

(19) **DANMARK**

(10) **DK/EP 3374620 T3**



(12)

Oversættelse af europæisk patentskrift

Patent- og
Varemærkestyrelsen

-
- (51) Int.Cl.: **F 02 F 1/14 (2006.01)** **F 01 P 3/02 (2006.01)** **F 02 F 1/10 (2006.01)**
F 02 F 1/36 (2006.01)
- (45) Oversættelsen bekendtgjort den: **2022-07-25**
- (80) Dato for Den Europæiske Patentmyndigheds bekendtgørelse om meddelelse af patentet: **2022-05-04**
- (86) Europæisk ansøgning nr.: **16791311.0**
- (86) Europæisk indleveringsdag: **2016-11-03**
- (87) Den europæiske ansøgnings publiceringsdag: **2018-09-19**
- (86) International ansøgning nr.: **EP2016001827**
- (87) Internationalt publikationsnr.: **WO2017080636**
- (30) Prioritet: **2015-11-11 DE 102015014514**
- (84) Designerede stater: **AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**
- (73) Patenthaver: **DEUTZ Aktiengesellschaft, Ottostrasse 1, 51149 Köln, Tyskland**
- (72) Opfinder: **BOEMER, Andreas, Hauptstrasse 109, 51 143 Köln, Tyskland**
JUNG, Marco, Goerdelerstrasse 19, 51429 Bergisch-Gladbach, Tyskland
- (74) Fuldmægtig i Danmark: **RWS Group, Europa House, Chiltern Park, Chiltern Hill, Chalfont St Peter, Bucks SL9 9FG, Storbritannien**
- (54) Benævnelse: **FORBRÆNDINGSMOTOR**
- (56) Fremdragne publikationer:
EP-A1- 1 491 739
AT-A2- 508 178
DD-A1- 101 459
DE-A1-102010 052 830
DE-A1-102013 113 609
DE-B- 1 220 203
FR-A1- 2 225 628
US-A- 2 713 332
US-A- 4 665 867
US-A- 5 915 346
US-A1- 2006 011 151
US-A1- 2012 240 876

Description

The invention relates to an internal combustion engine according to the preamble of Claim 1.

5

An internal combustion engine of this kind is known for example from DE 10 2013 113609 A1.

Another internal combustion engine with a coolant circuit is
10 known from DE 196 28 762 A1. This shows a coolant circuit of an internal combustion engine having a cast cylinder block with a coolant water jacket, a cylinder head with coolant water ducts, a common flange face between the cylinder head and cylinder block, as well as with coolant water guides inside the cylinder
15 block which are configured as supply or return channels, of which at least one coolant water guide opens into the flange face, wherein a connection in the form of a slot which is cast into the cylinder block and originates from the flange face is provided between the coolant water jacket and at least one of
20 the coolant water guides.

With the coolant water jackets known up until now the water is directed in different ways from the pump to the passages which are to be cooled in the crankcase. Mostly there is only one
25 or a maximum of two inlets into the water jacket of the crankcase. The thermostat is generally attached to the end face of the cylinder head. Uneven distributions of the water to the individual cylinders thereby occur which can only be compensated by suitable reductions of the passages in the cylinder head seal.
30 These passage reductions lead to increased pressure losses, increased pumping performance and thus ultimately to increased fuel consumption. The water flowing through the sealed passages from the crankcase into the head can only leave the head on one side so that a vastly different water supply to
35 the individual regions in the head is unavoidable.

The object of the present invention is to avoid the aforementioned drawbacks and to provide an internal combustion

engine which guides the flows of coolant to the cooling points substantially without any loss.

5 The object of the present invention is achieved by an internal combustion engine having the features of Claim 1.

10 It is advantageous that the coolant circuit has a low-pressure loss and a uniform distribution of the coolant. This saves the pumping performance, produces a lower cylinder distortion and ensures an effective cooling action.

Further advantageous configurations are apparent from the dependent claims.

15 The invention will now be explained in further detail below with reference to an exemplary embodiment shown in the drawings in which:

Fig. 1 shows a standard single-circuit water circuit;

20 Fig. 2 shows a "common rail" water jacket, single circuit water circuit;

Fig. 3 shows a "common rail" water jacket, dual circuit water circuit;

25 Fig. 4 shows a "common rail water jacket, dual circuit water circuit with oil cooler in the inlet rail;

Fig. 5 shows the water guide in the crankcase with flow guide blades on the inlet side;

Fig. 6 shows the water guide in the crankcase with flow guide blades on the inlet and outlet side;

30 Fig. 7 shows the water guide between the valves

Fig. 8 shows the combustion base.

35 Fig. 1 shows by way of example a standard single circuit water circuit, with an internal combustion engine 1 which has a crankcase 2 and a cylinder head 3 fastened thereon. The coolant circuit of the internal combustion engine 1 has a coolant pump 4 after which an engine oil cooler (MOK) 5 is arranged downstream in the flow direction of the coolant. After the engine oil

cooler (MOK) 5 in the flow direction of the coolant the coolant flow branches into the exhaust gas return (AGR) cooler 6 and the crankcase 2. After the coolant has flowed through the crankcase 2 it reaches the cylinder head 3. After the coolant has flowed through the cylinder head 3 it joins with the partial flow of the coolant which flows out from the exhaust gas return (AGR) cooler 6. This combined coolant flow now reaches the thermostat 7 which directs the coolant flow in dependence on the operating position either directly to the coolant pump 4 or lets it take the detour via the cooler 8.

Fig. 2 shows by way of example a "common rail" water jacket single circuit water circuit.

