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(54) **IMPROVED CLOSED-CYCLE STEAM ENGINE WITH DOUBLE CENTER OF ROTATION PISTON**

(57) A closed-loop steam engine (L) with a double-rotation centre piston comprising a stator (A) to a rotor (B) configured to expand and compress a fluid to generate mechanical work of use, the stator (A) and rotor (B) defining: an expansion chamber (Ve) configured to expand a pressurized fluid and having an inlet channel for receiving a pressurized fluid and an outlet channel for expelling the expanded fluid from the expansion chamber (Ve); a compression chamber (Vc) configured to compress a fluid and having an inlet channel for receiving a fluid to be compressed, and an outlet channel for expelling the compressed fluid from the compression chamber; a connection duct (77) configured to put in fluid communication the outlet duct of the expansion chamber (Ve) with the inlet duct of the compression chamber (Vc); a first one-way valve (V1) placed inside the connection duct (77) and configured to regulate the passage of fluid from the inlet channel of the compression chamber (Vc) to the outlet channel of the expansion chamber (Ve); a second one-way valve (V2) placed inside the inlet channel of the compression chamber (Vc) and placed upstream of the first one-way valve (V1), said second one-way valve (V2) being configured to regulate fluid inlet into the connection duct (77) and into the compression chamber (Vc) from the inlet channel of the compression chamber (Vc).

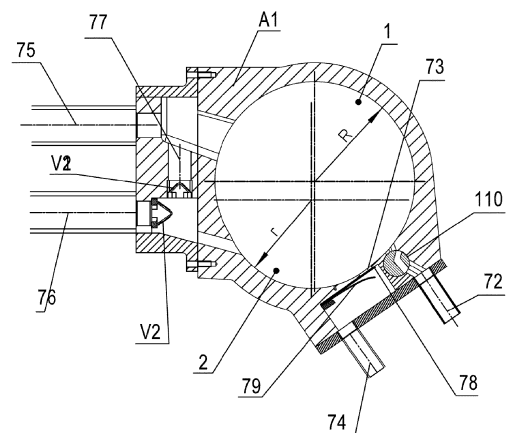


Fig. 2

Description

Technical field

[0001] The present invention relates to a steam engine with double-rotation centre piston configured to perform a thermodynamic loop, close to the Carnot cycle.

State of the art

[0002] A steam engine with a double-rotation centre piston which rotates in a substantially cylindrical double cavity, thus causing a closed thermodynamic loop for exploiting the temperature and pressure of the steam to obtain mechanical work of use, passing through the different temperatures and pressures in the various phases of the thermodynamic loop, is known from the state of the art. The steam engine comprises an expansion chamber and a compression chamber in fluid communication with a boiler which provides pressurized fluid to the inlet of the expansion chamber and receives compressed fluid from the compression chamber. The chambers are also in fluid communication with a condenser. Specifically, the condenser receives at its inlet the fluid expanded by the expansion chamber and, following condensation of the expanded fluid, supplies the condensed fluid to the inlet of the compression chamber. Such a steam engine is, for example described in Italian Patent No. 102016000123578. In this way, the steam engine is able to achieve a thermodynamic loop having the following phases:

- a) a heating of the fluid in a suitable exchanger/boiler at the upper temperature T_v ,
- b) a subsequent introduction into the expansion chamber ideally at boiler pressure, until the volume V_i or optimal mass for the loop is reached, by means of a valve that regulates the quantity thereof,
- c) an ideally adiabatic expansion of the fluid introduced into the expansion chamber until the final expansion volume V_f is reached,
- d) introduction of the expanded fluid into the condenser with reduction of the temperature to the lower level T_c ,
- e) the condensate outlet by gravity and/or pressure wave enters the compression chamber with volume V_c ,
- f) the condensate is compressed by the rotor and when the boiler pressure is exceeded, it is re-introduced into the heater through a one-way valve, which in the practical case is a reed valve, thus closing the loop.

Problems of the prior art

[0003] The machine known in achieving the thermodynamic loop in collaboration with other elements such as a boiler and condenser showed an impulsive type of op-

eration due to the alternation of expansion and compression phases. In other words, the thermodynamic loop achieved by the steam machine produces a continuous series of temperature and pressure transients.

[0004] The thermodynamic loop takes place in the phases in which the steam exhausted at the end of the expansion enters the condenser from which the condensate (two-phase water/steam) comes out, the condensate which is compressed by the machine in the boiler where it is heated again to the state of steam to be re-introduced, through a regulating valve, into the expansion chamber of the machine to start the loop again. This results in the creation of pressure waves in the "low pressure/temperature" area of the condenser shown in Figure 10. Such pressure waves are due to the reduction of the volume of fluid outlet from the expansion chamber V_e (with impulsive trend) which, by entering the condenser undergoes a volume reduction, causes a suction effect from the ducts 75 and 76e and from the motion of the rotor itself, which varies the distribution of the internal volumes, thus accentuating the phenomenon.

[0005] Figures 5 to 10 depict the steam engine of known art: unwanted pressure waves and/or pressure surges are depicted with a wavy arrow, while the desired flow is depicted with straight arrows. The generation of pressure waves is due to two main phenomena:

- (i) The first phenomenon which prevents a continuous flow of condensate out of the condenser towards the compression chamber of the machine is due to the 'puff' or pulse of steam outlet from the expansion chamber and entering the condenser. Specifically, the steam pulse that reached the condenser in contact with the cold surfaces undergoes a drastic decrease in volume. This causes a pressure drop, returning part of the fluid from the previous loop back into the condenser from the connection ducts between the expansion chamber and the compression chamber. This returning effect is accentuated by the fluid accumulated in the duct connecting the compression chamber where it has accumulated.
- ii) The second inconvenient phenomenon is due to the variation of the division of the internal volumes of the machine during the rotation. The rotor behaves as bellows by sucking in and out during the period of rotation. The total internal volume of the rotor chamber is kept constant at all times. During one phase of the rotation, the expansion volume increases, the remaining volume decreases by the same amount. With its decrease in volume, the fluid in the centre of the machine increases the pressure. The consequence is a puff or pulse of fluid from the machine towards the condenser along the connection duct between condenser and compression chamber in the opposite direction to the one desired for compressing the condensate in the boiler (Figures 5 and 6). In a second phase of the rotation, the same phenomenon occurs but in the opposite direction, where

with the decrease in suction volume, there is a suction effect in the central part of the rotor from the connection duct between the condenser inlet and the expansion chamber outlet.

[0006] The combination of these phenomena causes pressure pulses (or pressure waves) contrary to the desired flow. These pressure surges in the "cold zone" of the loop create a strong disturbance in the path of the condensate towards the compression chamber, which has to recompress it in the boiler. This creates a rejection of the condensate outlet from the condenser, which has difficulty entering the machine by gravity and consequently, the compression that brings it back to the boiler is penalised, creating an accumulation in the pipes and at the centre of the rotor. After a transition phase in which the accumulation of the condensed fluid increases more and more, this set of phenomena lead to the blocking of the machine rotation.

Purpose of the invention

[0007] The object of the present invention is to provide a steam engine with a double-rotation centre piston capable of overcoming the drawbacks of the above-mentioned known technique.

[0008] In particular, it is an object of the present invention to provide a closed-loop steam engine with a double-rotation centre piston capable of avoiding the effects of the pressure waves generated during the thermodynamic loop and at the same time improving the efficiency of the engine itself.

