(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 677 781 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
08.07.2020 Bulletin 2020/28

(21) Application number: **18867052.5**

(22) Date of filing: **10.10.2018**

(51) Int Cl.:
F04C 18/02 *(2006.01)* ***F04C 28/06*** *(2006.01)*
F04C 29/04 *(2006.01)*

(86) International application number:
PCT/JP2018/037669

(87) International publication number:
WO 2019/073993 (18.04.2019 Gazette 2019/16)

(84) Designated Contracting States:
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
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **12.10.2017 JP 2017198844**

(71) Applicant: **Anest Iwata Corporation**
Yokohama-shi, Kanagawa 223-8501 (JP)

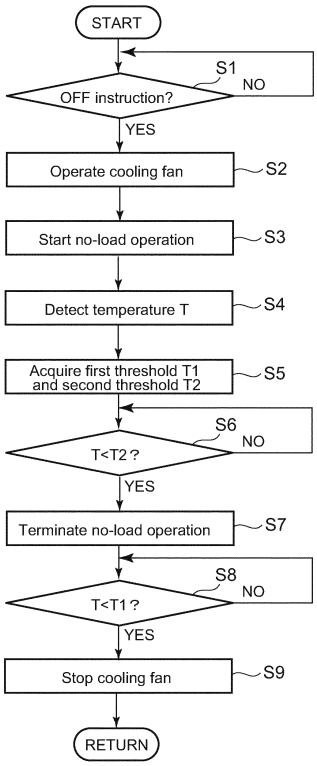
(72) Inventors:
- **KANAYAMA, Kazuyasu**
  Yokohama-shi
  Kanagawa 223-8501 (JP)
- **HANYU, Atsushi**
  Yokohama-shi
  Kanagawa 223-8501 (JP)
- **TAKAGI, Hiroyuki**
  Yokohama-shi
  Kanagawa 223-8501 (JP)

(74) Representative: **Regimbeau**
20, rue de Chazelles
75847 Paris Cedex 17 (FR)

(54) **SCROLL FLUID MACHINE UNIT**

(57) A scroll fluid machine unit includes a cooling fan capable of operating independently of a scroll fluid machine. The cooling fan is controlled so as to operate until the temperature of the scroll fluid machine is less than a predetermined first threshold when the scroll fluid machine is stopped.

FIG. 3



EP 3 677 781 A1

Description

TECHNICAL FIELD

[0001] The present disclosure relates to a scroll fluid machine unit having a pair of scrolls rotatable relative to each other.

BACKGROUND

[0002] A scroll fluid machine is known, which can compress or expand a fluid in a space formed between a pair of scrolls rotatable relative to each other. This type of scroll fluid machine increases its temperature due to the influence of friction between components, or compression or expansion of the fluid during operation. Such temperature increase may reduce the life of a bearing or a lubricant used in the scroll fluid machine and thus is not preferred. For this reason, the scroll fluid machine includes a cooling device such as a cooling fan to suppress temperature increase during operation.

[0003] For example, Patent Document 1 discloses a scroll fluid machine including a cooling fan integrally connected to a rotational shaft of the scroll fluid machine. This scroll fluid machine can drive the cooling fan by power transmitted from the rotational shaft of the scroll fluid machine. Thus, it is unnecessary to separately prepare a power source for the cooling fan, and it is possible to achieve good cooling performance with a compact configuration.

Citation List

Patent Literature

[0004] Patent Document 1: JP2017-53286A

SUMMARY

Problems to be Solved

[0005] The configuration in which the cooling fan is integrally connected to the rotational shaft of the scroll fluid machine as described above has to stop the cooling fan when the scroll fluid machine is stopped. Accordingly, when the scroll fluid machine is stopped, temperature increases due to heat generated during operation and hot fluid remaining inside the machine. Such temperature increase may reduce the life of a bearing accommodated in a casing or a lubricant such as grease and thus is not preferred.

[0006] At least one embodiment of the present invention was made in view of the above issue, and an object thereof is to provide a scroll fluid machine unit that can provide stable performance over a long period by suppressing temperature increase during suspension of operation.

