



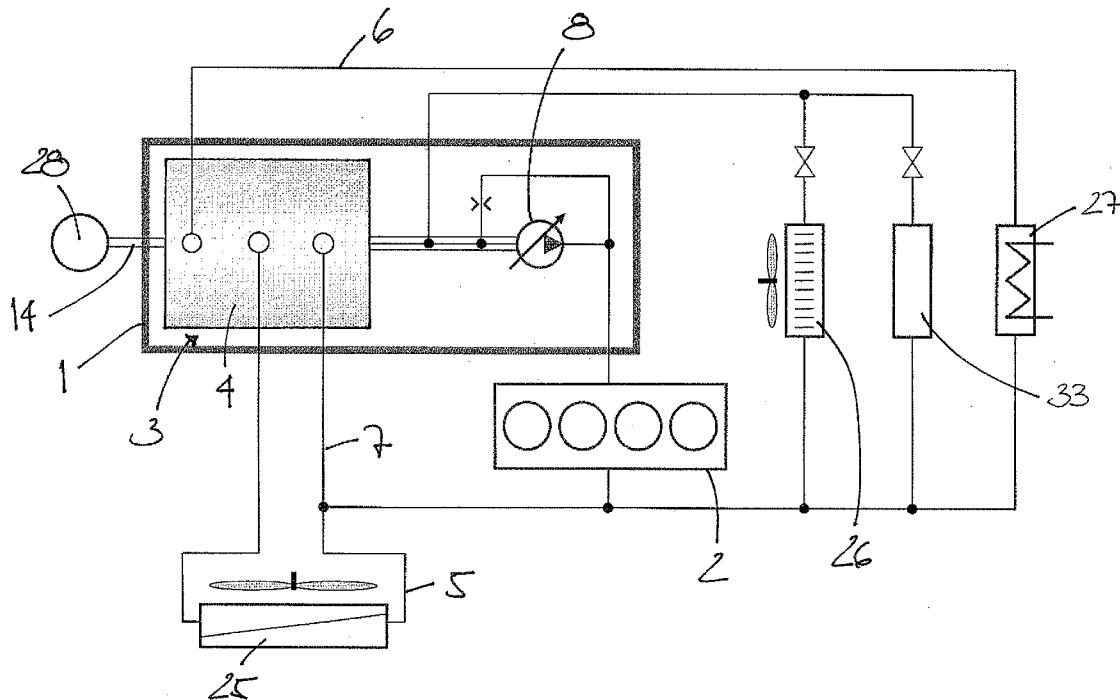
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POPP et al.(10) **Pub. No.: US 2012/0111291 A1**(43) **Pub. Date: May 10, 2012**(54) **DEVICE FOR REGULATING A COOLANT
FLOW AND COOLING SYSTEM**(30) **Foreign Application Priority Data**

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SEBASTIAN HURST,
BUBENREUTH (DE)**Publication Classification**(51) **Int. Cl.**
F01P 7/14 (2006.01)(52) **U.S. Cl.** **123/41.09**(57) **ABSTRACT**

A device (1) for regulating a coolant flow in a cooling system of an internal combustion engine (2) with a valve arrangement (3) that includes a rotary disk valve (4) for switching at least one cooling circuit (5, 6) and/or a bypass circuit (7), as well as a coolant pump (8) that is constructed as an impeller pump and is connected on the suction side to the valve arrangement (3). The coolant pump (8) has an axial adjustable guide plate (11) on an inside between two end stops (9, 10) for closing and releasing a pump outlet (12). The guide plate (11) for the axial adjustment is indirectly coupleable by a lead screw thread (13) to a drive shaft (14) of the rotary disk valve (4). A cooling system for an internal combustion engine (2) with such a device (1) is also provided.

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KG, Herzogenaurach (DE)(21) Appl. No.: **13/240,655**(22) Filed: **Sep. 22, 2011**