Advantages of the invention

[0009] Advantageously, the steam engine makes it possible to obtain the desired thermodynamic loop and optimize the flow of the condensed fluid.

[0010] Advantageously, the steam engine allows the improvement and practical implementation of a thermodynamic loop with fluid, water or other fluid, adapted to create a loop similar to the Carnot Loop, through the phase change between two temperatures T_v of the boiler or other heat source T_c and of the condenser in order to create mechanical energy.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Further features and advantages of the present invention will become more apparent from the indicative, and therefore non-limiting, description of a preferred but not exclusive embodiment of a closed-loop steam engine with a double-rotation centre piston, as illustrated in the accompanying drawings:

- Figure 1 shows a first perspective view of a steam engine in accordance with an embodiment of the present invention;

- Figure 2 shows a schematic sectional view of the steam engine in accordance with the embodiment in Figure 1;
- Figure 3 shows an exploded view of the steam engine in accordance with the embodiment in Figure 1;
- Figure 4 shows an exploded view of the rotor in accordance with the embodiment in Figure 1;
- Figure 5 shows a schematic sectional view of a steam engine in accordance with the state of the art, in a first angular position of the rotor;
- Figure 6 shows a schematic sectional view of a steam engine in accordance with the state of the art, in a second angular position of the rotor;
- Figure 7 shows a schematic sectional view of a steam engine in accordance with the state of the art, in a third angular position of the rotor;
- Figure 8 shows a schematic sectional view of a steam engine in accordance with the state of the art, in a fourth angular position of the rotor, and a relative enlargement of the circled area;
- Figure 9 shows a schematic sectional view of a steam engine in accordance with the state of the art, in a fifth angular position of the rotor;
- Figure 10 shows a schematic sectional view of a steam engine in accordance with the state of the art, in a sixth angular position of the rotor, and a relative enlargement of the circled area;
- Figure 11 shows a schematic sectional view of the steam engine in accordance with the embodiment in Figure 1, and a relative enlargement of the circled area;
- Figure 12 shows a further schematic sectional view of the steam engine in accordance with the embodiment in Figure 1.

DETAILED DESCRIPTION

[0012] Even if not explicitly highlighted, the individual features described in reference to the specific embodiments are to be understood as accessory and/or interchangeable with other features described in reference to other embodiments.

[0013] The present invention relates to a closed-loop steam engine L with a double-rotation centre piston, illustrated in Figures 1 to 4, 10 and 11, whose general features are disclosed in Italian Patent No. 102016000123578.

[0014] It should be noted that with respect to Patent No. 102016000123578, the solution illustrated in Figures 1 to 4, 10 and 11 has additional components, as more fully described below, that can solve the problems of the steam engine of Patent No. 102016000123578, which are illustrated in Figures 5 to 10 and the preceding paragraphs.

[0015] The steam engine L of the double-rotation centre piston type comprises a stator A and a rotor B and preferably a flywheel W configured to overcome dead points during the loop. Specifically, the motor L compris-

es a first and a second element A2, A3 defining the stator body A1. In other words, the first and second elements A2, A3 define the sides of the stator body A1 which in turn defines the stator A. With regard to the rotor B, this comprises a first semi-cylindrical element B1 on which the pressure of the fluid creating the rotation or driving torque acts, provided with a shaft for the power take-off, a second semi-cylindrical element B2 which acts as a compression element and a third element B3 configured to couple the first and second semi-cylindrical elements B1, B2. It should be noted that the stator A, rotor B and associated flywheel W have substantially the structural features of a steam engine with a double-rotation centre piston described in International Patent Applications WO 2004/020791 A1, WO 2010/031585 A1 and WO 2014/083204 A1.

[0016] The stator A and rotor B define an expansion chamber Ve and a compression chamber Vc. Specifically, defined in the stator body A1 is an expansion compartment 1, in which the expansion chamber Ve is formed, and a compression chamber 2, in which the compression chamber Vc is formed.

[0017] It should be noted that the expansion chamber Ve is configured to receive a pressurized fluid, such as steam, and expand it by putting the rotor B in rotation.

[0018] The expansion chamber Ve comprises an inlet opening 71 and an outlet opening. The inlet opening 71 is configured to receive the pressurized fluid, and the outlet opening is configured to expel the fluid expanded in the expansion chamber Ve from the expansion chamber Ve itself. Preferably, the expansion chamber Ve comprises an outlet duct connected to the corresponding outlet opening and is configured to expel fluid from the expansion chamber Ve by directing it towards a condenser D, as will be clarified below. The expansion chamber Ve comprises an inlet duct connected to the associated inlet opening 71 and configured to convey the pressurized fluid into the expansion chamber Ve, for example, from a boiler or heating element F.

[0019] In accordance with an embodiment illustrated in Figures 2, 11 and 12, the compression chamber Vc comprises an inlet opening and an outlet opening 73. The inlet opening is configured to receive a fluid to be compressed in the compression chamber Vc, while the outlet opening 73 expels the compressed fluid from the compression chamber Vc. Preferably, the compression chamber Vc comprises an inlet duct connected to the respective inlet opening and configured to convey a fluid to be compressed originating for example, from a condenser D. The expansion chamber Ve also comprises an outlet duct connected to the respective outlet opening 73 and configured to convey the compressed fluid from the compression chamber Vc to the boiler or heating element F.

[0020] Preferably, the compression chamber Vc comprises, at the outlet opening 79, an outlet valve 78 configured to regulate the outlet of the compressed fluid and direct it to the outlet duct towards the boiler or the heating

element F. Specifically, the outlet valve 78 provides a limiting end stop 79 depending on the pressure of the compression chamber Vc and the pressure downstream of the outlet valve 78. It should be noted that the outlet valve 78 is configured to allow the compressed fluid, which reached and/or exceeded the pressure downstream of the outlet valve 78 itself (for example, the pressure of the heating element or boiler F), to be expelled from the compression chamber Vc, for example, by introducing it into the heating element or boiler F. In addition, the outlet valve 78 prevents any introductions of fluid from the outlet duct towards the compression chamber Vc. Preferably, the outlet valve 78 comprises a carbon fibre reed valve. It should be noted that in accordance with the present invention, the outlet valve 78 is a one-way valve.

[0021] In accordance with a preferred embodiment, the steam engine L comprises a heating element or boiler F configured to produce the pressurized fluid and in fluid communication with the inlet channel of the expansion chamber Ve and the outlet channel of the compression chamber Vc. Specifically, the heating element F comprises at least one outlet configured to supply the steam engine L with pressurized fluid and an inlet configured to receive a fluid to be heated by the steam engine L. As illustrated in the embodiment in Figures 11 and 12, the engine further comprises a first inlet connection duct 72 configured to put the outlet of the heating element F in fluid communication with the inlet duct of the expansion chamber Ve and a second outlet connection duct 74 configured to put the inlet of the heating element F in fluid communication with the outlet duct of the compression chamber Vc. It should be noted that the heating element F may provide a further inlet for supplying the fluid to be heated in order to make up for any losses.

[0022] In accordance with a preferred embodiment, the first inlet connection duct 72 and the inlet duct of the expansion chamber Ve define an inlet duct 72 configured to put the outlet of the heating element F and the inlet opening 71 of the expansion chamber Ve in fluid communication.