Solution to the Problems

[0007]

(1) To solve the above problem, a scroll fluid machine unit according to at least one embodiment of the present invention comprises: a scroll fluid machine capable of compressing or expanding a fluid in a space formed between a pair of scrolls rotatable relative to each other; a cooling fan for cooling the scroll fluid machine, the cooling fan being capable of operating independently of the scroll fluid machine; at least one temperature detection part configured to detect a temperature of the scroll fluid machine; and a control part configured to control the cooling fan based on the temperature detected by the at least one temperature detection part. The control part is configured to operate the cooling fan until the temperature detected by the at least one temperature detection part is less than a predetermined first threshold when the scroll fluid machine is stopped.

With the above configuration (1), since the cooling fan is capable of operating independently of the scroll fluid machine, it is possible to cool the scroll fluid machine by operating the cooling fan even when the scroll fluid machine is stopped. Such a cooling fan operates until the temperature of the scroll fluid machine detected by the temperature detection part is less than the first threshold when the scroll fluid machine is stopped. Thus, it is possible to effectively suppress temperature increase caused in the stopped scroll fluid machine.

(2) In some embodiments, in the above configuration (1), the control part is configured to perform control so that the scroll fluid machine operates in a no-load condition before the scroll fluid machine is stopped.

With the above configuration (2), since the scroll fluid machine operates in a no-load condition before the scroll fluid machine is stopped, it is possible to discharge the hot fluid remaining inside the scroll fluid machine. Thus, when the scroll fluid machine is stopped, it is possible to suppress temperature increase of the scroll fluid machine due to the hot fluid remaining inside.

(3) In some embodiments, in the above configuration (2), the control part is configured to perform control so that the scroll fluid machine operates in a no-load condition until the temperature detected by the at least one temperature detection part is less than a predetermined second threshold.

With the above configuration (3), the no-load operation performed when the scroll fluid machine is stopped continues until the temperature of the scroll fluid machine detected by the temperature detection part is less than the second threshold. Thus, it is possible to reliably discharge the hot fluid remaining in the scroll fluid machine when the machine is stopped.

(4) In some embodiments, in the above configuration (3), the second threshold is set higher than the first threshold.

With the above configuration (4), the second threshold is set higher than the first threshold. Thus, when the scroll fluid machine is stopped, air cooling by the cooling fan continues even after the hot remaining fluid is discharged by the no-load operation of the scroll fluid machine, so that it is possible to reliably cool the scroll fluid machine. In other words, since the no-load operation is shorter than the operating time of the cooling fan, it is possible to reduce power consumption necessary for the no-load operation.

(5) In some embodiments, in any one of the above configurations (1) to (4), the at least one temperature detection part includes a plurality of temperature sensors disposed at different positions along a radial direction with respect to a rotational shaft of the scroll fluid machine.

In the scroll fluid machine, the radially inner side is hotter. Accordingly, in the stopped scroll fluid machine, heat transfer proceeds from the radially inner side with high temperature to the radially outer side with low temperature. With the above configuration (5), since the plurality of temperature sensors are disposed at different positions in the radial direction, it is possible to more reliably suppress temperature increase in consideration of heat transfer in the sopped scroll fluid machine.

(6) In some embodiments, in any one of the above configurations (1) to (5), the at least one temperature detection part is disposed on at least one of a fixed scroll and an orbiting scroll constituting the pair of scrolls, a housing accommodating the pair of scrolls, a crank shaft eccentrically connecting a rotational shaft of the scroll fluid machine with the orbiting scroll, and a bearing housing connected to the orbiting scroll.

With the above configuration (6), since the temperature detection part is disposed in such positions, it is possible to accurately grasp the temperature of the stopped scroll fluid machine and suppress temperature increase.

(7) In some embodiments, in any one of the above configurations (1) to (6), each of the pair of scrolls has a fin on an opposite side to the space, and the cooling fan is attached to the pair of scrolls from a side so as to able to send air to the fins.

With the above configuration (7), the cooling fan attached to the pair of scrolls from the side can sent air to the fins of the pair of scrolls, thus enabling efficient cooling with a compact configuration.

(8) To solve the above problem, a scroll fluid machine unit according to at least one embodiment of the present invention comprises: a scroll fluid machine capable of compressing or expanding a fluid in a space formed between a pair of scrolls rotatable relative to each other; and a control part configured to control the scroll fluid machine. The control part is configured to perform control so that the scroll fluid machine operates in a no-load condition for a predetermined period when the scroll fluid machine is stopped.