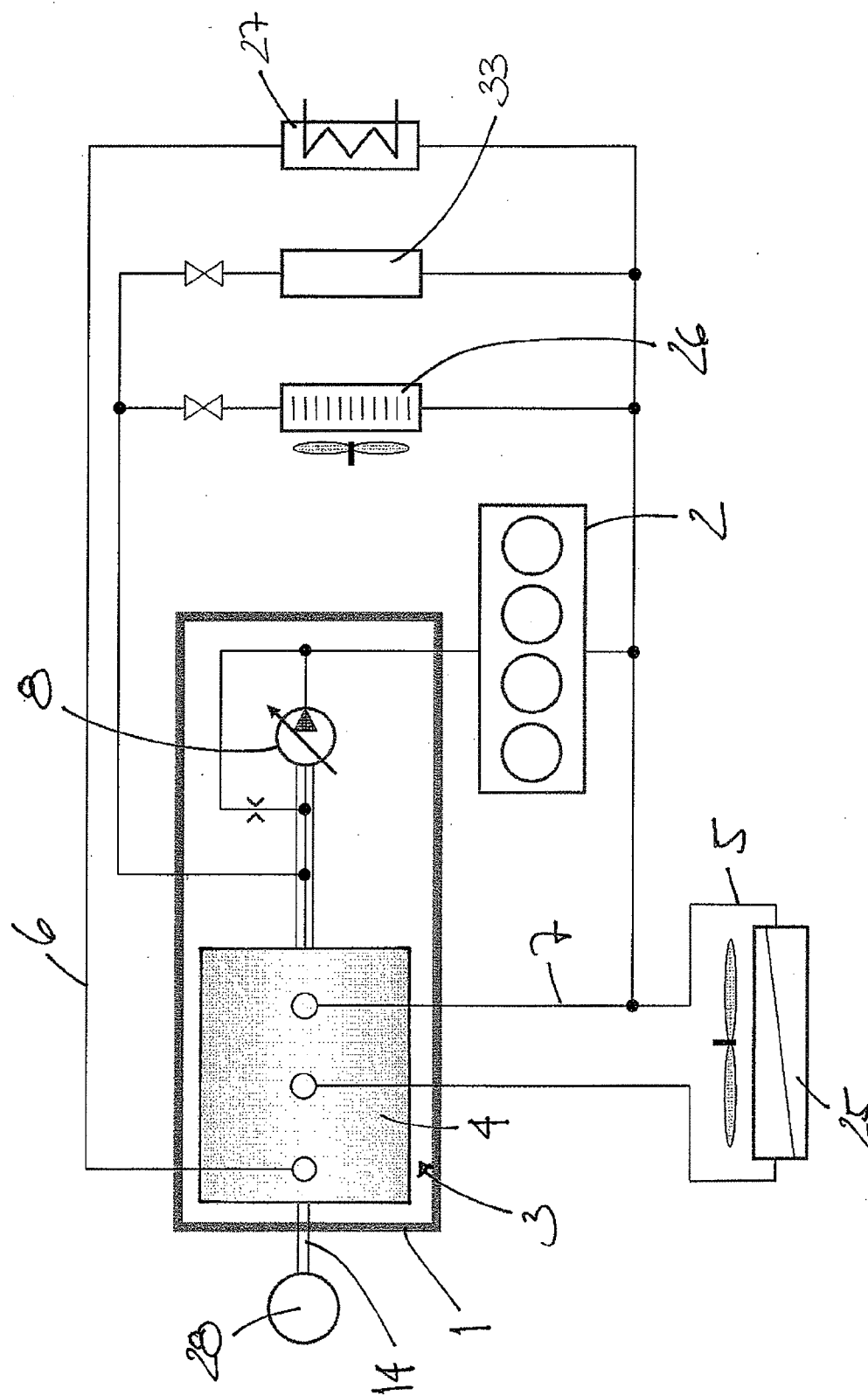


Fig. 1

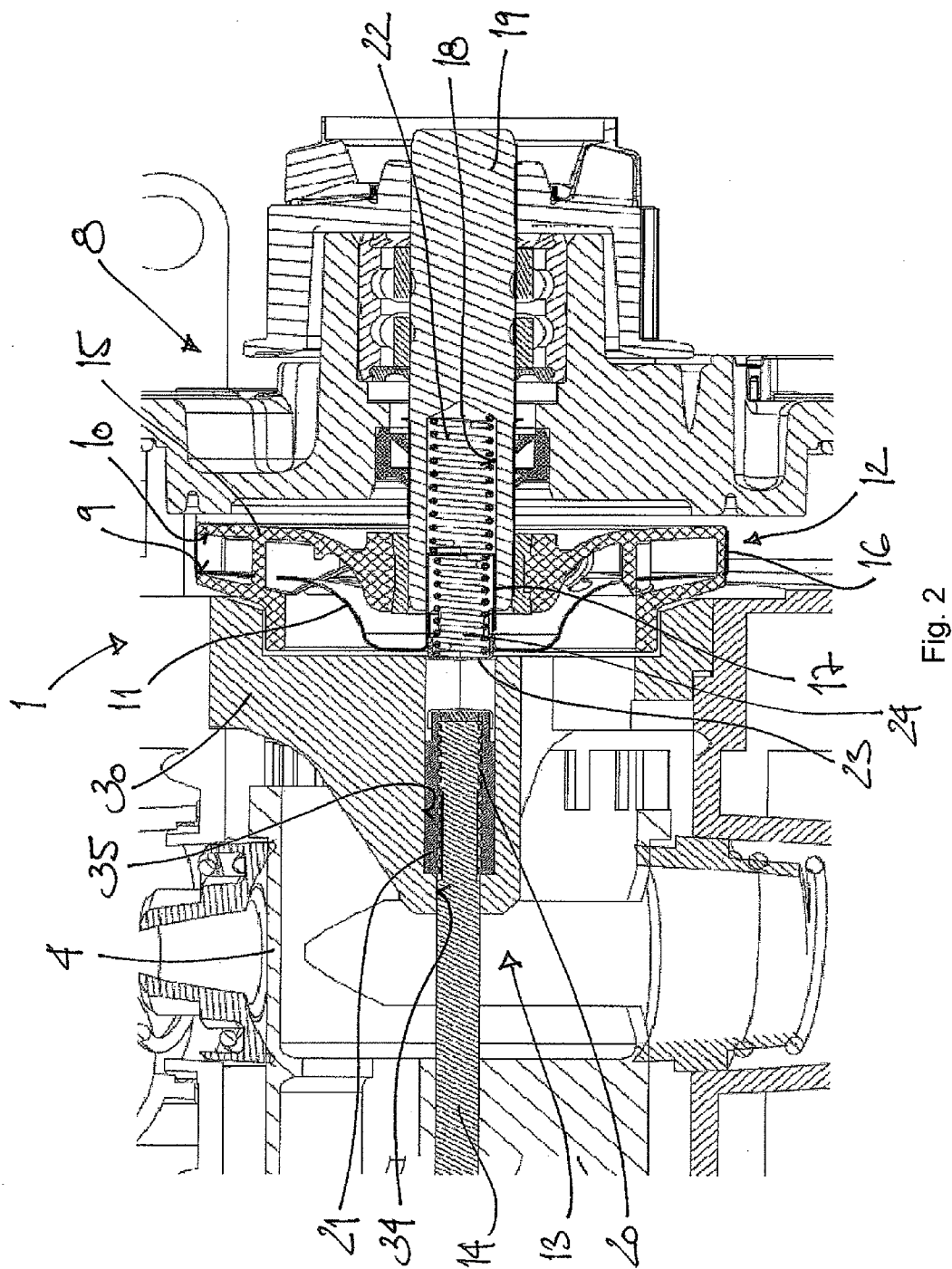


Fig. 2

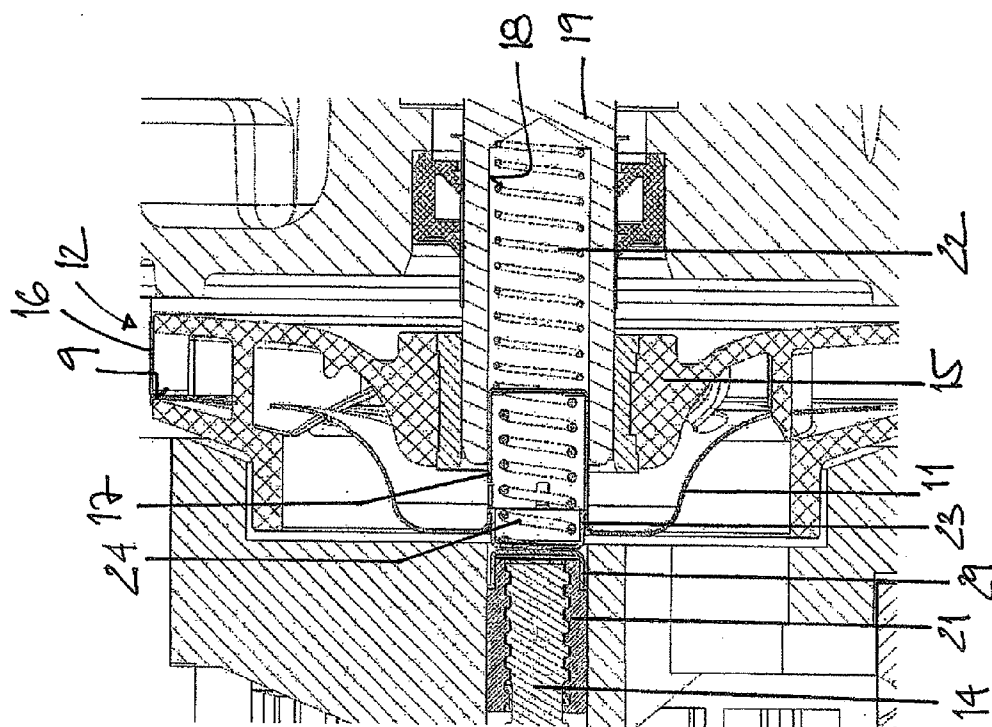


Fig. 4

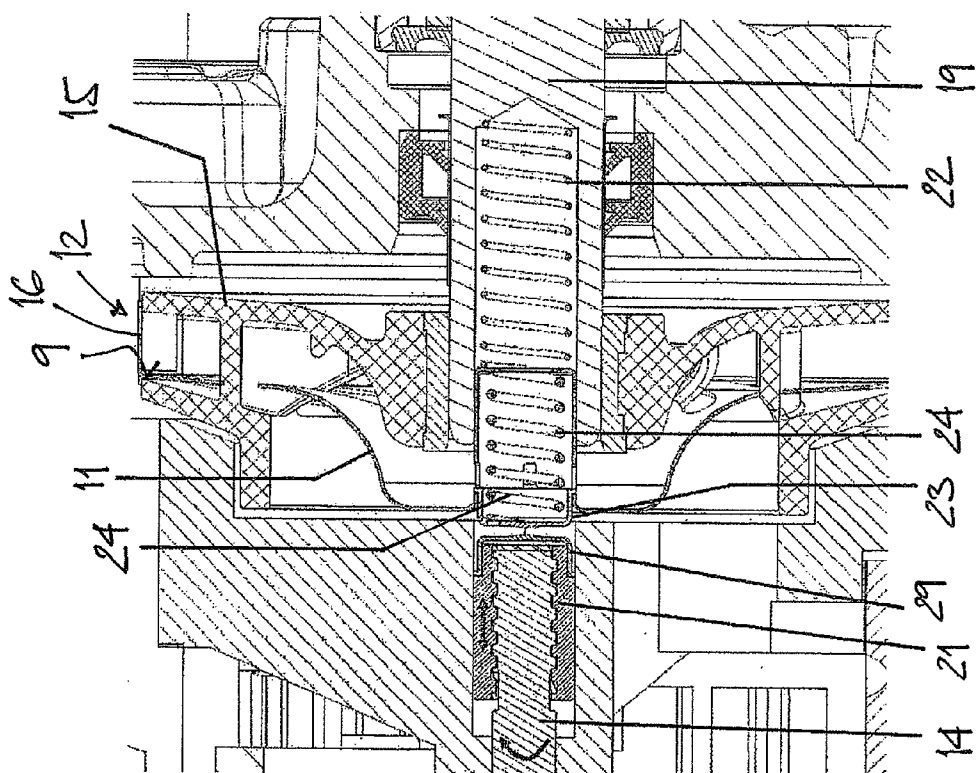


Fig. 3

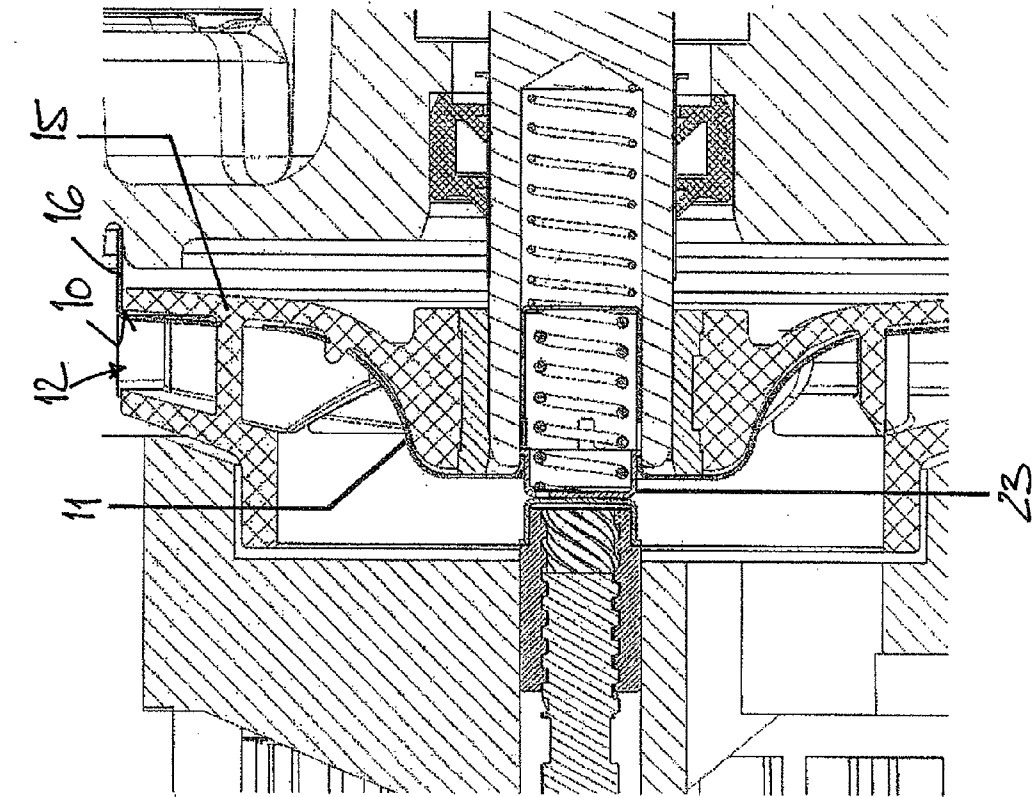


Fig. 6

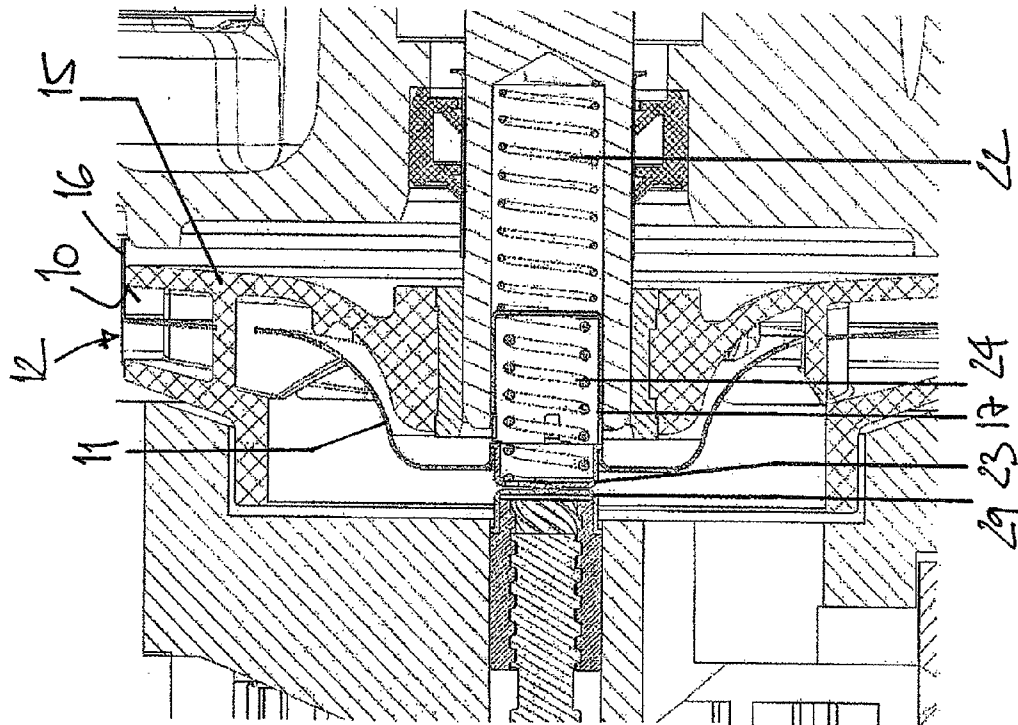


Fig. 5

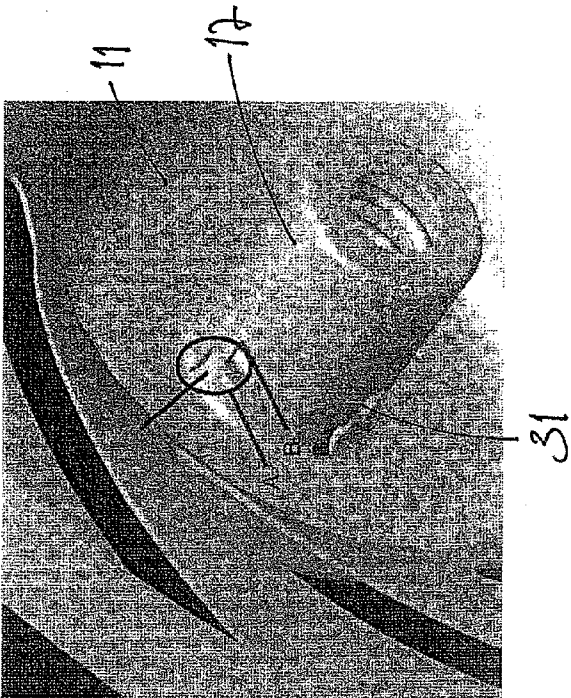


Fig. 8

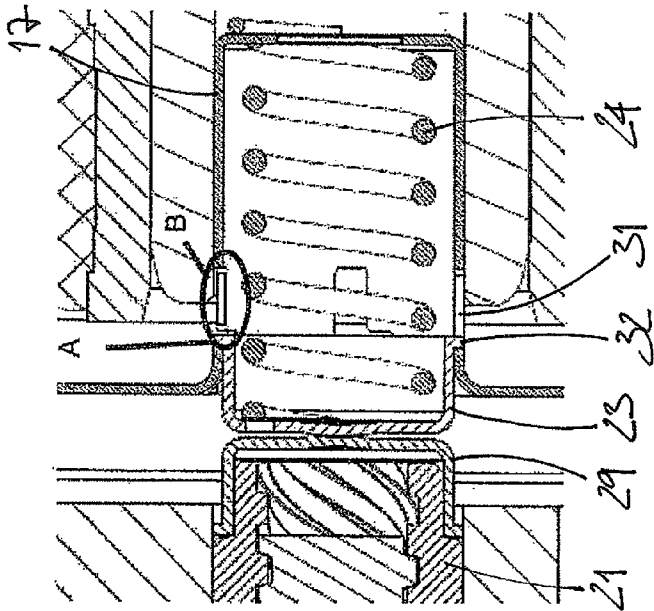


Fig. 7

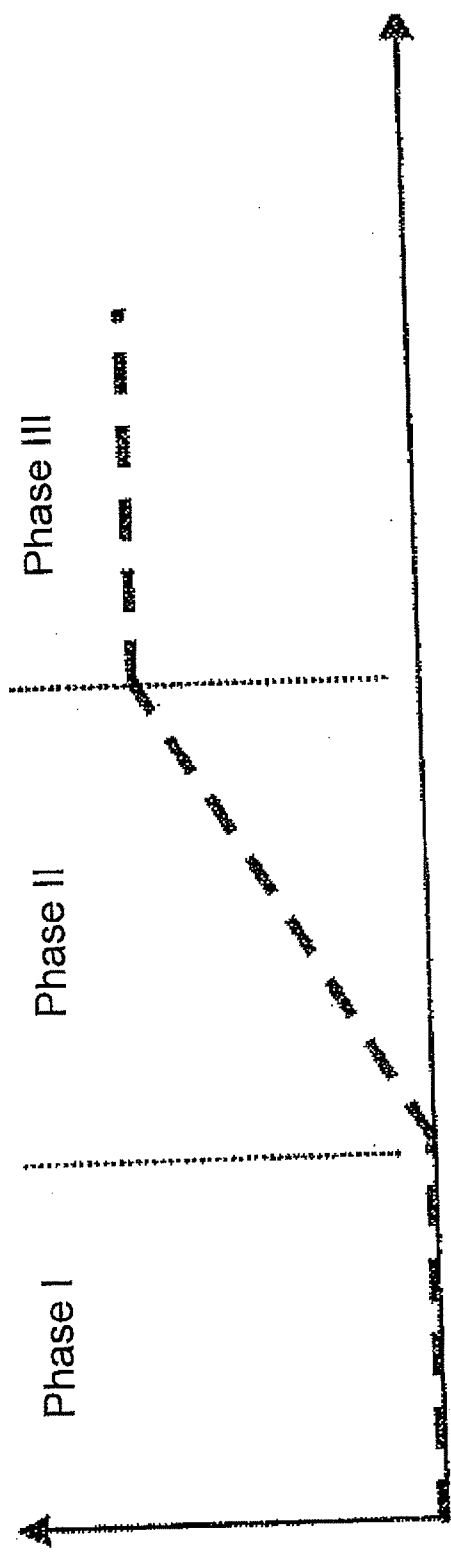


Fig. 9

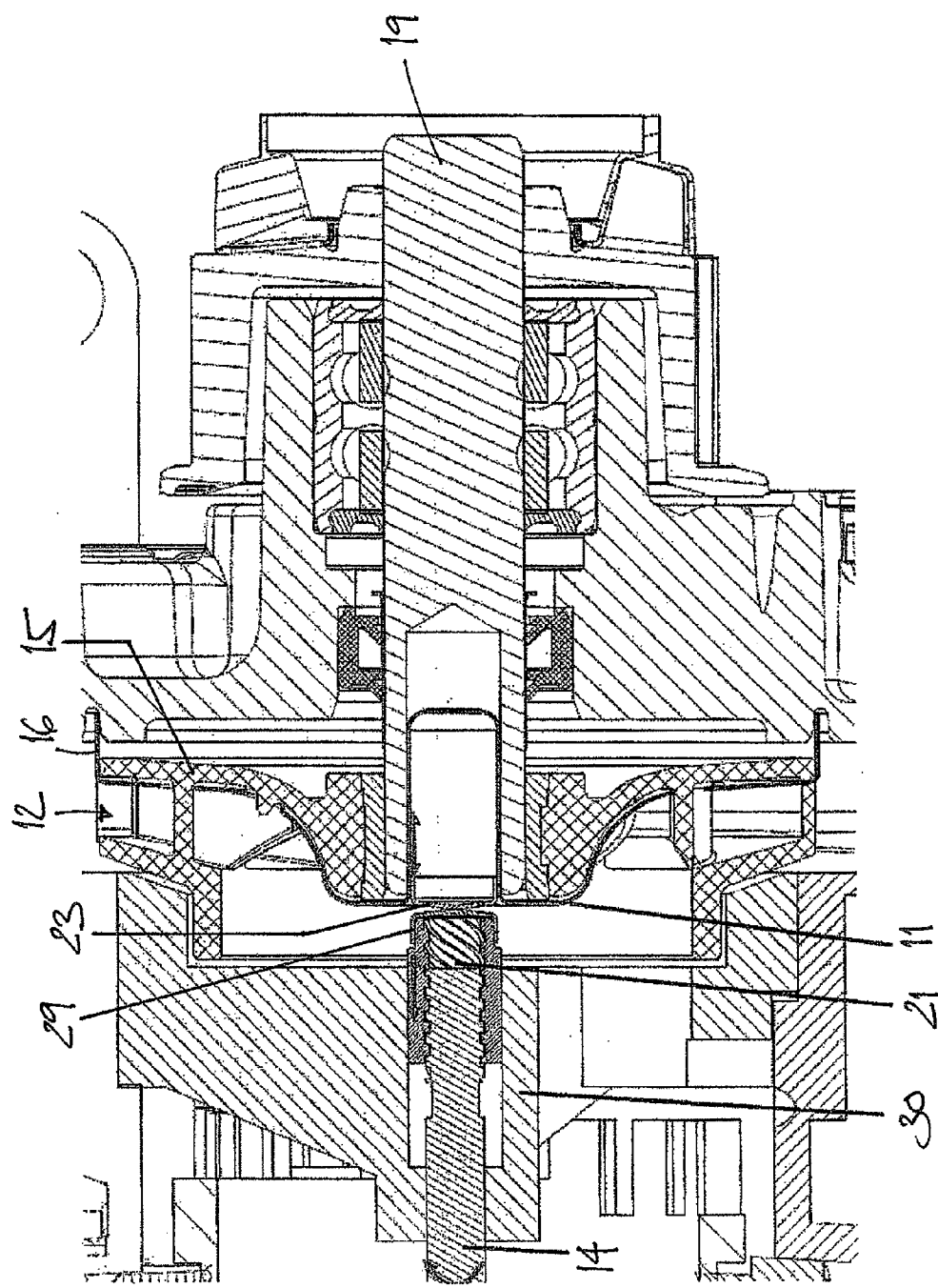


Fig. 10

DEVICE FOR REGULATING A COOLANT FLOW AND COOLING SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of German Patent Application No. 102010050605.2, filed Nov. 5, 2010, which is incorporated herein by reference as if fully set forth.

BACKGROUND

[0002] The invention relates to a device for regulating a coolant flow in a cooling system of an internal combustion engine. The invention further relates to a cooling system with such a device.

[0003] Internal combustion engines are today largely water-cooled. To this end, cooling water is pumped with the help of a coolant pump or a cooling-water pump in a closed circuit through cooling channels in the area of the cylinders for cooling the internal combustion engine and then fed to an air-water cooler, where the heated water is cooled down again by motion-induced wind. The pump required for circulating the water is advantageously driven by the internal combustion engine. To this end, the pump is typically connected by a belt to a belt disk on the crankshaft of the internal combustion engine.