[0023] In accordance with a preferred embodiment, the second outlet connection duct 74 and the outlet duct of the compression chamber Vc define an outlet duct 74 configured to put the outlet opening of the compression chamber Vc in fluid communication with the inlet of the heating element F.

[0024] In accordance with a preferred embodiment, the stator body A1 comprises a through hole 70 longitudinally formed in the stator body A1. The stator body A1 comprises an inlet valve 110 housed in the through hole 70, configured to regulate the passage of pressurized fluid, such as steam, through the inlet opening 71. Specifically, the inlet valve 110 is interposed between the inlet opening 71 and the inlet duct of the expansion chamber Ve to regulate the passage of the pressurized fluid from the heating element F to the expansion chamber Ve.

[0025] Preferably, the inlet valve 110 is, for example,

a rotary valve 110 made asynchronous by means of the gears R1, R2, R3, where the gear R1 is fixed on the engine shaft 80, the gear R3 is fixed on the rotary valve 110 and the gear R2 is fixed on the stator body and coupled to the gears R1, R3, as described in detail in the aforementioned patent applications.

[0026] In accordance with a preferred embodiment, the engine comprises a condenser D configured to at least partially condense the expanded fluid. The condenser is in fluid communication with the outlet channel of the expansion chamber Ve and the inlet channel of the compression chamber Vc. Specifically, the condenser D comprises an inlet configured to receive the fluid expelled from the expansion chamber Ve and an outlet configured to expel a condensed fluid, preferably also two-phase liquid-gas, and send it to the inlet duct of the compression chamber Vc. The condenser provides for the passage of a fluid at a temperature lower than the temperature of the inlet expanded fluid in order to condense the expanded fluid before sending it to the compression chamber.

[0027] As illustrated in the embodiment in Figure 11, the engine further comprises a first outlet connection duct 75 configured to put the outlet duct of the compression chamber in fluid communication with the inlet of the condenser D and a second inlet connection duct 76 configured to put the outlet of the condenser D in fluid communication with the inlet duct of the compression chamber Vc.

[0028] In accordance with a preferred embodiment, the first outlet connection duct 75 and the outlet duct of the expansion chamber Ve define an outlet duct 75 configured to put the outlet opening of the expansion chamber Ve in fluid communication with the inlet of the condenser D.

[0029] In accordance with a preferred embodiment, the second inlet connection duct 76 and the inlet duct of the compression chamber Vc define an inlet duct 76 configured to put the inlet opening of the compression chamber in fluid communication with the outlet of the condenser D.

[0030] Thus, in accordance with the described embodiment, the steam engine performs a closed thermodynamic loop:

- a) a heating of the fluid by means of the heating element or boiler F to the upper temperature Tv,
- b) a subsequent introduction into the expansion chamber Ve ideally at boiler pressure, until the optimal volume Vi or mass for the loop is reached by means of the valve 110 which regulates the quantity thereof,
- c) an ideally adiabatic expansion of the fluid introduced into the expansion chamber Ve until the final expansion volume Vf is reached,
- d) the introduction of the expanded fluid into the condenser D with reduction of the temperature to the lower level Tc by means of the heat exchange between the fluid at lower temperature passing through the condenser and the expanded fluid coming from

the expansion chamber Ve,

e) sending of the condensate outlet from the condenser by gravity and/or pressure wave to the compression chamber Vc,

f) compression of the condensate by the rotor B and when the boiler pressure is exceeded, through a one-way valve 79 with re-introduction into the heater, thus closing the loop.

[0031] In accordance with the preferred embodiment in Figure 11, the steam engine L, preferably the stator case A1, comprises a connection duct 77 configured to put the outlet duct of the expansion chamber Ve in fluid communication with the inlet duct Vc of the compression chamber Vc. Specifically, the connection duct 77 puts the outlet opening of the expansion chamber Ve and the inlet opening of the compression chamber Vc in fluid communication.

[0032] The steam engine L comprises a first one-way valve V1 placed in the connection duct 77 and configured to regulate the passage of fluid from the inlet channel of the compression chamber Vc to the outlet channel of the expansion chamber Ve. Specifically, the first one-way valve V1 allows the fluid to pass from the inlet duct of the compression chamber Vc to the outlet duct of the expansion chamber Ve. In addition, the first one-way valve V1 prevents fluid leaving the expansion chamber Ve from entering the connection duct 77.

[0033] Preferably, the first one-way valve V1 is configured to pass between a fluid-tight closed configuration and an open configuration to allow fluid to pass through the connection duct 77 from the inlet channel of the compression chamber Vc to the outlet channel of the expansion chamber Ve.

[0034] The steam engine comprises a second one-way valve V2 placed in the inlet channel of the compression chamber Vc and upstream of the first one-way valve V1. The second one-way valve V2 is configured to regulate the fluid inlet into the compression chamber Vc, for example, from the condenser. Further, the one-way valve V2 prevents fluid in the connection duct 76 from being sucked towards the condenser D. Specifically, the second one-way valve V2 allows fluid to enter the compression chamber Vc from the inlet duct of the compression chamber Vc as well as from the second inlet connection duct 76. In other words, the second one-way valve V2 allows the fluid coming from the condenser D to enter the compression chamber Vc while avoiding possible movements (suction, for example) of the fluid in the opposite direction. At the same time, the second one-way valve V2 prevents fluid in the inlet duct of the compression chamber and/or in the connection duct 76 from being sucked by the condenser D. It should be noted that the second one-way valve V2 is configured to divert any fluids exiting the compression chamber Vc towards the connection duct 77 and then into the outlet duct of the expansion chamber Ve.

[0035] Preferably, the second one-way valve V2 is con-

figured to pass between a fluid-tight closed configuration and an open configuration to allow passage of fluid from the inlet channel to the compression chamber Vc.

[0036] Advantageously, the insertion of the valves makes it possible to maintain the original thermodynamic loop, which is a highly efficient closed loop because it returns the condensate to the boiler at higher temperatures than those required for the loop of turbines with lower energy losses.

[0037] It should be noted that the first one-way valve V1 and the second one-way valve V2 avoid the occurrence of the first phenomenon i) related to the contraction of pressure in the condenser that returns the fluid in the inlet duct of the compression chamber Vc and/or in the duct 76 in the form of condensate, preferably two-phase, of the previous loop. In fact, the second one-way valve V2 prevents the condensate fluid in the inlet duct from migrating towards the condenser D as it sealingly blocks the condensate fluid itself from flowing in that direction. However, the one-way valve V2 lets the condensate flow in the correct direction of the loop, i.e. from the condenser towards the inlet opening of the compression chamber Vc. Preferably, the compression chamber Vc further comprises a routing channel downstream of the inlet opening of the compression chamber which is inclined so as to facilitate the inlet of the condensate fluid while avoiding excessive stagnation in the inlet channel or second inlet connection duct 76.

[0038] Further, the second one-way valve V2 cooperating with the first one-way valve V1 diverts the pressure wave or puff generated during the reduction of the compression volume and the increase of the expansion volume as the rotor closes as bellows. Said pressure wave or puff is diverted and finds outlet in the connecting channel 77 and then in the outlet channel of the expansion chamber Ve. In fact, the first one-way valve V1 is configured to open in the direction of the outlet duct of the expansion chamber Ve, thus venting the pressure wave or puff. It should be noted that the combination of the first one-way valve V1 and the second one-way valve V2 allows the return effect in the connection duct 76 to be overcome, thus also overcoming the second phenomenon ii).