With the above configuration (8), since the scroll fluid machine operates in a no-load condition, it is possible to discharge the hot fluid remaining inside the scroll fluid machine. Thus, when the scroll fluid machine is stopped, it is possible to suppress temperature increase of the scroll fluid machine due to the hot fluid remaining inside.

(9) In some embodiments, in any one of the above configurations (1) to (8), the scroll fluid machine is a compressor for supplying a compressed working fluid to a braking device of a mobile object.

[0008] In such an application, the operation and stop of the scroll fluid machine are repeated according to the braking operation of the mobile object. In this situation, heat is likely to be accumulated in the scroll fluid machine. However, by adopting the above configuration, it is possible to suppress temperature increase in the scroll fluid machine during stop, and it is possible to improve the life.

Advantageous Effects

[0009] At least one embodiment of the present invention provides a scroll fluid machine unit that can provide stable performance over a long period by suppressing temperature increase after suspension of operation.

BRIEF DESCRIPTION OF DRAWINGS

[0010]

FIG. 1 is a perspective view of a scroll fluid machine unit according to an embodiment of the present invention.

FIG. 2 is a vertical cross-sectional view along a rotational shaft of the scroll fluid machine unit of FIG. 1.

FIG. 3 is a flowchart showing steps of control of the scroll fluid machine unit performed by a control part of FIG. 2.

FIG. 4 is a graph showing transition of temperature T of the scroll fluid machine in respond to an ON/OFF instruction from an ECU.

FIG. 5 is a graph showing transition of temperature T of the scroll fluid machine in respond to an ON/OFF instruction from an ECU.

DETAILED DESCRIPTION

[0011] Embodiments of the present invention will now be described in detail with reference to the accompanying drawings. It is intended, however, that unless particularly identified, dimensions, materials, shapes, relative positions and the like of components described in the em-

bodiments shall be interpreted as illustrative only and not intended to limit the scope of the present invention.

[0012] For instance, an expression of relative or absolute arrangement such as "in a direction", "along a direction", "parallel", "orthogonal", "centered", "concentric" and "coaxial" shall not be construed as indicating only the arrangement in a strict literal sense, but also includes a state where the arrangement is relatively displaced by a tolerance, or by an angle or a distance whereby it is possible to achieve the same function.

[0013] Further, for instance, an expression of a shape such as a rectangular shape or a cylindrical shape shall not be construed as only the geometrically strict shape, but also includes a shape with unevenness or chamfered corners within the range in which the same effect can be achieved.

[0014] On the other hand, an expression such as "comprise", "include", "have", "contain" and "constitute" are not intended to be exclusive of other components.

[0015] FIG. 1 is a perspective view of a scroll fluid machine unit 1 according to an embodiment of the present invention. FIG. 2 is a vertical cross-sectional view along a rotational shaft 18 of the scroll fluid machine unit 1 of FIG. 1.

[0016] In FIG. 2, a control system of the scroll fluid machine unit 1 omitted in FIG. 1 is also shown by a functional block.

[0017] The scroll fluid machine unit 1 is a unit in which a scroll fluid machine (main body) 2, an electric motor 4 serving as a power source of the scroll fluid machine 2, and a cooling fan 6 for cooling the scroll fluid machine 2 are integrally combined. The scroll fluid machine unit 1 according to the present embodiment comprises a compressor for compressing a fluid as the scroll fluid machine 2 and, in particular, forms a part of a brake system for supplying a compressed working fluid to a braking device mounted on a mobile object such as a vehicle.

[0018] Although the following embodiments will be described with respect to the scroll fluid machine unit 1 that is used to supply the compressed working fluid to the braking device of the vehicle, the unit may be used for other applications. Further, the scroll fluid machine unit 1 may be an expander unit for expanding a fluid.

[0019] The scroll fluid machine 2 has, on a front side (left side in FIG. 2), a supply port 8 to which a fluid (e.g., air such as outside air) to be compressed is supplied, and an outlet port 10 from which the fluid compressed by the scroll fluid machine 2 is discharged. The fluid supplied to the supply port 8 is compressed in a space (compression chamber) formed between a pair of scrolls rotating relative to each other inside the scroll fluid machine 2 and then is discharged from the outlet port 10.