[0004] The direct coupling between coolant pump and crankshaft here provides for a dependency of the rotational speed of the pump on the rotational speed of the internal combustion engine. This has the result that, in the high rotational-speed range of the internal combustion engine, a correspondingly large volume flow is made available by the pump, wherein this large volume flow is not needed to this extent for cooling. For cold starting of the internal combustion engine, in contrast, the problem occurs that the coolant already circulating through the cooling channels impairs the heating of the combustion chambers and thus delays when an optimal operating temperature is reached.

[0005] For preventing the problems noted above, modern internal combustion engines use controllable coolant pumps whose output volume flow can be adjusted to the respective demand.

[0006] From the prior art, coolant pumps are also known that are connected on the suction side to a valve arrangement. The valve arrangement allows the switching of different sub-circuits of a cooling system, for example, a cooling circuit and a bypass circuit, in order to reach an optimal coolant temperature in this way.

[0007] From DE 10 2008 007 766 A1, for example, a device emerges for cooling an internal combustion engine that comprises a coolant circuit having coolant sub-circuits, as well as an electromechanical assembly with a rotary disk valve for the separate switching of the coolant sub-circuits that are separated from each other. The device allows a completely variable regulation of the coolant temperature, in particular, the cooling-water temperature, as well as a heating and cooling of engine oil. The device further comprises a switchable coolant pump, in particular, cooling-water pump, for the regulation of a coolant volume flow. The coolant pump can be switched such that, during the warm-up period of the internal combustion engine, the coolant in the cooling circuit can be brought to a standstill. To this end, the switchable coolant pump cooperates with a pot arranged on the rotary disk valve. In the case of a cold start of the internal combustion engine,

the pot is located over a rotor disk of the coolant pump and provides for standing coolant or cooling water in the internal combustion engine and thus for a shorter warm-up period of the engine. If the rotary disk valve is rotated at the beginning by a certain rotational angle, then a compression piece moves in the axial direction on a trapezoidal thread. Then a spring pushes the pot away from the rotor disk of the pump, so that the pump is now in the position to feed coolant. If the compression piece moves farther away from the pot in the axial direction due to a continued rotational movement of the rotary disk valve, then the rotary disk valve can be rotated further, without this having effects on the pot.

SUMMARY

[0008] Starting with the prior art noted above, the invention is based on the objective of providing a device for regulating a coolant flow that has an especially compact structure. Simultaneously, the device should guarantee a precise regulation of a coolant flow and allow the setting of a zero-volume flow.

[0009] The objective is met by a device for regulating a coolant flow as well as a cooling system according to the invention. Advantageous refinements of the invention are disclosed below and in each of the claims.

[0010] The proposed device for regulating a coolant flow in a cooling system of an internal combustion engine comprises a valve arrangement with a rotary disk valve for switching between a cooling circuit and/or a bypass circuit, as well as a coolant pump that is constructed as an impeller pump and is connected on the suction side to the valve arrangement. According to the invention, the coolant pump has a guide plate that can be adjusted in the axial direction on the inside between two end stops for closing and releasing a pump outlet, wherein the guide plate for axial adjustment can be coupled indirectly by a lead screw thread with a drive shaft of the rotary disk valve.