Advantageously from the cooling point of view there is a water flow flowing substantially in the transverse direction in the crankcase 2 and in the cylinder head 3.

Before the inlet into the crankcase there is an inlet volume ("common rail") into which the water can flow from the pump without loss. The water flows are directed from this rail uniformly to the individual cylinders. Furthermore, water can be removed as required from this rail for other coolers, such as e.g., AGR coolers and engine oil coolers. The respective water volume flows can be adapted by the cross sections. The rail should in the optimum case be conical in order to enable uniform water speeds and loss-free water removal. After the water has flowed transversely through the cylinder passages in the crankcase it flows through the cylinder head seal on the other side upwards into the head. The head is then likewise flowed through transversely. On leaving the head region (in the ideal case on the side of the outlet channels in order to provide maximum cooling there) the water flows into a second volume, the outlet rail, which should likewise be conically shaped corresponding to the water quantities. From there the water flows in the normal way further on to the thermostat. This is shown diagrammatically in Fig. 2 for a single circuit water circuit.

The internal combustion engine 1 is shown which has a crankcase 2 and a cylinder head 3 fixed thereon. The coolant circuit of the internal combustion engine 1 has a coolant pump 4 after which an inlet rail 9 is arranged downstream in the flow direction of the coolant, wherein the coolant flow branches in the flow direction into an engine oil cooler (MOK) 5 and an exhaust gas return (AGR) cooler 6 which are arranged before or after the inlet rail 9, and into the crankcase 2. After the engine oil cooler (MOK) 5 and the exhaust gas return (AGR) cooler 6 in the flow direction of the coolant the coolant flow joins with the coolant partial flow which emerges from the outlet rail 10. The coolant of the partial flow stemming from the inlet rail 9 flows through the crankcase 2 and after it has flowed through the crankcase 2 it reaches the cylinder head 3. After the coolant has flowed through the cylinder head 3 it flows into the outlet rail 10. This coolant flow which stems from the outlet rail 10, MOK 5 and AGR6 and becomes combined now reaches the thermostat 7 which in dependence on the operating position directs the coolant flow directly to the coolant pump 4 or lets it take the detour via the cooler 8.

When using a dual circuit water circuit according to Fig. 3 ("split cooling") two separate outlet rails are used so that the cooling of the crankcase can be switched off for a faster heating up of the engine with a regulated valve. This type of pattern is shown in Fig. 3.

Fig. 3 shows a "common rail" water jacket - dual circuit water circuit with "split cooling" (Figs. 3+ 4).

Advantageously from the cooling point of view a substantially transversely flowing water flow is provided in the crankcase 2 and in the cylinder head 3 and there is the ability to switch off the crankcase cooling for a faster heating up of the engine.

Fig 3 shows by way of example the internal combustion engine 1 which has a crankcase 2 and a cylinder head 3 fixed thereto.

The coolant circuit of the internal combustion engine 1 has a coolant pump 4 after which an inlet rail 9 is arranged downstream in the flow direction of the coolant wherein the coolant flow branches in the flow direction into an engine oil cooler (MOK) 5 and an exhaust gas return (AGR) cooler 6, which are arranged after the inlet rail 9, and into the crankcase 2 and the cylinder head 3. After the engine oil cooler (MOK) 5 and the exhaust gas return (AGR) cooler 6 downstream in the flow direction of the coolant, the coolant flow joins with the coolant partial flow which emerges from the outlet rail 10 of the cylinder head and the outlet rail 11 of the crankcase. The partial flow of the coolant emerging from the outlet rail 11 of the crankcase flows through a regulated flap valve 12 which communicates with the engine control (not shown). The regulated valve 12 is in a position to control in terms of quantity the coolant flow emerging from the outlet rail 11 of the crankcase, or at least to switch it on or off. The through-flow region of the regulated valve lies between the marginal conditions "full through-flow" and "completely closed". The coolant of the partial flow stemming from the inlet rail 9 flows on one side through the crankcase 2 and the cylinder head 3. After the coolant has flowed through the crankcase 2 it reaches the outlet rail 11. After the other partial flow of the inlet rail coolant has flowed through the cylinder head 3 it flows into the outlet rail 10 of the cylinder head. This coolant flow stemming from the outlet rail 10, outlet rail 11, MOK 5 and AGR 6 and then being combined now reaches the thermostat 7 which in dependence on the operating position directs the coolant flow either directly to the coolant pump 4 or lets it take the detour via the cooler 8.

In both cases, a particularly effective uniform transverse flow cooling of the crankcase 2 and cylinder head 3 is possible without pressure losses through the "common rail" water jacket. These details had to be interpreted by means of CFD calculations.

Fig. 4 shows a "common rail" water jacket with dual circuit water circuit and oil cooler 13 in the inlet rail 9.

Advantageous from the cooling perspective a substantially transversely flowing water flow is provided in the crankcase 2 and in the cylinder head 3.