[0020] The scroll fluid machine 2 has a housing 12 forming the shell. As shown in FIG. 2, the housing 12 accommodates a pair of scrolls rotatable relative to each other, namely, a fixed scroll 14 and an orbiting scroll 16. The fixed scroll 14 is fixed to the housing 12, and the orbiting scroll 16 is configured to be rotatable by power transmitted from the electric motor 4.

[0021] The fixed scroll 14 includes a fixed-side end plate 14a oriented perpendicular to the front-back direction, and a fixed scroll wrap 14b in a spiral shape disposed on the back surface of the end plate 14a. The tip of the fixed scroll wrap 14b has a groove, and the groove receives a tip seal (not shown) made of a self-lubricating material, such as fluororesin. On the front surface of the fixed-side end plate 14a, a cooling fin 14c is disposed for heat dissipation.

[0022] An outlet hole 17 communicating with the outlet port 10 is formed in a substantially central portion of the fixed-side end plate 14a of the fixed scroll 14. The fixed scroll wrap 14b is formed spirally from the vicinity of the outlet hole 17 toward the outer periphery.

[0023] The orbiting scroll 16 includes an orbiting-side end plate 16a oriented perpendicular to the front-back direction, and an orbiting scroll wrap 16b in a spiral shape disposed on the front surface of the end plate 16a. The tip of the orbiting scroll wrap 16b has a groove, and the groove receives a tip seal (not shown) made of a self-lubricating material, such as fluororesin. On the back surface of the orbiting-side end plate 16a, a cooling fin 16c is disposed for heat dissipation.

[0024] To the back surface of the orbiting-side end plate 16a, a bearing housing 25 is fixed. The bearing housing 25 has a hub 24 into which a bearing 22 of an eccentric shaft part rotatably supporting a crank shaft 20 of the rotational shaft 18 is fitted.

[0025] The orbiting scroll 16 is substantially prevented from rotating by a rotation prevention mechanisms 28 disposed between the orbiting-side end plate 16a and the housing 12. The rotation prevention mechanisms 28 are disposed at three locations on the back surface of the orbiting-side end plate 16a along the periphery at 120° intervals. The rotation prevention mechanism 28 includes a crank member 30 having an orbiting-side crankpin and a fixed-side crankpin eccentric with respect to the orbiting-side crankpin. The eccentricity amount of the crank member 30 is set equal to the eccentricity amount of the crank shaft 20 with respect to the rotational shaft 18. Such a crank member 30 is rotatably supported by bearings 32 and 34 which are radial bearings.

[0026] Since the scroll fluid machine 2 includes the rotation prevention mechanism 28 having the above configuration, when the rotational shaft 18 is driven by power transmitted from the electric motor 4, the orbiting scroll 16 orbits (revolves) while rotation is substantially prevented. As a result, a space (compression chamber) 19 formed between the fixed scroll 14 and the orbiting scroll 16 (i.e., between the fixed scroll wrap 14b and the orbiting scroll wrap 16b) moves from the radially outer side to the radially inner side as the fixed scroll 14 and the orbiting scroll 16 rotate relative to each other, and a fluid is compressed.

[0027] In the present embodiment, the scroll fluid machine 2 is provided with first to fifth temperature sensors 36a to 36e as a temperature detection part for detecting

temperature of the scroll fluid machine 2. The first temperature sensor 36a is attached to the fixed scroll 14. The second temperature sensor 36b is attached to the orbiting scroll 16. The third temperature sensor 36c is attached to the housing 12. The fourth temperature sensor 36d is attached to the crank shaft 20. The fifth temperature sensor 36e is attached to the bearing housing 25.

[0028] Further, the first to fifth temperature sensors 36a to 36e are disposed at different positions in the radial direction with respect to the rotational shaft 18 of the scroll fluid machine 2. As described above, since the temperature of the scroll fluid machine 2 increases as the space (compression chamber) 19 moves radially inward, in the stopped scroll fluid machine 2, heat transfer proceeds from the radially inner side where the hot fluid remains to the radially outer side. Therefore, when the first to fifth temperature sensors 36a to 36e are disposed at different positions in the radial direction, it is possible to favorably evaluate heat transfer in the stopped scroll fluid machine.