[0011] Therefore, because the axial adjustable guide plate is an integral component of the coolant pump, the device according to the invention has an especially compact structure. As an integral component of the coolant pump, the guide plate is also protected from damage, so that the functionality of the guide plate and thus adjustability of the coolant pump is guaranteed to be as long-lasting as possible. The construction of end stops between which the guide plate is axially adjustable also specifies an exactly defined control range. When the guide plate contacts a first end stop, the coolant pump is advantageously completely closed, and is completely opened when the guide plate contacts the second end stop.

[0012] Although the guide plate is an integral component of the coolant pump, that is, it is arranged within the pump, the guide plate can be coupled with the drive shaft of the rotary disk valve arranged on the suction side. Thus, the drive of the rotary disk valve, advantageously an electric motor, can be used as a common drive. The coupling is here realized by a lead screw thread that converts the rotational movement of the drive shaft of the rotary disk valve into a translational movement for the axial adjustment of the guide plate. Advantageously, the coupling is constructed such that an activation of the rotary disk valve does not necessarily also cause an axial adjustment of the guide plate. That is, a coupling of the guide plate with the drive shaft of the rotary disk valve is given optionally only at some times. In order for the coupling of the coolant pump with the drive shaft of the rotary disk valve to

have an especially compact and simple structure, the drive shaft is advantageously arranged coaxial to the support shaft of the coolant pump.

[0013] According to a preferred embodiment of the invention, the guide plate has contours adapted to an impeller of the coolant pump with a collar constructed on the outer periphery side for closing and releasing the pump outlet. The adapted contours support the interaction of the impeller and guide plate. For example, the impeller could construct at least one end stop. Advantageously, both end stops specifying the control range of the coolant pump are constructed by the impeller. To this end, the impeller could comprise an axially spaced covering disk that forms a first end stop. The second end stop is then formed by the actual impeller. The axial distance between the impeller and the covering disk then gives the control range of the coolant pump. In order to guarantee the axial distance, the impeller and the covering disk can be connected to each other by at least one axial connecting piece. The axial connecting piece is guided by the guide plate, so that this experiences a guidance for an axial adjustment by the axial connecting piece. The collar constructed on the guide plate is advantageously oriented in the direction of the impeller, in order to counteract an eddy formation especially for the case of partial feeding operation of the coolant pump.

[0014] According to another preferred embodiment of the invention, the guide plate has a pin-shaped projection with which the guide plate is guided in the axial direction in a hole of a support shaft of the coolant pump. Alternatively or additionally the axial guidance could be provided for guiding by an axial connecting piece of the impeller. To this end, the hole in the support shaft of the coolant pump could be constructed as a blind hole. Means for the rotationally locked support of the guide plate relative to the support shaft or the impeller connected locked in rotation to the support shaft could further be provided on the pin-shaped projection of the guide plate and/or within the hole of the support shaft. A rotational locking could also be implemented by the at least one axial connecting piece.

[0015] The lead screw thread provided for coupling the guide plate with the drive shaft of the rotary disk valve comprises a trapezoidal thread and a threaded sleeve that is in engagement with the trapezoidal thread and is secured against rotation. Advantageously, the threaded sleeve has, as the anti-rotation mechanism, at least one flattened section on the outer peripheral side for support on a hole wall of a receptacle hole. The threaded sleeve could also be constructed as a hexagon and could be inserted into a hole with a corresponding cross section. The support of the threaded sleeve must be constructed, however, so that it remains displaceable in the axial direction. This is because the axial adjustability of the threaded sleeve is a prerequisite such that the rotational movement of the drive shaft of the rotary disk valve is converted by the lead screw thread into a translational movement. Through the use of the threaded sleeve, the guide plate can be loaded at least indirectly with a compressive force and/or tensile force active in the axial direction. That is, the axial adjustment of the guide plate can be created by the threaded sleeve, in that the guide plate is pressed against an end stop or is pulled in the direction of an end stop. If the coupling between the guide plate and the lead screw thread is constructed such that only a compressive force can be transferred, then the restoring of the guide plate must be realized in a different way. For example, the restoring can be created by at least one restoring spring.

[0016] Advantageously, the pitch of the lead screw thread is adjusted to the control path of the rotary disk valve such that, when the rotary disk valve is closed, the coolant pump is also closed and/or when the rotary disk valve is opened, the coolant pump is also opened. The trapezoidal thread could be constructed, for example, on a pump-side end of the drive shaft of the rotary disk valve that is supported so that it can rotate in a housing part of the valve arrangement. To this end, the housing part has a support hole. A hole with increased diameter for the holding and rotationally locked support of the threaded sleeve could connect to the support hole. In addition to the support hole and/or the holding hole, the housing part also has at least one flow opening for the coolant.

[0017] Advantageously, the axial adjustable guide plate is biased in the axial direction by the spring force of at least one compression spring against an end stop. Consequently, for the axial adjustment of the guide plate by the threaded sleeve, initially the spring force of the compression spring must be overcome. For restoring the guide plate, the spring force of the compression spring can be used, in turn. The compression spring can be held—if provided—in the hole of the support shaft of the coolant pump and can be supported, on one side, on the support shaft, on the other hand, on the pin-shaped projection of the guide plate. The restoring of the guide plate by the spring force of a compression spring could also be used for the realization of a fail-safe function, as is already known from other controllable coolant pumps.

[0018] According to another preferred embodiment of the invention, the guide plate has a pot-shaped insert that is supported displaceable in the guide plate in the axial direction and is biased by the spring force of a compression spring in the axial direction. In contrast to the restoring spring already mentioned above, the other compression spring provided for biasing is used as a compensation spring (lost-motion spring). It allows an inconstant axial adjustment of the guide plate for a constant drive of the rotary disk valve. That is, after reaching an end stop, the movement of the threaded sleeve has no further influence on the axial position of the guide plate. For the continued movement of the threaded sleeve, only the pot-shaped insert is shifted relative to the guide plate. If the threaded sleeve moves back, the compensation spring holds the pot-shaped insert in contact with the threaded sleeve. Thus, the compensation spring can also be used simultaneously as a restoring spring.

[0019] For the holding and displaceable support of the pot-shaped insert, the pin-shaped projection of the guide plate could be constructed at least partially as a hollow cylinder. In order to guarantee a guidance of the pot-shaped insert, a guidance element can be further provided. This can comprise at least one tab that is constructed on the outer periphery side on the pot-shaped insert and is in engagement with a guide groove constructed in the guide plate or in the pot-shaped projection of the guide plate. Advantageously, the guide groove has a Z-shaped construction. This is because, on one hand, due to the Z-shape, stops that are active in the axial direction are formed that prevent the spring-loaded, pot-shaped insert from falling out from the guide plate. On the other hand, the Z-shape of the guide groove simplifies the installation of the pot-shaped insert. The orientation of the Z-shape here depends on the rotational direction of the pump.