[0039] Advantageously, the insertion of the one-way valves V1, V2 made it possible to transform the pressure wave problem into an advantage for the smoothness of the loop. In fact, the pressure wave or puff generated by the compression chamber Vc allows the circulation of the fluid to be forced in the correct direction of the loop. In particular, the first one-way valve V1 in Figures 3 and 13 placed in the connection duct 77 between the outlet of the expansion chamber Ve and the inlet of the compression chamber Vc favours the overpressure at or near the inlet of the compression chamber Vc to find a vent towards the connection duct 75 so as to favour the correct flow of the fluid in the loop through the condenser.

[0040] In accordance with a preferred embodiment, the first one-way valve V1 and the second one-way valve V2

comprise reed valves, for example of a motorcycle type. According to alternative embodiments, the first one-way valve V1 and the second one-way valve V2 are of different type and known to the expert technician.

Claims

1. Closed-loop steam engine (L) with double-rotation centre piston comprising

- a stator (A) and a rotor (B) configured to expand and compress a fluid to generate mechanical work of use, the stator (A) and the rotor (B) defining:

- an expansion chamber (Ve) configured to expand a pressurized fluid and having an inlet channel for receiving a pressurized fluid and an outlet channel for expelling the expanded fluid from the expansion chamber (Ve),

- a compression chamber (Vc) configured to compress a fluid and having an inlet channel to receive a fluid to be compressed, and an outlet channel to eject the compressed fluid from the compression chamber;

characterised by comprising

- a connection duct (77) configured to put in fluid communication the outlet duct of the expansion chamber (Ve) with the inlet duct of the compression chamber (Vc);

- a first one-way valve (V1) placed inside the connection duct (77) and configured to regulate the passage of fluid from the inlet channel of the compression chamber (Vc) to the outlet channel of the expansion chamber (Ve);

- a second one-way valve (V2) placed inside the inlet channel of the compression chamber (Vc) and placed upstream of the first one-way valve (V1), said second one-way valve (V2) being configured to regulate the inlet into the compression chamber (Vc) from the inlet channel of the compression chamber (Vc) and to deviate towards the connection duct (77) fluids and/or pressure waves exiting from the compression chamber (Vc).

2. Steam engine (L) according to claim 1, wherein:

- the first one-way valve (V1) is configured to pass from a fluid-tight closed configuration to an open configuration to allow the passage of fluid by the connection duct (77) from the inlet channel of the compression chamber to the outlet channel of the expansion chamber (Ve);

- the second one-way valve (V2) is configured to pass from a fluid-tight closed configuration to an open configuration to allow the passage of fluid from the inlet channel to the compression chamber (Vc) 5
- 3. Steam engine (L) according to claim 1 or 2, wherein the first one-way valve (V1) and the second one-way valve (V2) comprise reed valves. 10
- 4. Steam engine (L) according to any one of claims 1 to 3, wherein the engine comprises a heating element (F) configured to produce by heating the compressed fluid to be sent to the expansion chamber (Ve) and receive a fluid to be heated, the heating element (F) having an outlet in fluid communication with the inlet channel of the expansion chamber (Ve) to send the compressed fluid and an inlet in fluid communication with the outlet channel of the compression chamber (Vc) to receive the compressed fluid. 15 20
- 5. Steam engine (L) according to claim 4, wherein the engine comprises 25
 - a first inlet connection duct (72) configured to put in fluid communication the inlet duct of the expansion chamber (Ve) with the outlet of the heating element (F);
 - a second outlet connection duct (74) configured to put in fluid communication the outlet duct of the compression chamber (Vc) with the inlet of the heating element (F). 30
- 6. Closed-loop steam engine (L) according to any one of claims 1 to 5, wherein the engine comprises a condenser (D) configured to condense at least partially the expanded fluid and send it to the compression chamber (Vc), the condenser (D) having an inlet in fluid communication with the outlet channel of the expansion chamber (Ve) to receive the expanded fluid and an outlet in fluid communication with the inlet channel of the compression chamber (Vc) to send the condensed fluid to the compression chamber (Vc). 35 40 45
- 7. Steam engine (L) according to claim 6, wherein the engine comprises
 - a first outlet connection duct (75) configured to put in fluid communication the outlet duct of the expansion chamber (Ve) with the inlet of the condenser (D); 50
 - a second inlet connection duct (76) configured to put in fluid communication the inlet duct of the compression chamber (Vc) with the outlet of the condenser (D). 55