[0029] The electric motor 4 is an electric motor that can be driven by power supplied from the outside and functions as a power source of the scroll fluid machine 2. The electric motor 4 is disposed behind (right side in FIG. 2) the scroll fluid machine 2. The electric motor 4 is a magnet motor including a motor casing 40 containing a rotor 42 and a stator 44. The rotor 42 is connected to the rotational shaft 18 of the scroll fluid machine 2 so that output power of the electric motor 4 is transmitted via the rotational shaft 18 to drive the scroll fluid machine 2. Thus, since the scroll fluid machine 2 and the electric motor 4 are directly connected not via a transmission member such as a coupling or a belt, the scroll fluid machine unit 1 is compact with reduced power transmission loss.

[0030] As shown in FIG. 1, the cooling fan 6 is attached to a side of the scroll fluid machine 2 and includes a fan casing 46 and a fan body 48 accommodated therein. When the fan body 48 operates, the air taken from the outside is introduced into the scroll fluid machine 2 via a passage formed by the fan casing 46. In the present embodiment, particularly, the housing 12 of the scroll fluid machine 2 has an opening 49 partially opening at a connection portion with the fan casing 46, and the air from the fan casing 46 is introduced into the cooling fin 14c of the fixed scroll 14 and the cooling fin 16c of the orbiting scroll 16 via the opening 49.

[0031] The air passing through the cooling fin 14c of the fixed scroll 14 and the cooling fin 16c of the orbiting scroll 16 is discharged to the outside from a discharge port (not shown) formed in the housing 12 of the scroll fluid machine 2.

[0032] Such a cooling fan 6 is configured to be operable independently of the scroll fluid machine 2. For example, the cooling fan 6 has a drive power supply (not shown) independent of the electric motor 4, which is the power source of the scroll fluid machine 2.

[0033] Since the cooling fan 6 is to cool the scroll fluid machine 2, the electric motor 4 may include its own cooling device (e.g., a dedicated fan separate from the cooling fan 6).

[0034] Further, as shown in FIG. 2, the scroll fluid machine unit 1 has a control part 50 which is a controller for controlling the operation of the scroll fluid machine unit 1. The control part 50 includes, for example, an electronic arithmetic device loaded with a program designed to execute a predetermined operation. In the present embodiment, the control part 50 acquires detection values from the first to fifth temperature sensors 36a to 36e which are the temperature detection part, and controls the operation of the scroll fluid machine unit 1 in accordance with the detection results.

[0035] The control part 50 may be a part of the scroll fluid machine unit 1, or may be a separate device from the external scroll fluid machine unit 1.

[0036] Further, the control part 50 is configured to be able to communicate with an ECU 60 which is a control unit of the vehicle equipped with the scroll fluid machine unit 1. The ECU 60 transmits a control signal corresponding to ON/OFF of the scroll fluid machine unit 1 to the control part 50 in accordance with the amount of compressed fluid required by the braking device mounted on the vehicle. The control part 50 performs control to switch ON/OFF of the scroll fluid machine unit 1 in response to the control signal from the ECU 60.

[0037] Next, the details of control of the scroll fluid machine unit 1 having the above configuration will be described. FIG. 3 is a flowchart showing steps of control of the scroll fluid machine unit 1 performed by the control part 50 of FIG. 2.

[0038] First, the control part 50 determines whether an OFF instruction of the scroll fluid machine unit 1 is issued based on a control signal from the ECU 60 (step S1). If it is determined that the OFF instruction is issued to the scroll fluid machine unit 1 (step S1: YES), the control part 50 operates the cooling fan 6 (step S2). By operating the cooling fan 6 before the scroll fluid machine 2 is stopped, it is possible to suppress temperature increase of the scroll fluid machine 2.

[0039] If the cooling fan 6 has been operating from before step S1, the operation of the cooling fan 6 simply continues in step S2.

[0040] Further, the control part 50 starts to operate the scroll fluid machine 2 in a no-load condition (step S3). By operating the scroll fluid machine 2 in a no-load condition before the scroll fluid machine 2 is stopped, it is possible to discharge the hot fluid remaining inside the scroll fluid machine 2. Thus, when the scroll fluid machine 2 is stopped, it is possible to suppress temperature increase of the scroll fluid machine 2 due to the hot fluid remaining inside.