5 Fig. 4 shows by way of example the internal combustion engine 1 which has a crankcase 2 and a cylinder head 3 fixed thereon. The cooling circuit of the internal combustion engine 1 has a coolant pump 4 after which an inlet rail 9 is arranged downstream in the flow direction of the coolant, wherein the coolant flow
10 is branched in the flow direction into an engine oil cool (MOK) 5 and an exhaust gas return (AGR) cooler 6 which are arranged after the inlet rail 9, and into the crankcase 2 and the cylinder head 3. After the engine cooler (MOK) 5 and the exhaust gas return (AGR) cooler 6 downstream in the flow direction of the
15 coolant the coolant flow is joined with the coolant partial flow which emerges from the outlet rail 10 of the cylinder head and the outlet rail 11 of the crankcase. The partial flow of coolant emerging from the outlet rail 11 of the crankcase flows through a regulated valve 12 which communicates with the engine control
20 (not shown). The regulated valve 12 is in the position to control in terms of quantity the coolant flow emerging from the outlet rail 11 of the crankcase. The throughflow region of the regulated valve lies between the marginal conditions "complete throughflow" and "completely closed". The coolant of the
25 partial flow emerging from the inlet rail 9 flows on one side through the crankcase 2 and the cylinder head 3. After the coolant has flowed through the crankcase 2 it reaches the outlet rail 11. After the other partial flow of the inlet rail coolant has flowed through the cylinder head 3 it flows into the outlet
30 rail 10 of the cylinder head. The combined coolant flow emerging from the outlet rail 10, outlet rail 11, MOK 5 and AGR 6 now reaches the thermostat 7 which in dependence on the operating position either guides the coolant flow directly to the coolant pump 4 or lets it take the detour via the cooler 8.

35

Fig. 5 shows by way of example the water guide in the crankcase 2 of the six-cylinder internal combustion engine 1 with flow-guiding vanes 14 formed as claws on the inlet side. The flow-

guiding vanes should be regarded as a replacement or completion for the conical shape of the rail. In Fig. 6 they are not conical by way of example. The internal combustion engine 1 has claw-like flow-guiding vanes 14 in the water jacket guide. The
5 claw-like water jacket guide has an individual depth x (1-6) between the end tips of the flow-guiding vanes 14. It can be seen in Fig. 5 that the outlet rails 10 and/or inlet rails 9 which are of conical design here are a constituent part of the water jacket. The flow of the coolant liquid takes place within
10 the flow-guiding vanes upwards into the cylinder head 15. The depth x is interpreted by means of CFD.

Fig. 6 shows the water guide in the crankcase 2 of the six-cylinder (in this example) internal combustion engine 1 with
15 flow-guiding vanes 14 formed as claws on the inlet and outlet side. The internal combustion engine 1 has claw-like flow-guiding vanes 14 in the water jacket guide arranged both on the inlet and also on the outlet sides. The claw-like water jacket guide has an individual depth a (1-6), e (1-6) between the end
20 tips of the flow-guiding vanes 14. A targeted guide can thus be achieved without losses. It can be seen in Fig. 6 that the outlet rails 10, 11 and/or inlet rail 9 are a constituent part of the water jacket.

25 Fig. 7 shows the water guide between the valves in the cylinder head 3.

Fig. 7 shows the water guide between the outlet valves 15, the inlet valves 16 and the injector 17. The main cooling water
30 flow passes through between the hot outlet channels. The distances a , b , c , d between the valves are interpreted by means of computational fluid dynamics (CFD).

Fig. 8 shows the combustion base 19 along the sectional line A-A and B-B between the valves 15, 16 in the cylinder head 3. For
35 better cooling of the combustion base 19 the water jacket bulges downwards with individually designed lug-like flow-guiding vanes 18.

Reference numeral list

- 1 Internal combustion engine
- 2 Crankcase
- 5 3 Cylinder head
- 4 Coolant pump
- 5 Engine oil cooler (MOK)
- 6 Exhaust gas return (AGR)
- 7 Thermostat
- 10 8 Cooler
- 9 Inlet rail
- 10 Outlet rail
- 11 Outlet rail
- 12 Regulated valve
- 15 13 Oil cooler
- 14 Flow-guiding vanes
- 15 Outlet valve
- 16 Inlet valve
- 17 Injector
- 20 18 Flow-guiding vanes
- 19 Combustion base

Patentkrav

1. Forbrændingsmotor omfattende
et krumtaphus (2), som har en vandkappe og fører kølemiddel,
5 i det mindste en i strømningsretningen for kølemidlet foran
krumtaphuset placeret og med dette kommunikerende indgangs-rail
(6), som optager kølemiddel, eller i det mindste en indgangs-
rail (9), som optager et kølemiddel, og som er en bestanddel af
vandkappen, i det mindste et kølemiddel-førende cylinderhoved
10 (3) og i det mindste en i strømningsretningen for kølemidlet
efter cylinderhovedet (3) placeret og med cylinderhovedet (3)
kommunikerende kølemiddel-optagende udgangs-rail (10),
kendetegnet ved,
at indgangs-railen (9) er udformet således, at den kommunikerer
15 både med krumtaphuset (2) og med cylinderhovedet (3),
at indgangs-railen (9) er udført konisk, og
at vandkappen har en kloagtig vandkappeføring.
2. Forbrændingsmotor ifølge krav 1,
20 kendetegnet ved,
at udgangs-railen (10) er udført konisk.
3. Forbrændingsmotor ifølge krav 1 eller 2,
kendetegnet ved,
25 at den kloagtige vandkappeføring har strømningsledeskovle (14).
4. Forbrændingsmotor ifølge et af de foregående krav,
kendetegnet ved,
at den kloagtige vandkappeføring har en individuel dybde x_1 , a_1
30 og e_1 .
5. Forbrændingsmotor ifølge et af de foregående krav,
kendetegnet ved,
at der i indgangs-railen (9) er integreret i det mindste en EGR-
35 køler (6).
6. Forbrændingsmotor ifølge et af de foregående krav,
kendetegnet ved,

at kølevandshovedstrømningen strømmer mellem de varme udgangskanaler.

7. Forbrændingsmotor ifølge et af de foregående krav,
5 kendetegnet ved,
at der mellem indgangs- (16) og udgangs- (15) kanalerne hen imod forbrændingsbunden (19) er placeret strømningsledeskovle (18), som buler næseagtigt ud.