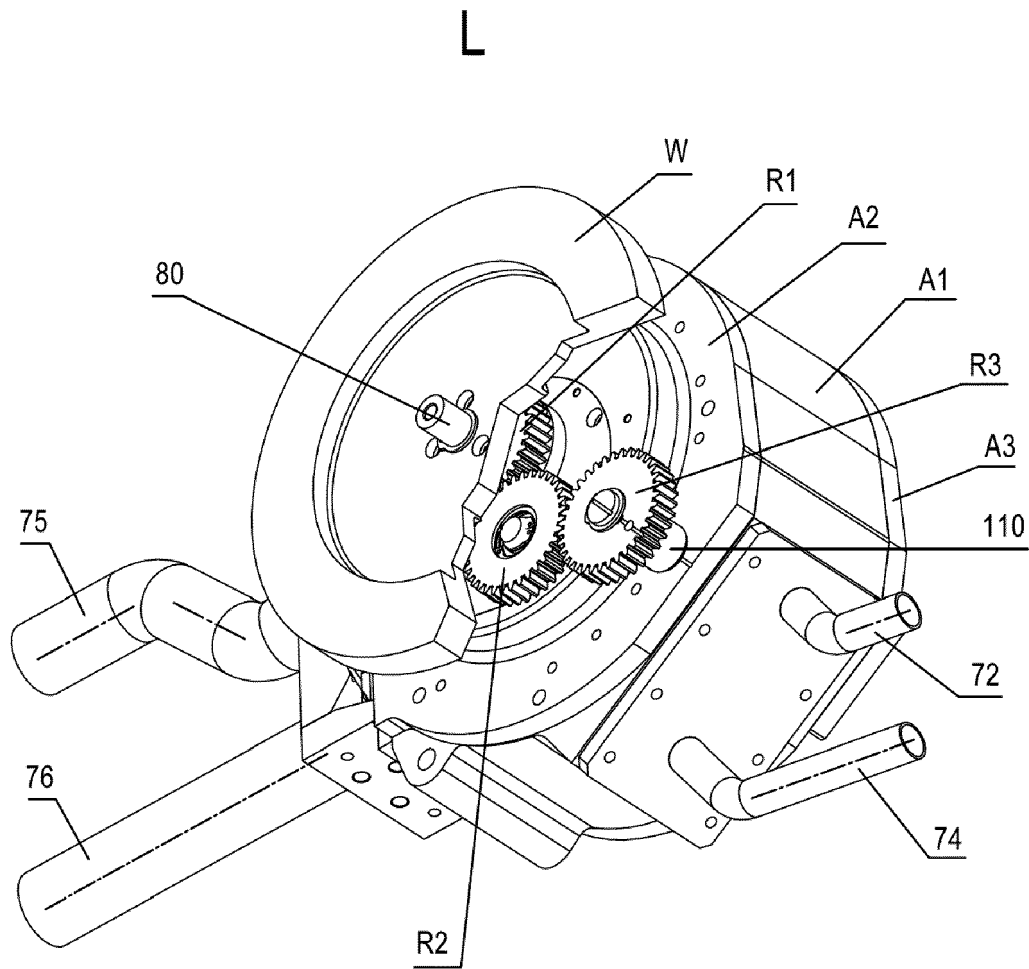


Fig. 1

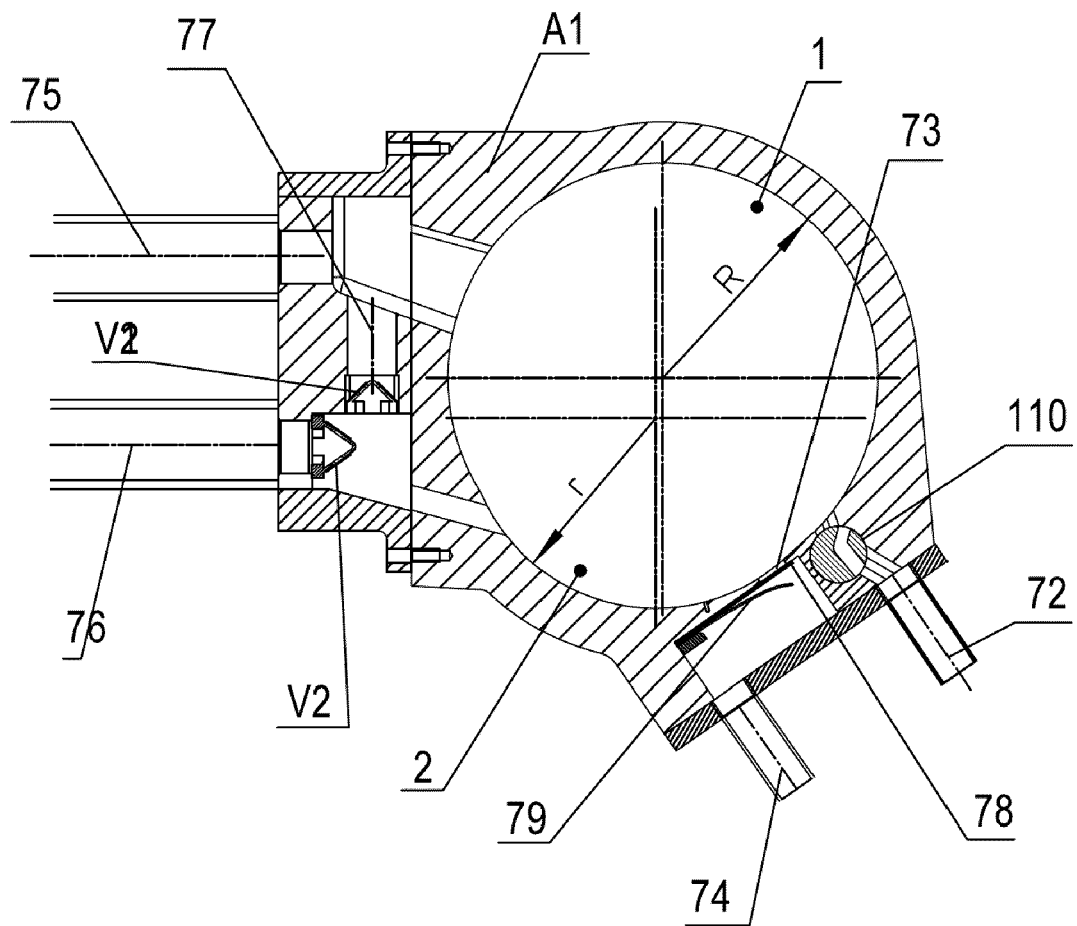


Fig. 2

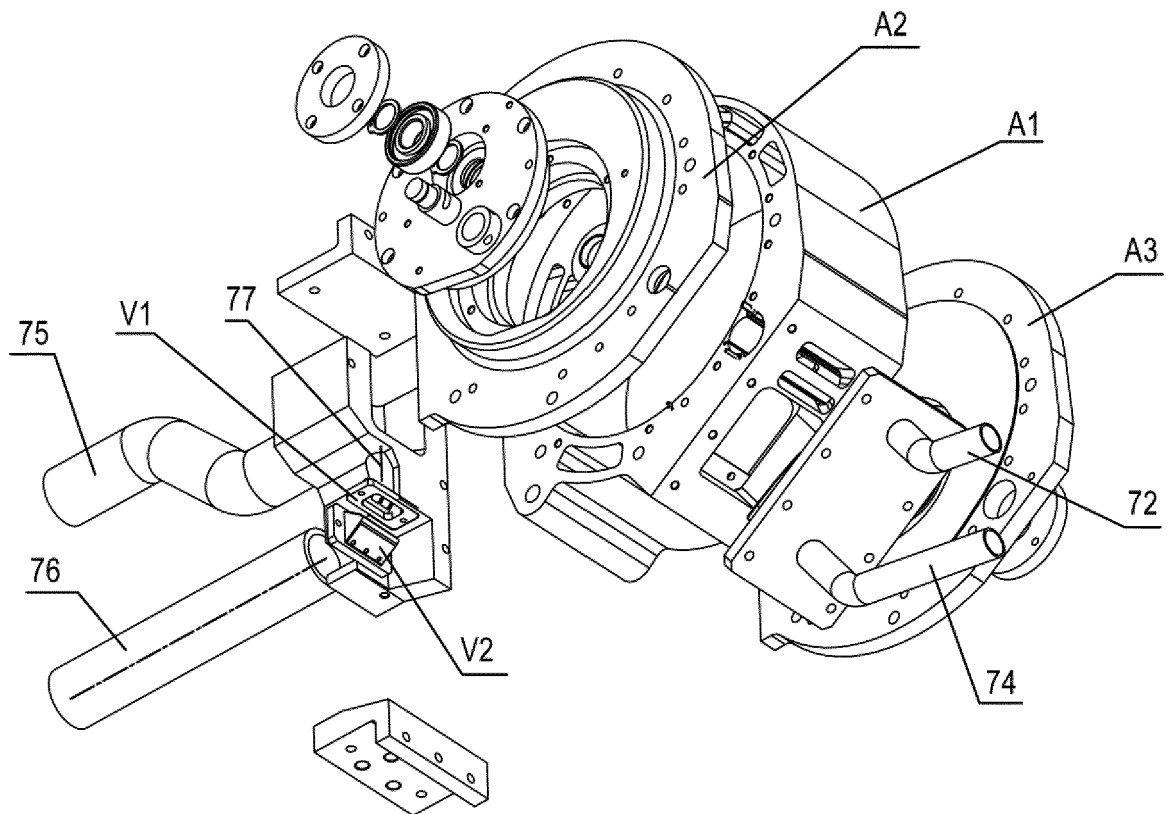


Fig. 3

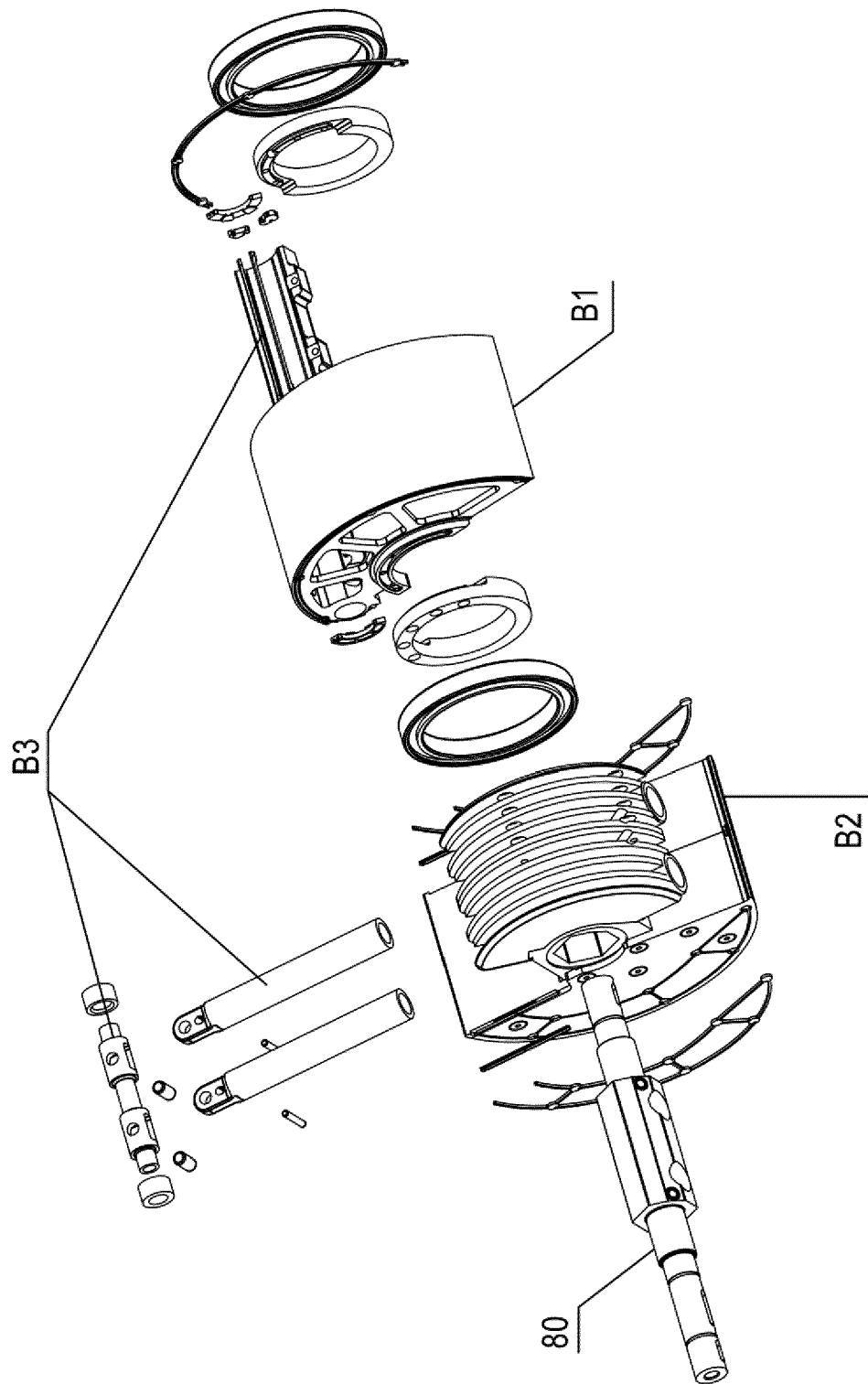


Fig. 4

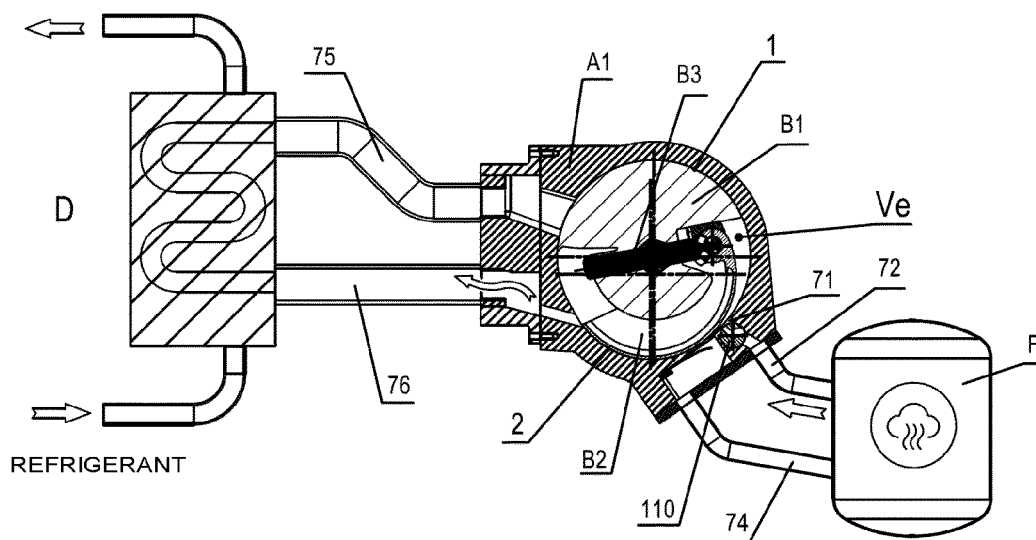