[0041] Steps S2 and S3 may be performed before or after each other, or may be performed simultaneously with each other.

[0042] Then, the control part 50 acquires a detection value from at least one of the first to fifth temperature sensors 36a to 36e to detect the temperature T of the

scroll fluid machine unit 1 (step S4). In step S4, the detection value of at least one of the first to fifth temperature sensors 36a to 36e may be used as the temperature T of the scroll fluid machine unit 1, or representative temperature of the scroll fluid machine unit 1 may be calculated from respective detection values of the first to fifth temperature sensors 36a to 36e, and this value may be used as the temperature T of the scroll fluid machine unit 1.

[0043] Then, the control part 50 acquires a first threshold T1 and a second threshold T2 which are used as reference values of the temperature T of the scroll fluid machine unit 1 acquired in step S4 (step S5). Such first threshold T1 and second threshold T2 are previously stored, for example, in a memory built in the control part 50, and the control part 50 is configured to be able to read the thresholds as appropriate. As described later, the first threshold T1 is a threshold for determining whether to continue the operation of the cooling fan 6 executed in step S2, and the second threshold T2 is a threshold for determining whether to continue the no-load operation of the scroll fluid machine executed in step S3.

[0044] Then, the control part 50 determines whether the temperature T of the scroll fluid machine unit 1 acquired in step S4 is less than the second threshold T2 (step S6). If the temperature T of the scroll fluid machine unit 1 is less than the second threshold T2 (step S6: YES), the control part 50 determines that the hot fluid remaining inside the scroll fluid machine 2 is sufficiently discharged, and terminates the no-load operation of the scroll fluid machine 2, and stops the scroll fluid machine 2 (step S7). Thus, by terminating the no-load operation of the scroll fluid machine 2 at an appropriate timing, it is possible to reduce useless power consumption.

[0045] Here, since the second threshold T2 is set higher than the first threshold T1, the cooling fan 6 continues to operate when the no-load operation of the scroll fluid machine 2 is terminated in step S7. In other words, the cooling fan 6 operates while the scroll fluid machine 2 is stopped.

[0046] Then, the control part 50 continuously monitors the temperature T of the scroll fluid machine unit 1 to determine whether the temperature T is less than the first threshold T1 (step S8). If it is determined that the temperature T of the scroll fluid machine unit 1 is less than the first threshold T1 (step S8: YES), the control part 50 stops the cooling fan 6 (step S9). In other words, the operation of the cooling fan 6 continues until the temperature T of the scroll fluid machine unit 1 is less than the first threshold T1. Thus, even after the discharge of the hot remaining fluid is completed by the no-load operation of the scroll fluid machine 2, air cooling by the cooling fan continues, so that it is possible to reliably cool the scroll fluid machine 2.

[0047] FIG. 4 and FIG. 5 are graphs showing transition of the temperature T of the scroll fluid machine 2 in respond to an ON/OFF instruction from the ECU 60.

[0048] In FIG. 4 and FIG. 5, as comparative examples, temperature transition of a scroll fluid machine in which the above control is not performed (i.e., a scroll fluid machine unit that has the same structure as the scroll fluid machine unit 1 according to the present embodiment, but is configured to be controlled such that the scroll fluid machine unit 1 is wholly stopped immediately in response to an OFF instruction from the ECU 60) is shown by the dashed line.

[0049] FIG. 4 shows the case of repeating cycles in which an OFF instruction is issued from the ECU 60, and then, after the temperature T of the scroll fluid machine 2 reaches the first threshold T1, an ON instruction is issued from the ECU 60 again. In this case, in the comparative example, the temperature of the scroll fluid machine increases to Tmax1'; while in the present embodiment, when the scroll fluid machine unit 1 is stopped, the operation of the cooling fan 6 (see step S2 of FIG. 3) and the no-load operation of the scroll fluid machine 2 (see step S3 of FIG. 3) are performed, so that the maximum temperature is reduced to Tmax1.