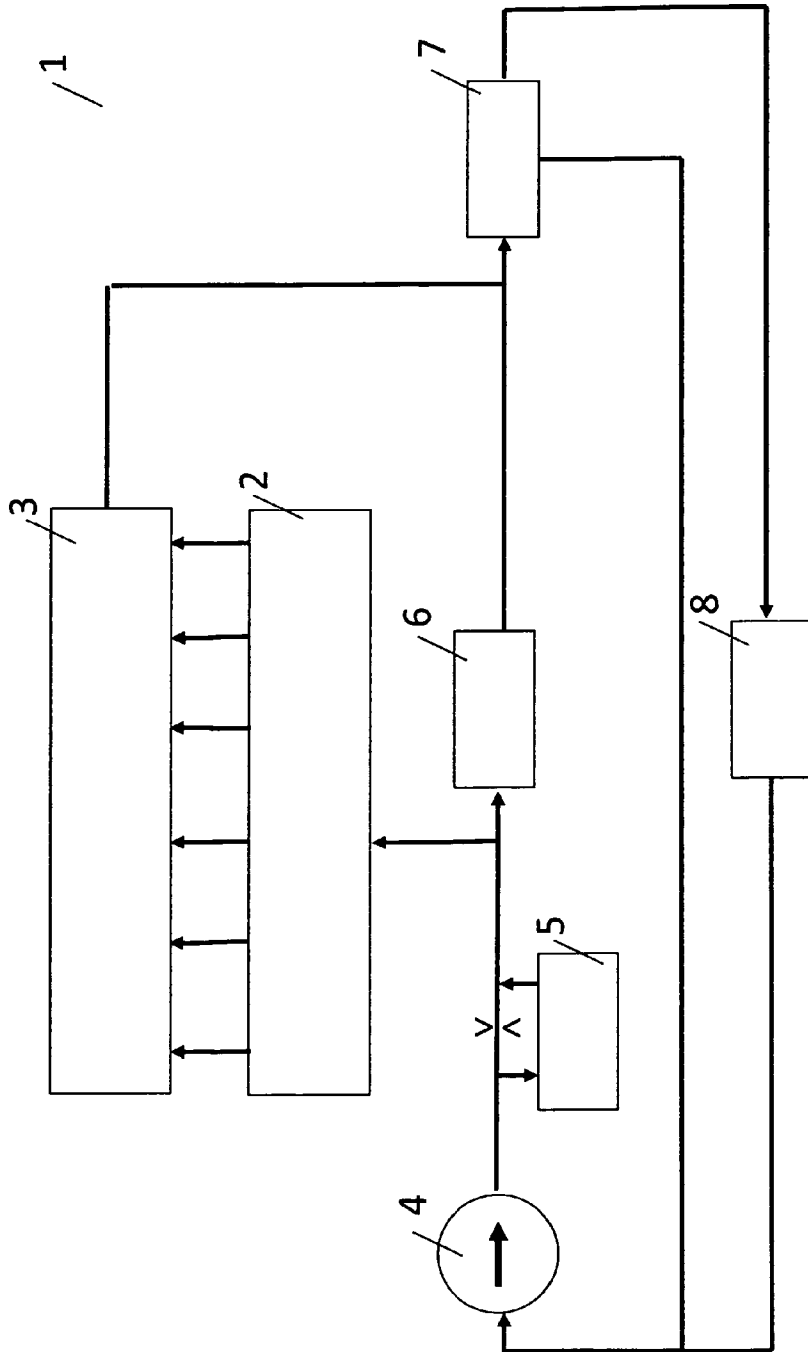