Fig. 5

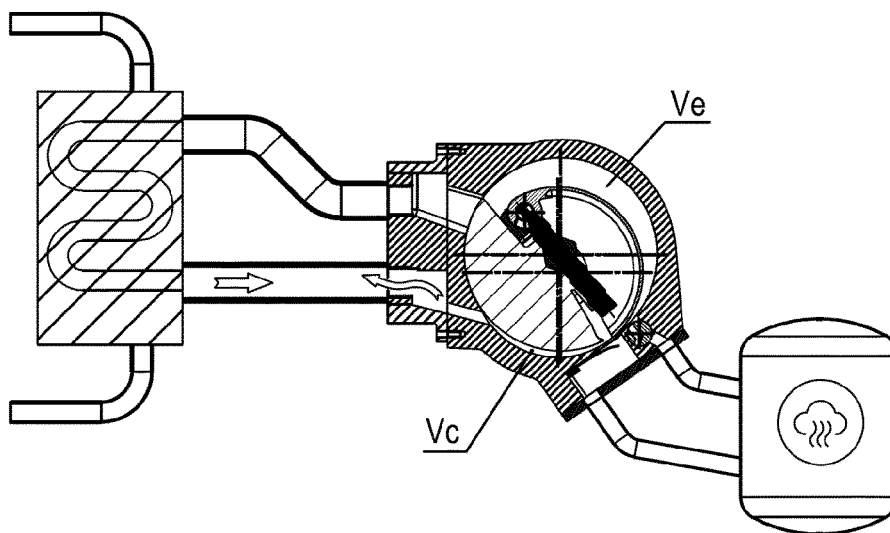


Fig. 6

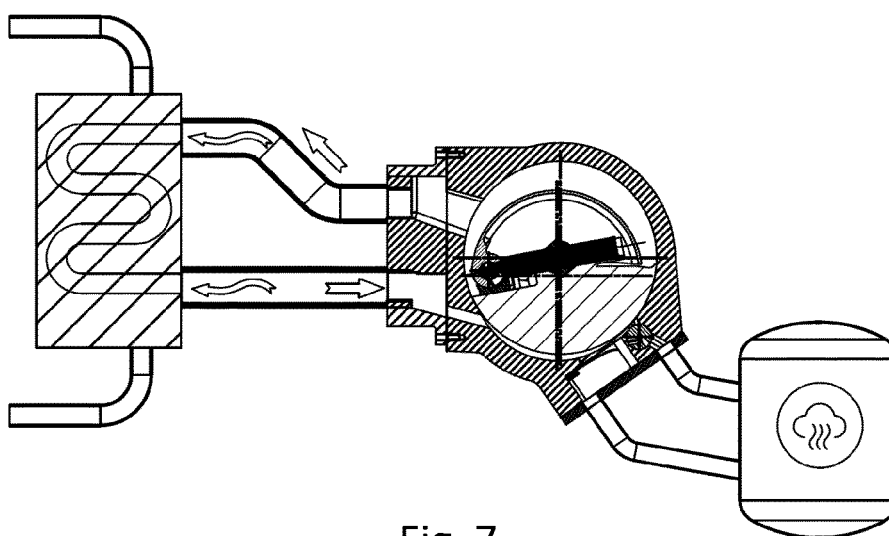


Fig. 7

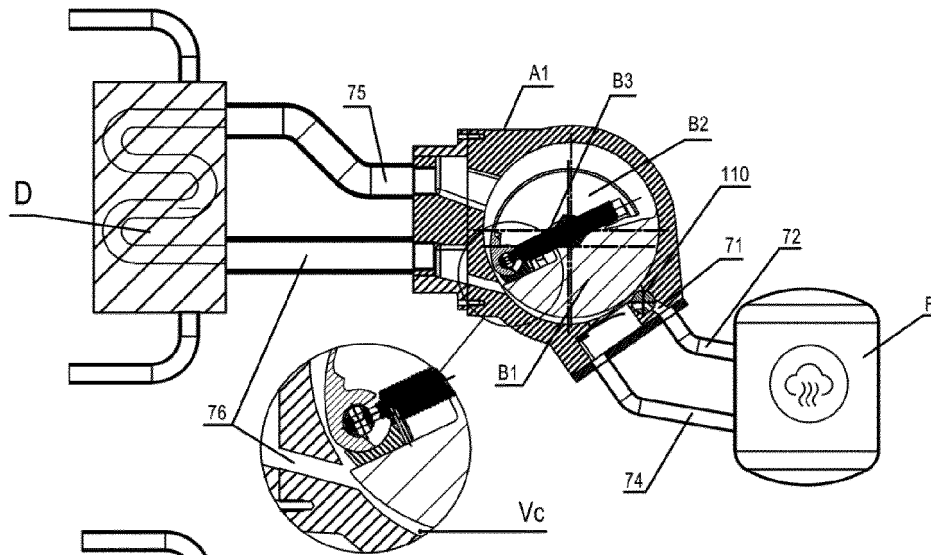


Fig. 8

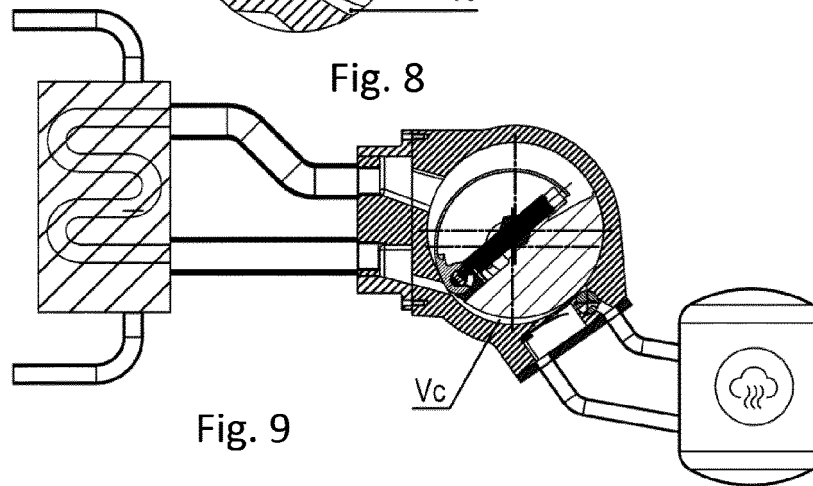


Fig. 9