[0020] The spring stiffness of the compression spring provided for biasing of the pot-shaped insert is selected in a further preferable way higher than the spring stiffness of the compression spring provided for biasing the guide plate. In

this way it is guaranteed that an axial movement of the threaded sleeve is compensated only by an axial displacement of the pot-shaped insert when the guide plate contacts an end stop, that is, the coolant pump is completely closed or opened.

[0021] The compression spring provided for biasing the pot-shaped insert and the compression spring provided for biasing the guide plate are preferably arranged coaxial within the hole in the support shaft of the coolant pump. This allows, on one hand, a compact arrangement of the springs, on the other hand, a uniform distribution of the spring forces on the guide plate or the pot-shaped insert.

[0022] The cooling system further provided for meeting the objective noted above for an internal combustion engine comprises a device according to the invention for regulating a coolant flow, as well as at least one cooling circuit with a cooler and/or a bypass circuit for bypassing the cooler. The cooling circuit and/or the bypass circuit is or are switchable by the rotary disk valve of the valve arrangement. By switching on or off a cooling circuit and/or a bypass circuit, the coolant temperature can be varied and an optimal coolant temperature can be set.

[0023] According to one preferred refinement of the cooling system according to the invention, at least one other load, for example, an engine-oil cooler, and/or a thermocouple, for example, a heater, is connected to the cooling system. A distribution of the coolant flows according to demand can then be created by the rotary disk valve.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] Preferred embodiments of the invention are explained in detail below with reference to the enclosed drawings. Shown are:

[0025] FIG. 1 is a schematic diagram of a cooling system according to the invention,

[0026] FIG. 2 is a section view through a device according to the invention,

[0027] FIGS. 3-6 are each a portion taken from FIG. 2 in the coupling range of the coolant pump with the drive shaft of the rotary disk valve, wherein each of the guide plates assumes a different axial position,

[0028] FIG. 7 is a detailed portion taken from FIG. 2 in the coupling range of the coolant pump with the drive shaft of the rotary disk valve,

[0029] FIG. 8 is a perspective view of the detail portion of FIG. 7,

[0030] FIG. 9 is a diagram for illustrating the control range of the coolant pump as a function of the rotational movement of the drive shaft, and

[0031] FIG. 10 is a view of another embodiment of a device according to the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0032] FIG. 1 shows an exemplary embodiment of a cooling system according to the invention which comprises a device 1 for regulating a coolant flow, wherein this device can be used, among other things, for cooling an internal combustion engine 2. An engine-oil cooler 26 as an additional load and also a heater 27 are further connected to the cooling circuit. In addition, other optional components 33 could be connected to the cooling system. To allow a distribution of the coolant flows according to demand, the cooling system further has different cooling circuits 5, 6 and also a bypass circuit

7 for bypassing a cooler 25 in the cooling circuit 5. Thus, through the bypass circuit, a non-cooled coolant flow is provided that allows the setting of an optimal coolant temperature. To this end, coolant from the bypass circuit 7 is mixed with coolant from the cooling circuit 5. The mixing is realized by a valve arrangement 3 that is a component of the device 1 according to the invention for regulating the coolant flow. As an additional component, the device 1 has a coolant pump 8 that is connected on the suction side with the valve arrangement 3. The coolant pump 8 can be regulated to be able to reduce the volume flow of the coolant to zero, for example, in the case of a cold start of the internal combustion engine 2. That is, no coolant is fed to the internal combustion engine 2. In this way, the internal combustion engine 2 reaches its optimal operating temperature more quickly.

[0033] For switching the cooling circuits 5, 6 and the bypass circuit 7, the valve arrangement 3 comprises a rotary disk valve 4. The rotational movement of the rotary disk valve 4 required for switching is carried out by a drive shaft 14 of an electric motor 28.

[0034] As is to be taken from FIG. 2, which shows a section through a device 1 according to the invention, the end of the drive shaft 14 facing toward the coolant pump 8 is supported in a rotatable manner in a support hole 34 of a housing part 30 and provided with a trapezoidal thread 20 that interacts with a threaded sleeve 21. Because the threaded sleeve 21 is supported locked in rotation but displaceable in the axial direction in a hole 35 connecting to the support hole 34, the rotational movement of the drive shaft 14 of the rotary disk valve 4 is converted into a translational movement of the threaded sleeve 21 by the lead screw thread 13 comprising the trapezoidal thread 20 and the threaded sleeve 21. If the threaded sleeve 21 moves in the direction of the coolant pump 8, then it or a pot 29 set on the threaded sleeve 21 comes into contact with an axial adjustable guide plate 11 of the coolant pump 8 or a pot-shaped insert 23 of the guide plate 11 after spanning a gap area. In contact with the guide plate 11 or the pot-shaped insert 23, the threaded sleeve 21 may transfer at least indirectly by the pot-shaped insert 23 a compressive force onto the guide plate 11 or the pot-shaped insert 23, which initially causes an axial adjustment of the guide plate 11 and then an axial displacement relative to the guide plate 11 (see the sequence of FIGS. 2 to 6). The adjustment area of the guide plate 11 is limited by two end stops 9, 10 that are constructed by an impeller 15. The guide plate 11 is biased in the axial direction against the first end stop 9 by the spring force of a compression spring 22. In order to cause an axial adjustment of the guide plate 11 by the threaded sleeve 21, first the spring force of the compression spring 22 must be overcome. The compression spring 22 is used for restoring the guide plate 11 against the end stop 9, when the threaded sleeve 21 moves back in the direction of the electric motor 28 and no longer exerts a compressive force on the guide plate 11.

[0035] The pot-shaped insert 23 is also loaded by the spring force of a compression spring 24. The compression spring 24 is held in a pin-shaped projection 17 of the guide plate 11 with which the guide plate 11 is guided in a hole 18 of the support shaft 19 of the coolant pump 8.

[0036] The pot-shaped insert 23 is also guided in the axial direction. To this end, the pot-shaped insert 23 has, on the outer peripheral side, several tabs 32, each of which engage in a guide groove 31 in the pin-shaped projection 17 of the guide plate 11 (see FIG. 7). The guide grooves 31 have a Z-shaped

construction (see FIG. 8), to simplify the insertion of the pot-shaped insert 23 into the pin-shaped projection 17, as well as to prevent the pot-shaped insert 23 from falling out. This is because the Z-shaped guide groove 31 simultaneously forms a stop for the spring-loaded, pot-shaped insert 23.