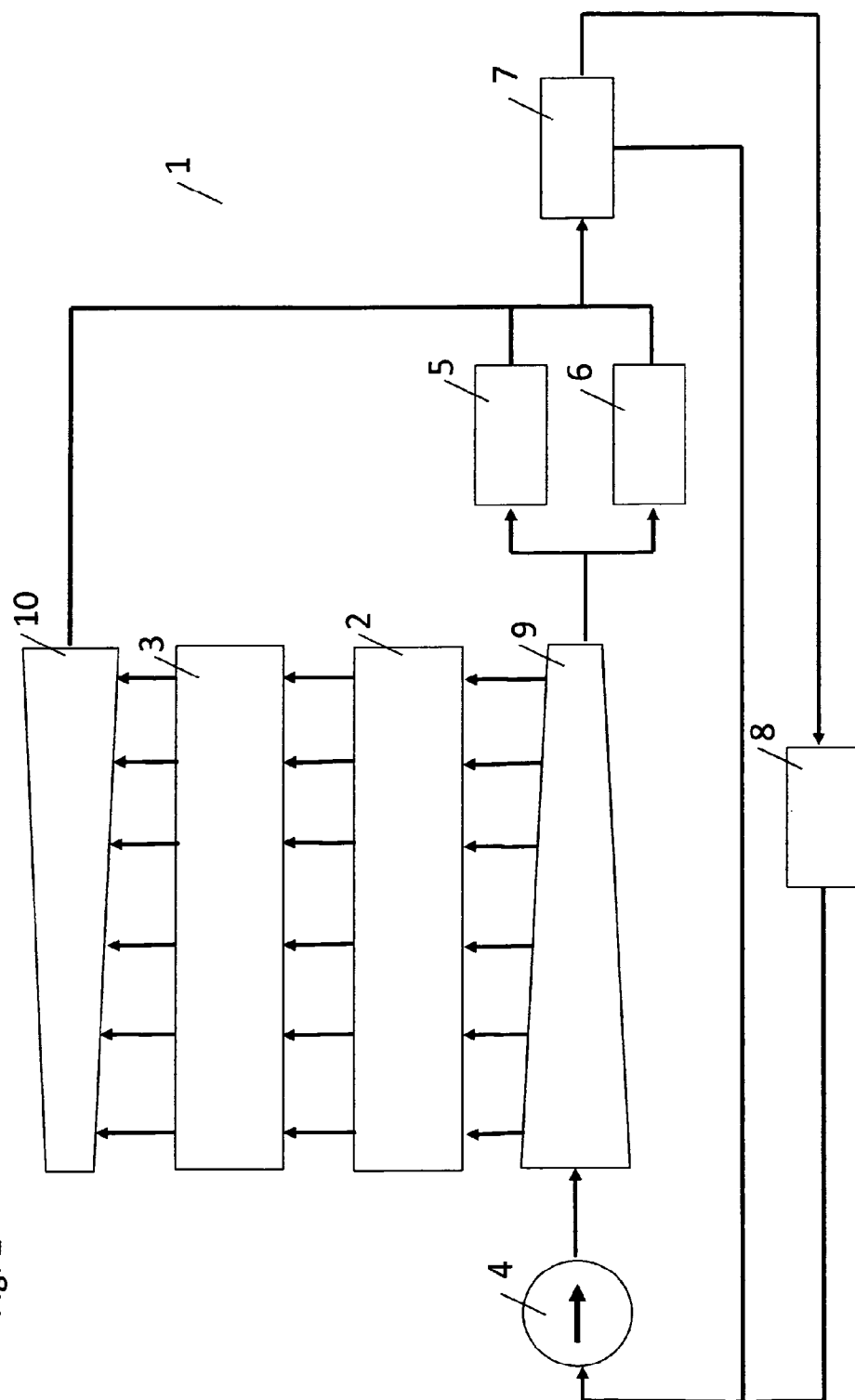
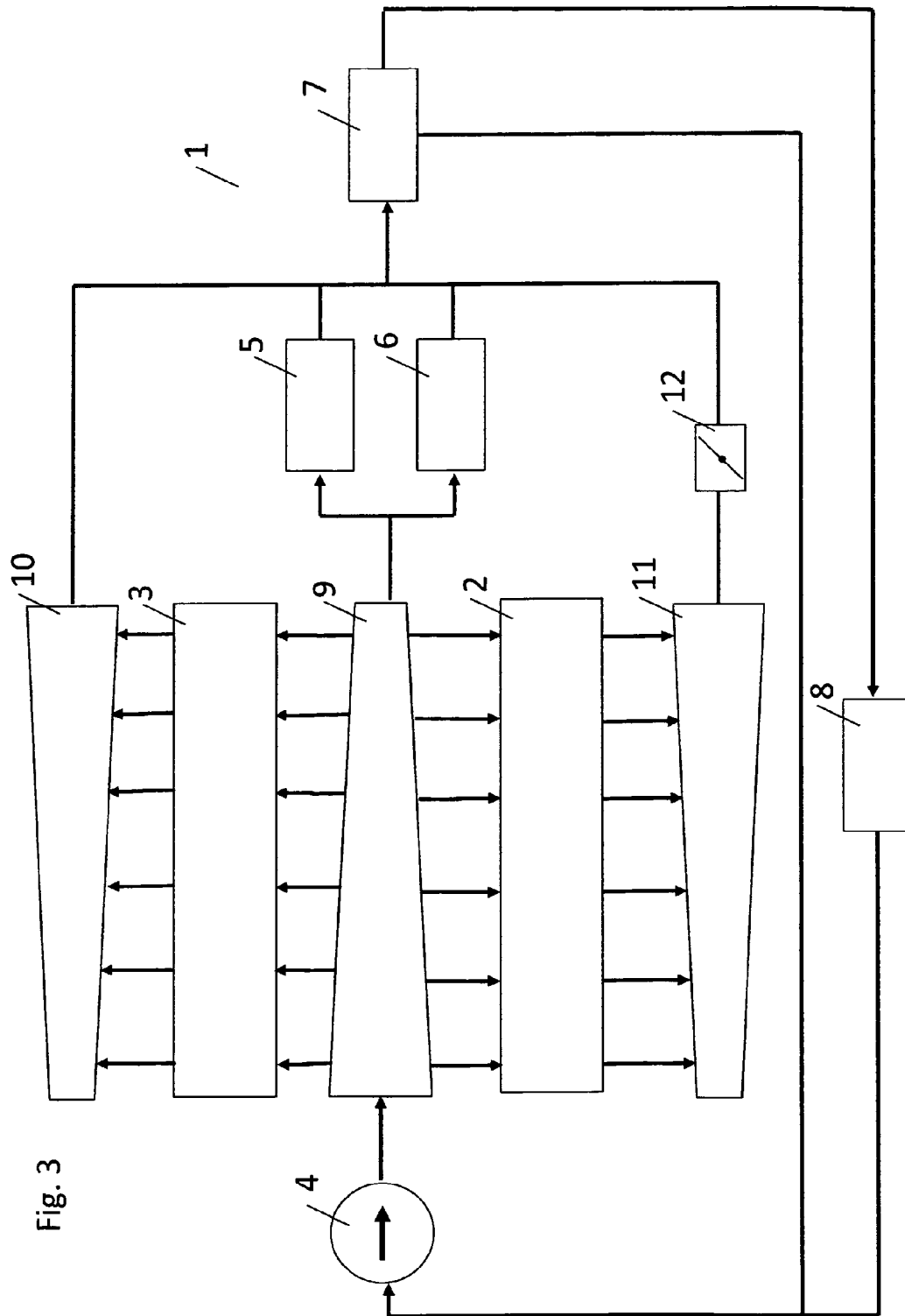