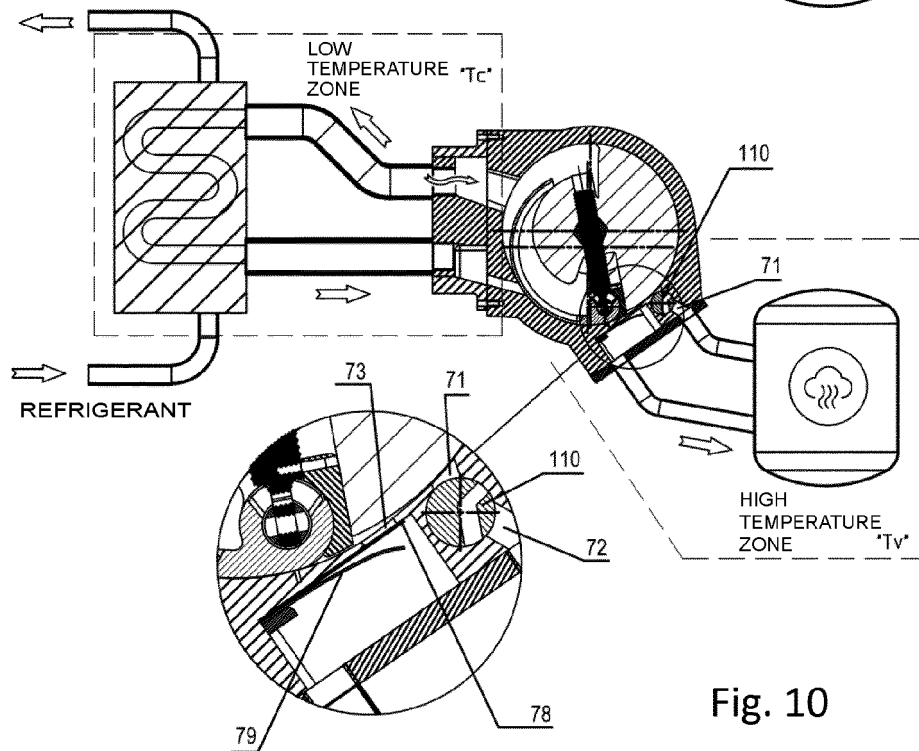


Fig. 10

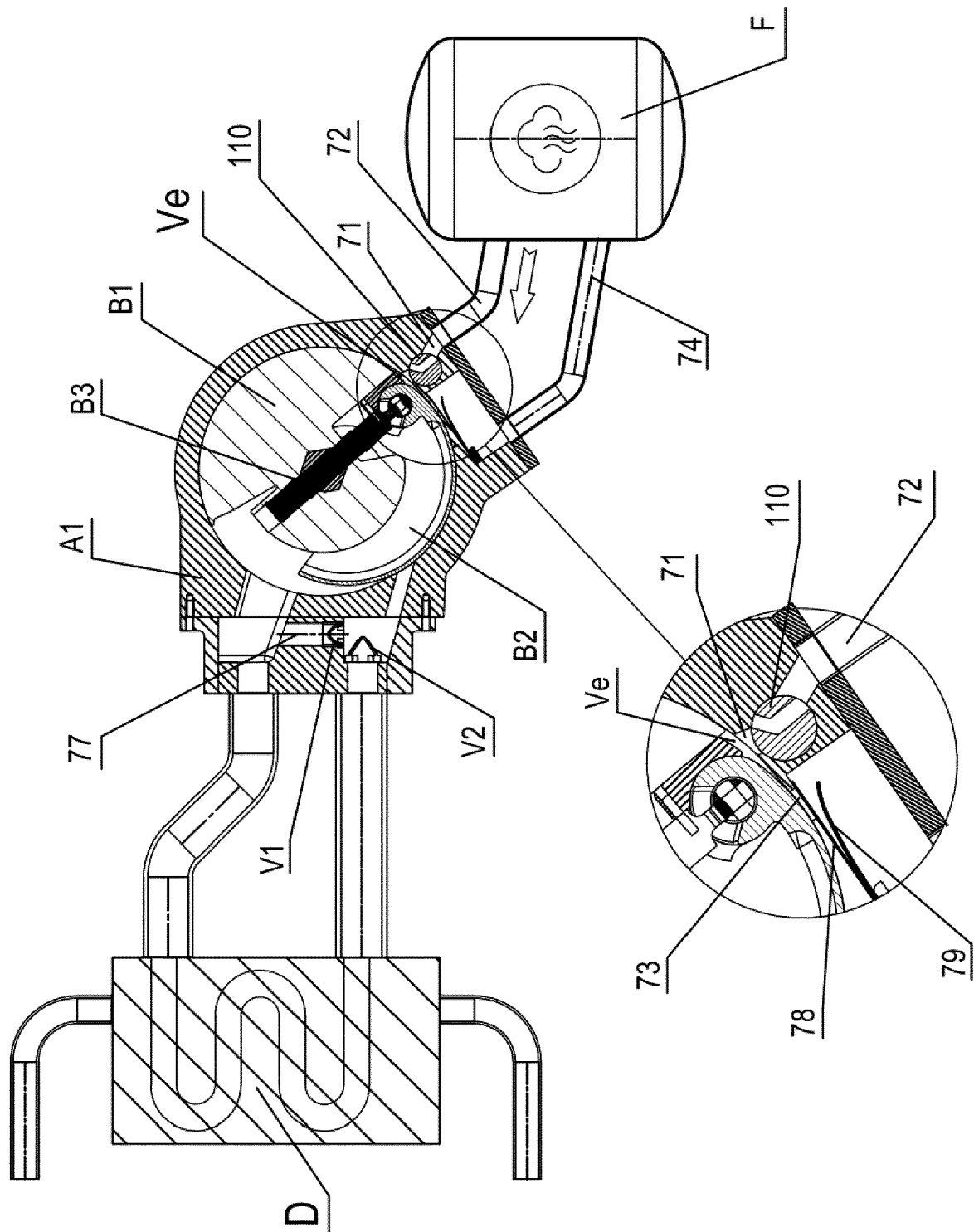


Fig. 11

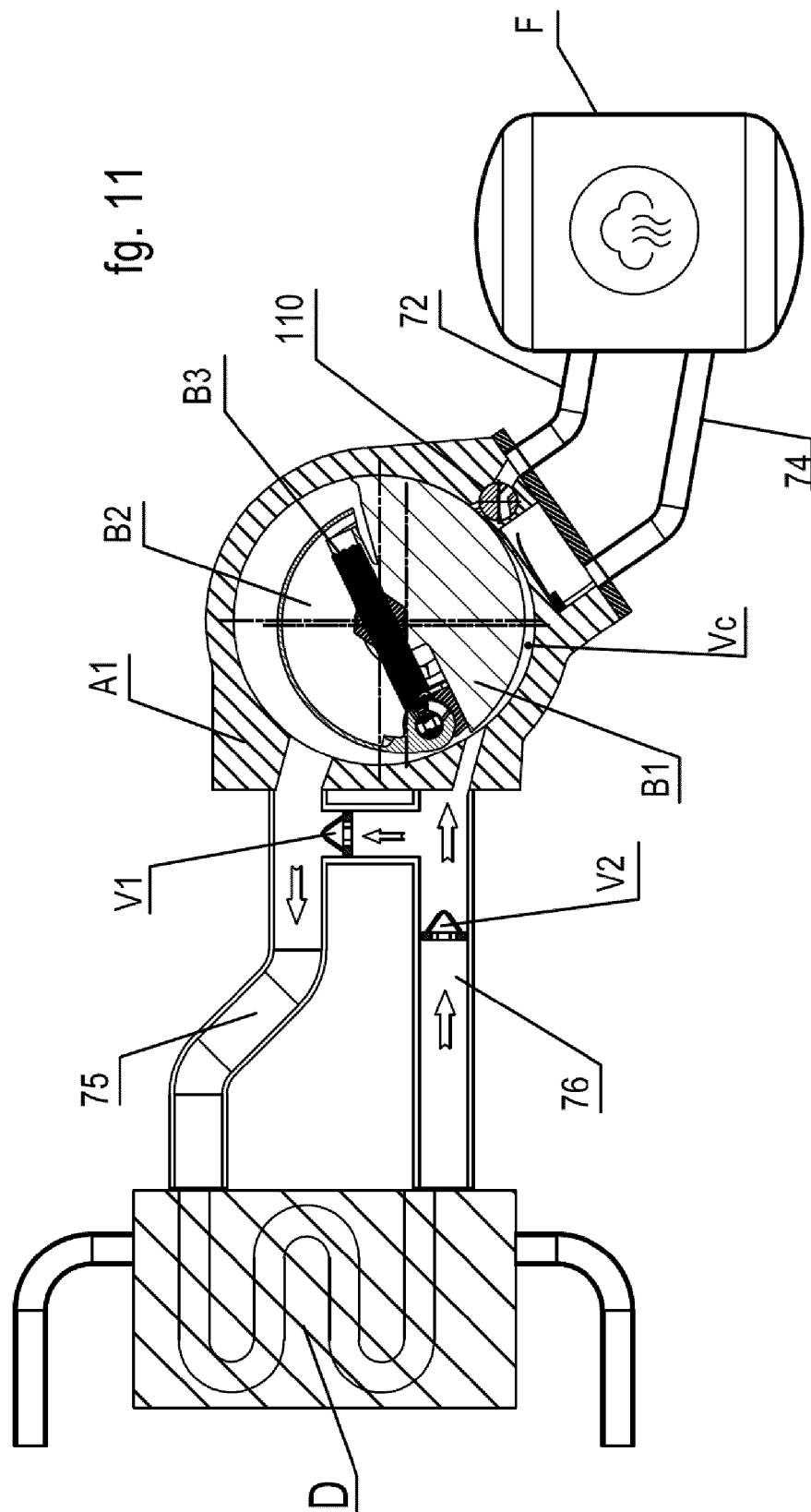


Fig. 12



EUROPEAN SEARCH REPORT

Application Number
EP 21 17 6928

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DOCUMENTS CONSIDERED TO BE RELEVANT			
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 8 November 2021	Examiner Durante, Andrea
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