage bore of the pump shaft and is allocated to a pressure space, and the pressure space is connected indirectly to a high pressure space in which a high pressure piston applying a force on the push rod is guided in a displaceable manner.

2. Coolant pump according to claim 1, wherein a cam carriage or slide is provided that can move continuously in a radial direction in the pump housing, the carriage or slide has a receptacle in which a cylindrical sleeve or an outer ring of a

roller bearing is positioned, and the piston of the radial piston pump is guided on an inside of an inner ring of the roller bearing or the sleeve and an adjustment of the cam carriage influences an eccentricity (E) and thus a stroke of the piston.

3. Coolant pump according to claim 1, wherein the radial piston pump includes two of the pistons offset relative to each other by 180°, and at least one of the pistons is fixed in rotation on the inner ring of the roller bearing.

4. Coolant pump according to claim 3, wherein a spring element is inserted between the pistons of the radial piston pump.

5. Coolant pump according to claim 2, wherein the piston for rotational coupling has a piston peak rounded on an end that engages with a positive fit in a complementarily shaped receptacle of the roller bearing inner ring.

6. Coolant pump according to claim 1, wherein, in a suction phase of the piston, coolant flows out from the coolant pump via a suction valve constructed as a one-way valve into the pressure space.

7. Coolant pump according to claim 1, wherein a closing valve is inserted between the pressure space and the high pressure space, and the closing valve allows a flow of coolant from the pressure space into the high pressure space when there is a pressure drop between the two pressure spaces.

8. Coolant pump according to claim 1, wherein a leakage gap is provided between the high pressure piston and a bore wall of the high pressure space.

9. Coolant pump according to claim 1, wherein an open overpressure valve inserted in the high pressure piston guarantees a coolant flow from the high pressure space via a drainage channel of the push rod into an outflow opening of the pump shaft.

10. Coolant pump according to claim 2, wherein the cam carriage is adjustable by a hydraulically, electronically, or pneumatically acting control element.

11. Coolant pump according to claim 10, wherein, for fault protection, at least one of the cam carriage or the push rod interacts with a fail safe device constructed as a spring element.

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