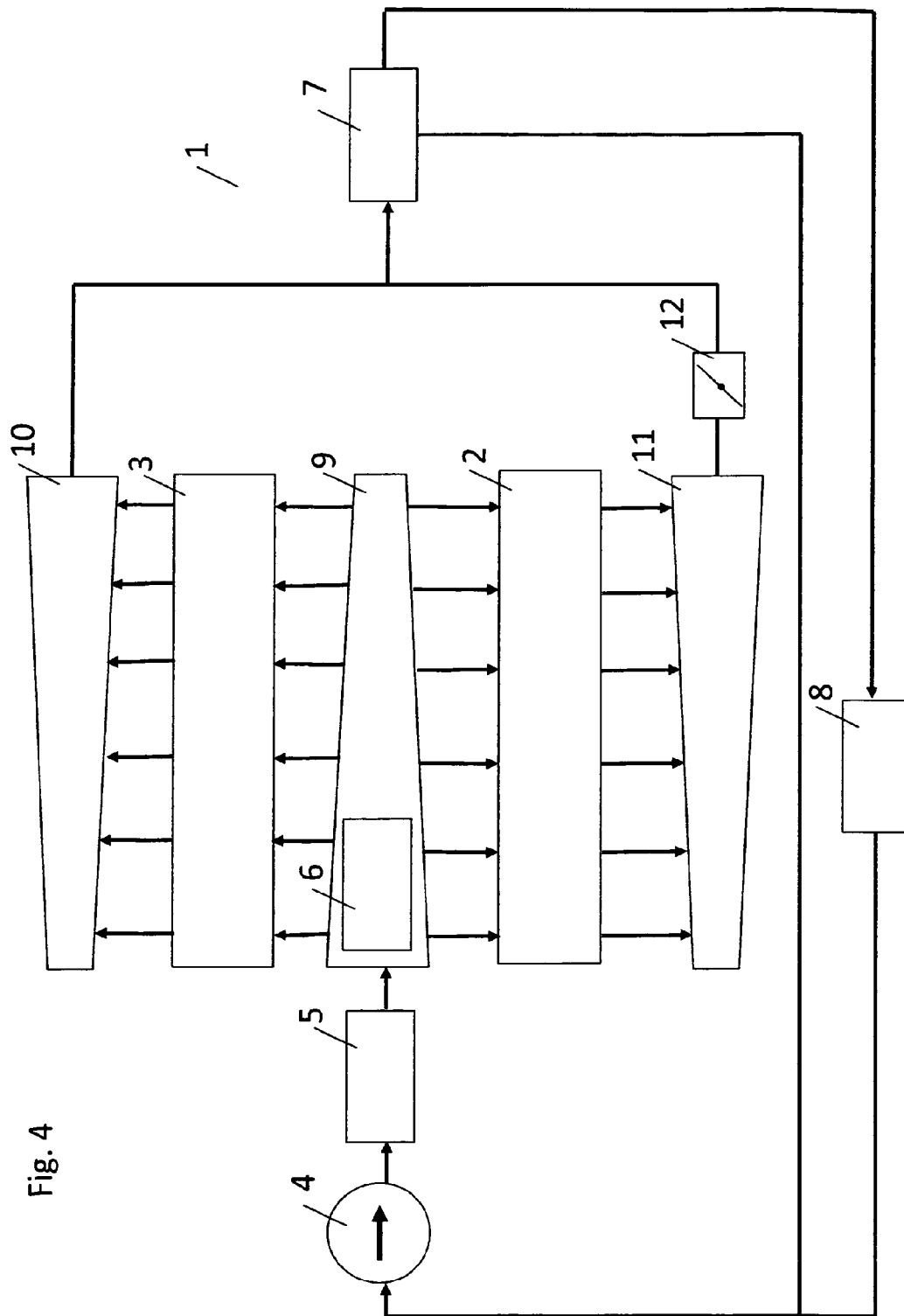