[0050] FIG. 5 shows the case of repeating cycles in which an OFF instruction is issued from the ECU 60, and then, before the temperature T of the scroll fluid machine 2 reaches the first threshold T1, an ON operation is performed again. In this case, in the comparative example, the temperature of the scroll fluid machine increases to Tmax2'; while in the present embodiment, when the scroll fluid machine unit 1 is stopped, the operation of the cooling fan 6 (see step S2 of FIG. 3) and the no-load operation of the scroll fluid machine 2 (see step S3 of FIG. 3) are performed, so that the maximum temperature is reduced to Tmax2.

[0051] Although the above embodiment has been described with respect to the case where, when the scroll fluid machine unit 1 is stopped, both the operation of the cooling fan 6 (see step S2 of FIG. 3) and the no-load operation of the scroll fluid machine 2 (see step S3 of FIG. 3) are performed, either one may be performed.

[0052] As described above, at least one embodiment of the present invention provides a scroll fluid machine unit 1 that can provide stable performance over a long period by suppressing temperature increase after stop.

Industrial Applicability

[0053] At least one embodiment of the present invention can be applied to the scroll fluid machine unit having a pair of scrolls rotatable relative to each other.

Reference Signs List

[0054]

1	Scroll fluid machine unit
2	Scroll fluid machine
4	Electric motor
6	Cooling fan
8	Supply port

10	Outlet port
12	Housing
14	Fixed scroll
14a	Fixed-side end plate
14b	Fixed scroll wrap
14c, 16c	Cooling fin
16	Orbiting scroll
16a	Orbiting-side end plate
16b	Orbiting scroll wrap
17	Outlet hole
18	Rotational shaft
19	Space (Compression chamber)
20	Crank shaft
22, 32, 34	Bearing
24	Hub
25	Bearing housing
28	Rotation prevention mechanism
30	Crank member
36a	First temperature sensor
36b	Second temperature sensor
36c	Third temperature sensor
36d	Fourth temperature sensor
36e	Fifth temperature sensor
42	Rotor
46	Fan casing
48	Fan body
49	Opening
50	Control part
60	ECU

Claims

1. A scroll fluid machine unit comprising:

a scroll fluid machine capable of compressing or expanding a fluid in a space formed between a pair of scrolls rotatable relative to each other;
a cooling fan for cooling the scroll fluid machine, the cooling fan being capable of operating independently of the scroll fluid machine;
at least one temperature detection part configured to detect a temperature of the scroll fluid machine; and
a control part configured to control the cooling fan based on the temperature detected by the at least one temperature detection part,
wherein the control part is configured to operate the cooling fan until the temperature detected by the at least one temperature detection part is less than a predetermined first threshold when the scroll fluid machine is stopped.

2. The scroll fluid machine unit according to claim 1, wherein the control part is configured to perform control so that the scroll fluid machine operates in a no-load condition before the scroll fluid machine is stopped.

3. The scroll fluid machine unit according to claim 2, wherein the control part is configured to perform control so that the scroll fluid machine operates in a no-load condition until the temperature detected by the at least one temperature detection part is less than a predetermined second threshold.

4. The scroll fluid machine unit according to claim 3, wherein the second threshold is set higher than the first threshold.

5. The scroll fluid machine unit according to any one of claims 1 to 4,
wherein the at least one temperature detection part includes a plurality of temperature sensors disposed at different positions along a radial direction with respect to a rotational shaft of the scroll fluid machine.

6. The scroll fluid machine unit according to any one of claims 1 to 5,
wherein the at least one temperature detection part is disposed on at least one of a fixed scroll and an orbiting scroll constituting the pair of scrolls, a housing accommodating the pair of scrolls, a crank shaft eccentrically connecting a rotational shaft of the scroll fluid machine with the orbiting scroll, and a bearing housing connected to the orbiting scroll.

7. The scroll fluid machine unit according to any one of claims 1 to 6,
wherein each of the pair of scrolls has a fin on an opposite side to the space, and
wherein the cooling fan is attached to the pair of scrolls from a side so as to able to send air to the fins.

8. A scroll fluid machine unit comprising:

a scroll fluid machine capable of compressing or expanding a fluid in a space formed between a pair of scrolls rotatable relative to each other; and
a control part configured to control the scroll fluid machine,
wherein the control part is configured to perform control so that the scroll fluid machine operates in a no-load condition for a predetermined period when the scroll fluid machine is stopped.