[0037] The compression spring 24 whose spring force holds the pot-shaped insert 23 in contact with the stop is used in the present case as a compensation spring. To this end, the spring stiffness of the compression spring 24 is selected greater than that of the compression spring 22 whose spring force biases the guide plate 11 in the axial direction against the end stop 9. Consequently, when the rotary disk valve 4 is activated by the drive shaft 14, initially an axial adjustment of the guide plate 11 is caused when the threaded sleeve 21 or its pot 29 comes into contact with the pot-shaped insert 23 of the guide plate 11. If the guide plate 11 reaches the end stop 10, then the continued movement of the threaded sleeve 21 causes an axial displacement of the pot-shaped insert 23 relative to the guide plate 11, that is, the movement of the threaded sleeve 21 is compensated by the movement of the pot-shaped insert 23 against the spring force of the compression spring 24. A correspondingly non-steady axial adjustment of the guide plate 11 for a constant drive by the drive shaft 14 is shown schematically in the diagram of FIG. 9. Here, on the x-axis, the constant drive is plotted and on the y-axis, the non-constant movement of the guide plate 11 is plotted. During a first phase I of the activation of the drive shaft 14, the threaded sleeve 21 or its pot 29 does not yet contact the guide plate 11 or the pot-shaped insert 23 of the guide plate 11 (state corresponding to FIG. 2 and FIG. 3). Consequently, no axial adjustment of the guide plate 11 is caused. First, the gap between the threaded sleeve 21 and the guide plate 11 must be spanned. During a second phase II, the threaded sleeve 21 or the pot 29 contacts the guide plate 11 or the pot-shaped insert 23 (state corresponding to FIG. 4 and FIG. 5). The guide plate 11 is moved by the threaded sleeve 21 against the spring force of the compression spring 22 in the direction of the end stop 10. When the end stop 10 is reached, the second phase II ends. Subsequently, the phase III starts in which the pot-shaped insert 23 compensates the further movement of the threaded sleeve 21 or the drive shaft 14. The guide plate 11 further contacts the end stop 10 of the impeller 15. The restoring of the guide plate 11 is realized by the spring force of the compression spring 22 when the threaded sleeve 21 moves back in the direction of the electric motor 28. The control range of the coolant pump 8 is consequently traveled only in phase II. In phases I and III, the guide plate 11 contacts either the end stop 9 or 10, that is, the coolant pump 8 is completely closed or completely opened.

[0038] For opening and closing the coolant pump 8, the guide plate 11 has a collar 16 on the outer peripheral side, by which a pump outlet 12 of the coolant pump 8 can be opened or closed (see FIGS. 3 to 6). The pump outlet 12 is formed by at least one peripheral-side opening of the impeller 15 and is advantageously connected to a ring channel (not shown) surrounding the impeller 15.

[0039] An alternative embodiment of a device 1 according to the invention for regulating a coolant flow shall be explained in detail with reference to FIG. 10. In the case of this embodiment, the compression spring 22 for restoring the guide plate 11 is unnecessary. This is because the pot 29 of the threaded sleeve 21 can transfer both compressive forces and also tensile forces to the guide plate 11 or the pot-shaped insert 23 of the guide plate 11 that is, in the present case, not

displaceable in the axial direction relative to the guide plate 11. In this respect, an activation of the drive shaft 14 of the rotary disk valve 4 always also leads to an axial adjustment of the guide plate 11. The pitch of the trapezoidal thread 20 is adapted accordingly with the regulating paths of the rotary disk valve 4 such that, for a completely closed rotary disk valve 4, the coolant pump 8 is also completely closed and vice versa.

[0040] A forced guidance of the guide plate 11 corresponding to the embodiment of FIG. 10 can further be eliminated when it is guaranteed that, in the operation of the coolant pump 8, the hydraulic forces cause the restoring of the guide plate 11 in the direction of the suction port. According to an alternative embodiment that corresponds incidentally to that of FIG. 10, it is therefore provided that the pot 29 of the threaded sleeve 21 transfers merely compressive forces onto the guide plate 11 or onto the pot-shaped insert 23 of the guide plate 11.

LIST OF REFERENCE SYMBOLS

[0041]	1 Device
[0042]	2 Internal combustion engine
[0043]	3 Valve arrangement
[0044]	4 Rotary disk valve
[0045]	5 Cooling circuit
[0046]	6 Cooling circuit
[0047]	7 Bypass circuit
[0048]	8 Coolant pump
[0049]	9 End stop
[0050]	10 End stop
[0051]	11 Guide plate
[0052]	12 Pump outlet
[0053]	13 Lead screw thread
[0054]	14 Drive shaft
[0055]	15 Impeller
[0056]	16 Collar
[0057]	17 Pin-like projection
[0058]	18 Hole
[0059]	19 Support shaft
[0060]	20 Trapezoidal thread
[0061]	21 Crankshaft
[0062]	22 Compression spring
[0063]	23 Pot-shaped insert
[0064]	24 Compression spring
[0065]	25 Cooler
[0066]	26 Engine oil cooler
[0067]	27 Heater
[0068]	28 Electric motor
[0069]	29 Pot
[0070]	30 Housing part
[0071]	31 Guide groove
[0072]	32 Tab
[0073]	33 Component
[0074]	34 Support hole
[0075]	35 Hole

1. A device for regulating a coolant flow in a cooling system of an internal combustion engine comprising a valve arrangement that comprises a rotary disk valve for switching at least one of a cooling circuit or a bypass circuit, a coolant pump that is constructed as an impeller pump and is connected on a suction side to the valve arrangement, the coolant pump has an internal guide plate that can be adjusted in an axial direction between two end stops for closing and releasing a pump

output, and the guide plate is indirectly coupleable by a lead screw thread with a drive shaft of the rotary disk valve.

2. The device according to claim 1, wherein the guide plate has contours adapted to an impeller of the coolant pump with a collar constructed on an outer circumferential side for closing and releasing the pump outlet.

3. The device according to claim 1, wherein the guide plate has a pin-shaped projection with which the guide plate is guided in an axial direction in a hole of a support shaft of the coolant pump.

4. The device according to claim 1, wherein the lead screw thread comprises a trapezoidal thread and a threaded sleeve that is in engagement with the trapezoidal thread and is secured against rotation and by which the guide plate can be loaded at least indirectly with a compression force and/or tensile force active in the axial direction.

5. The device according to claim 4, wherein the axial adjustable guide plate is biased in the axial direction by a spring force of at least one compression spring against one of the end stops.

6. The device according to claim 1, wherein the guide plate has a pot-shaped insert that is supported displaceable in the

axial direction in the guide plate and is biased by the spring force of a compression spring in the axial direction.

7. The device according to claim 6, wherein a spring stiffness of the compression spring provided for biasing of the pot-shaped insert is selected higher than a spring stiffness of the compression spring provided for the biasing of the guide plate.

8. The device according to claim 6, wherein the compression spring provided for biasing of the pot-shaped insert and the compression spring provided for biasing of the guide plate are arranged coaxial within a hole of the support shaft of the coolant pump.

9. A cooling system for an internal combustion engine comprising a device according to claim 1, at least one cooling circuit with at least one of a cooler or a bypass circuit for the bypassing of the cooler, wherein the cooling circuit or the bypass circuit can be switched by the rotary disk valve of the valve arrangement.

10. The cooling system according to claim 9, wherein at least one other load is connected to the cooling system and a distribution of coolant flows tailored to demand can be generated by the rotary disk valve.

* * * * *