Fig. 1

Fig. 2







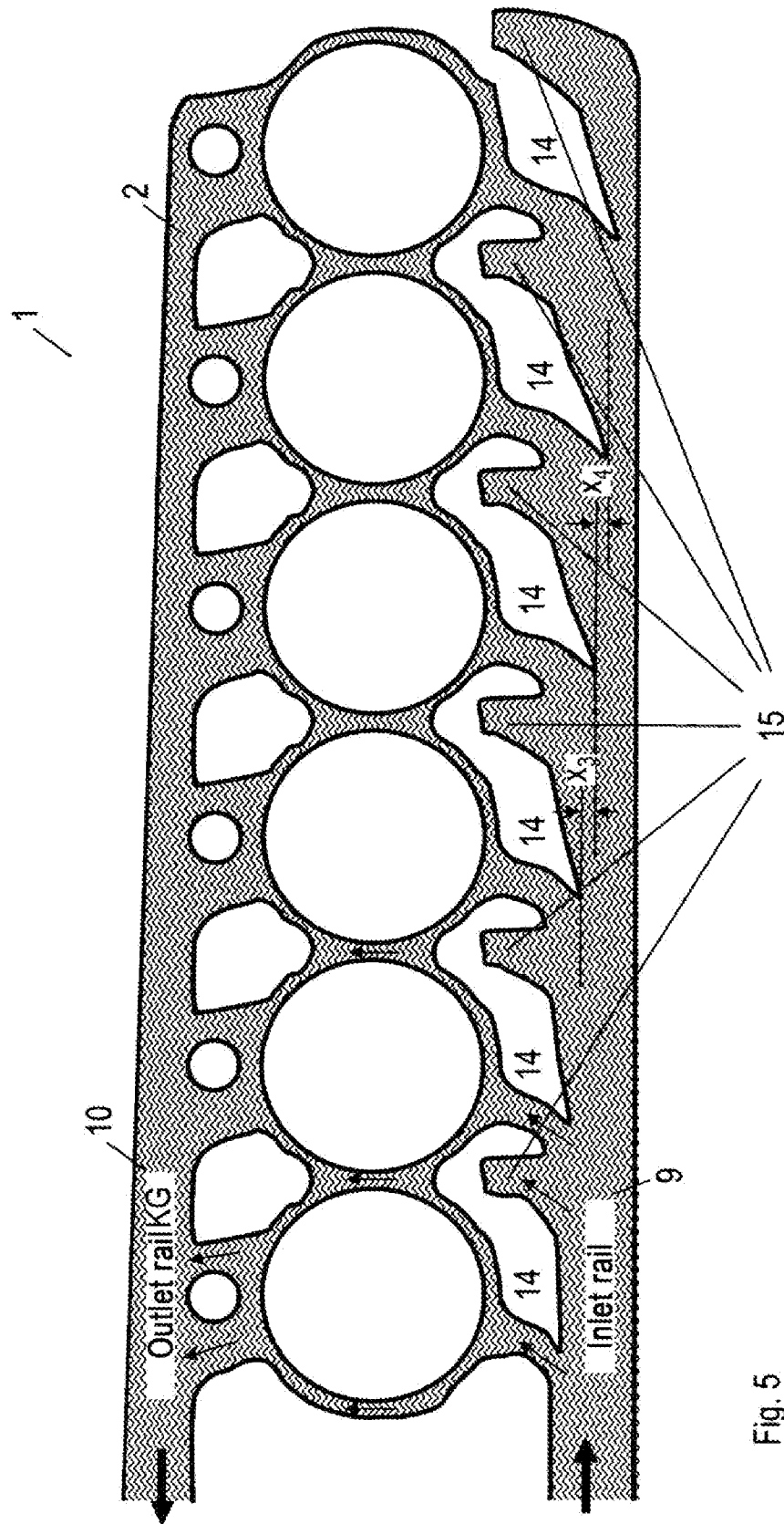
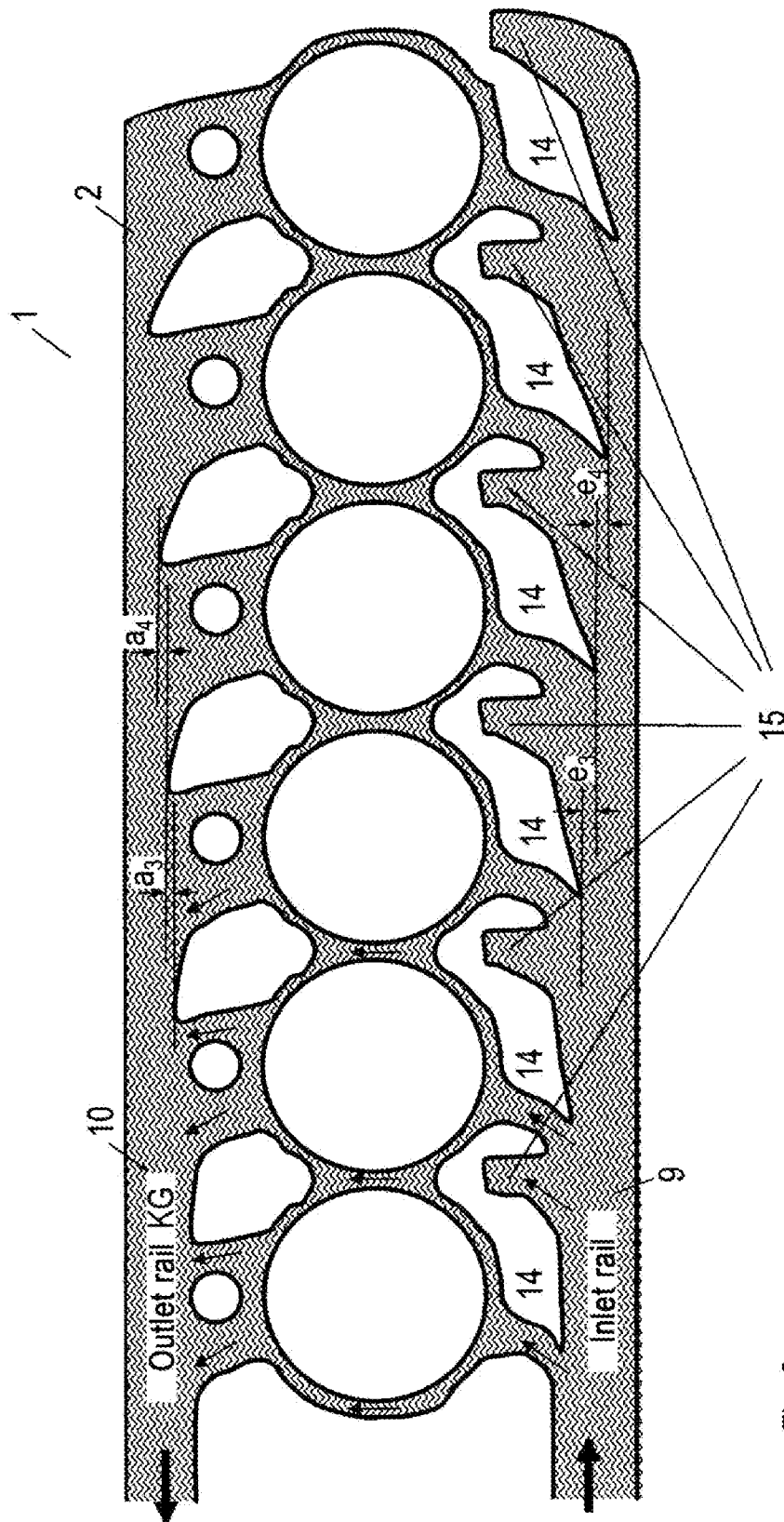


Fig. 5



69

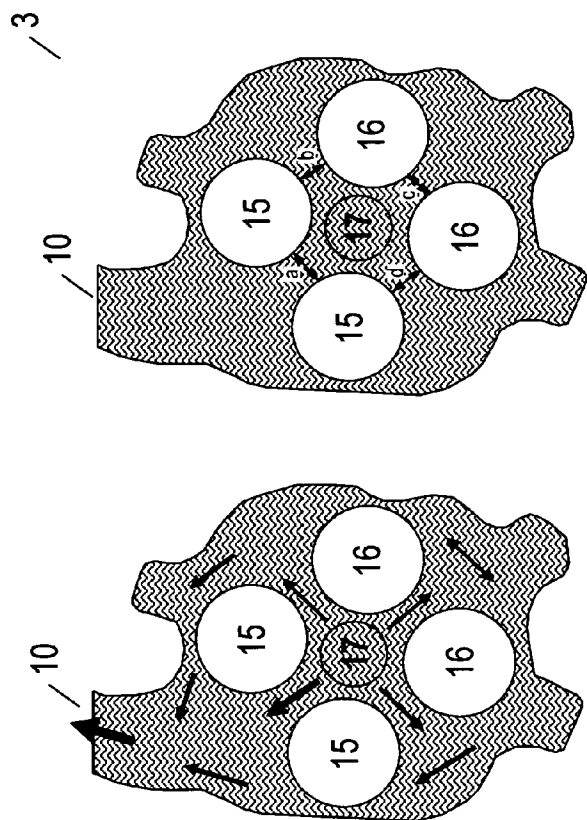


Fig. 7

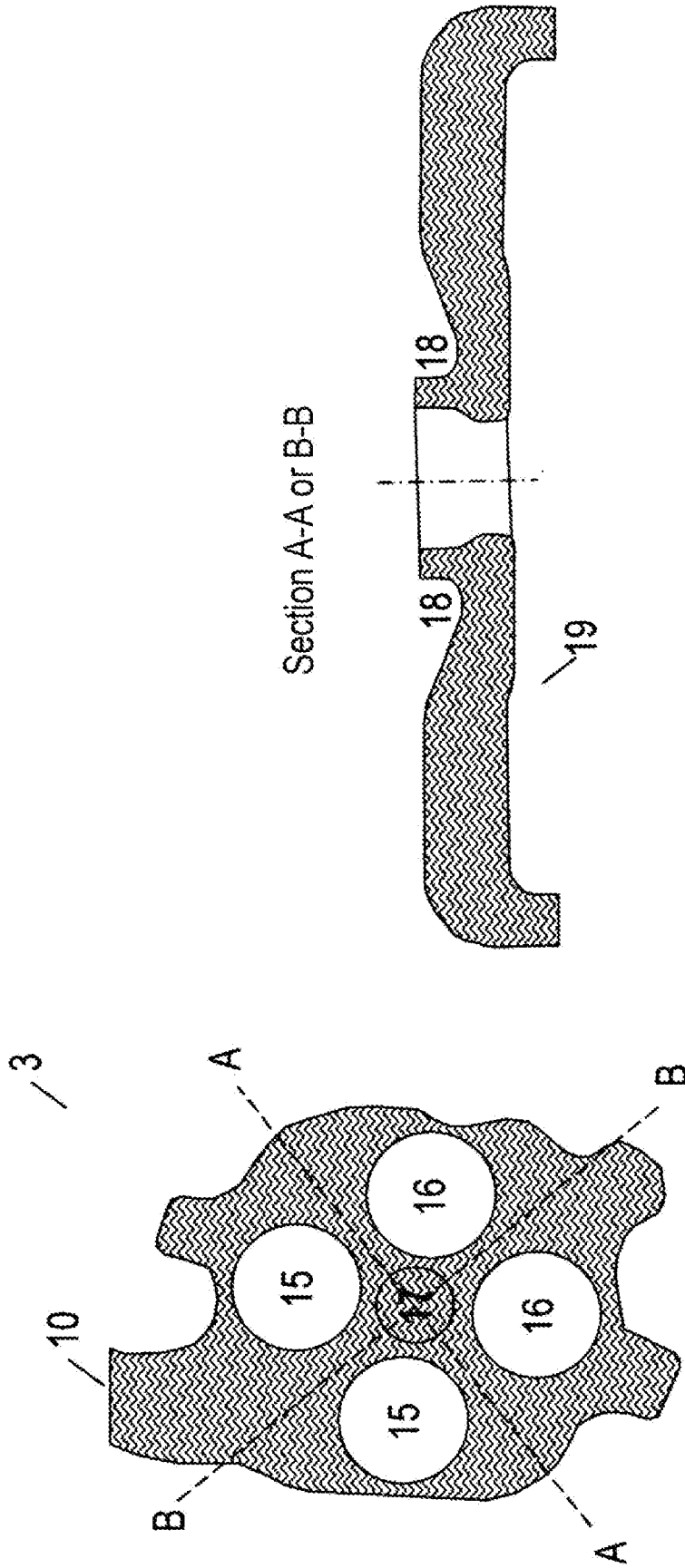


Fig. 8