9. The scroll fluid machine unit according to any one of claims 1 to 8,
wherein the scroll fluid machine is a compressor for supplying a compressed working fluid to a braking device of a mobile object.

FIG. 1

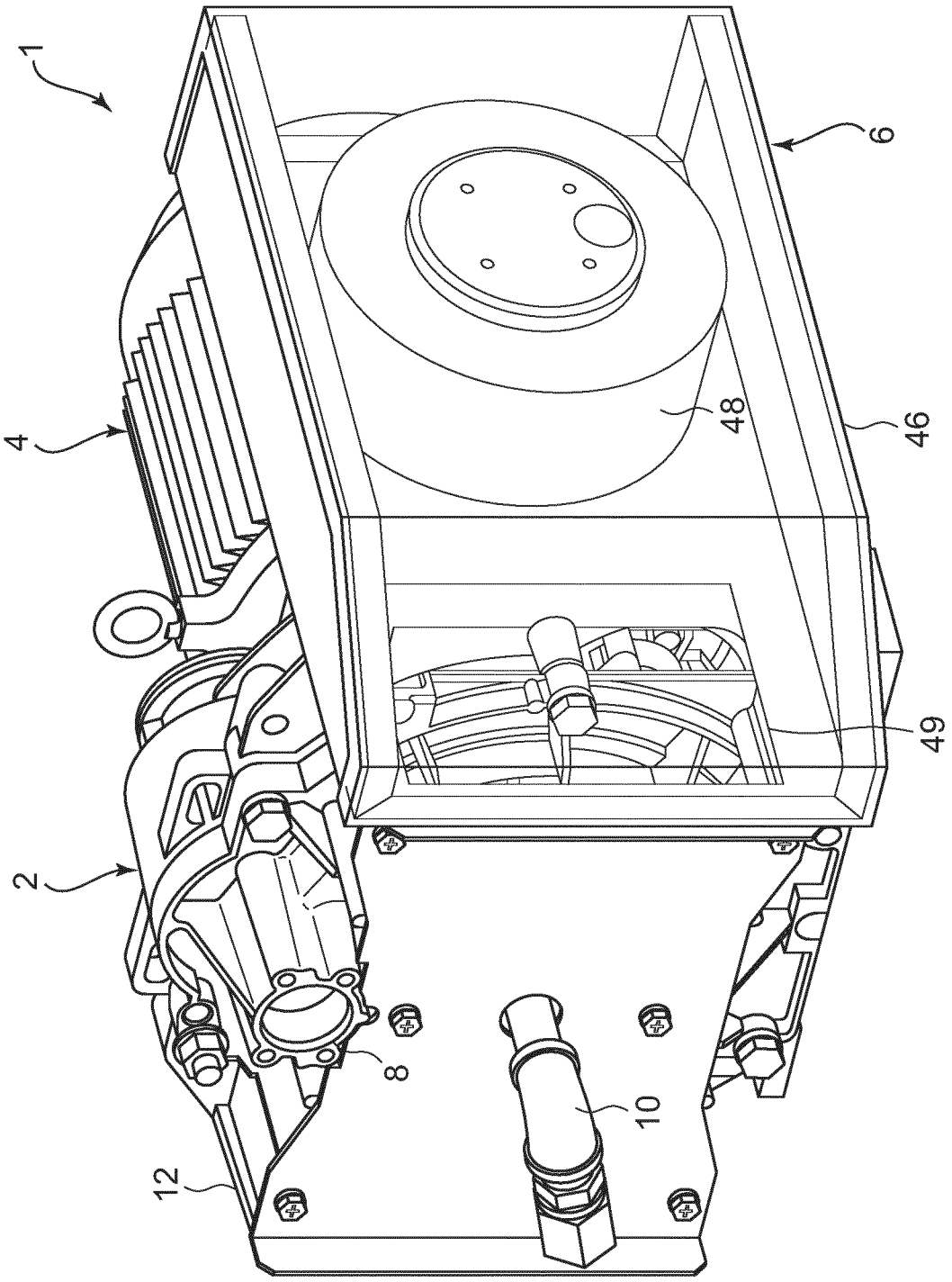


FIG. 2

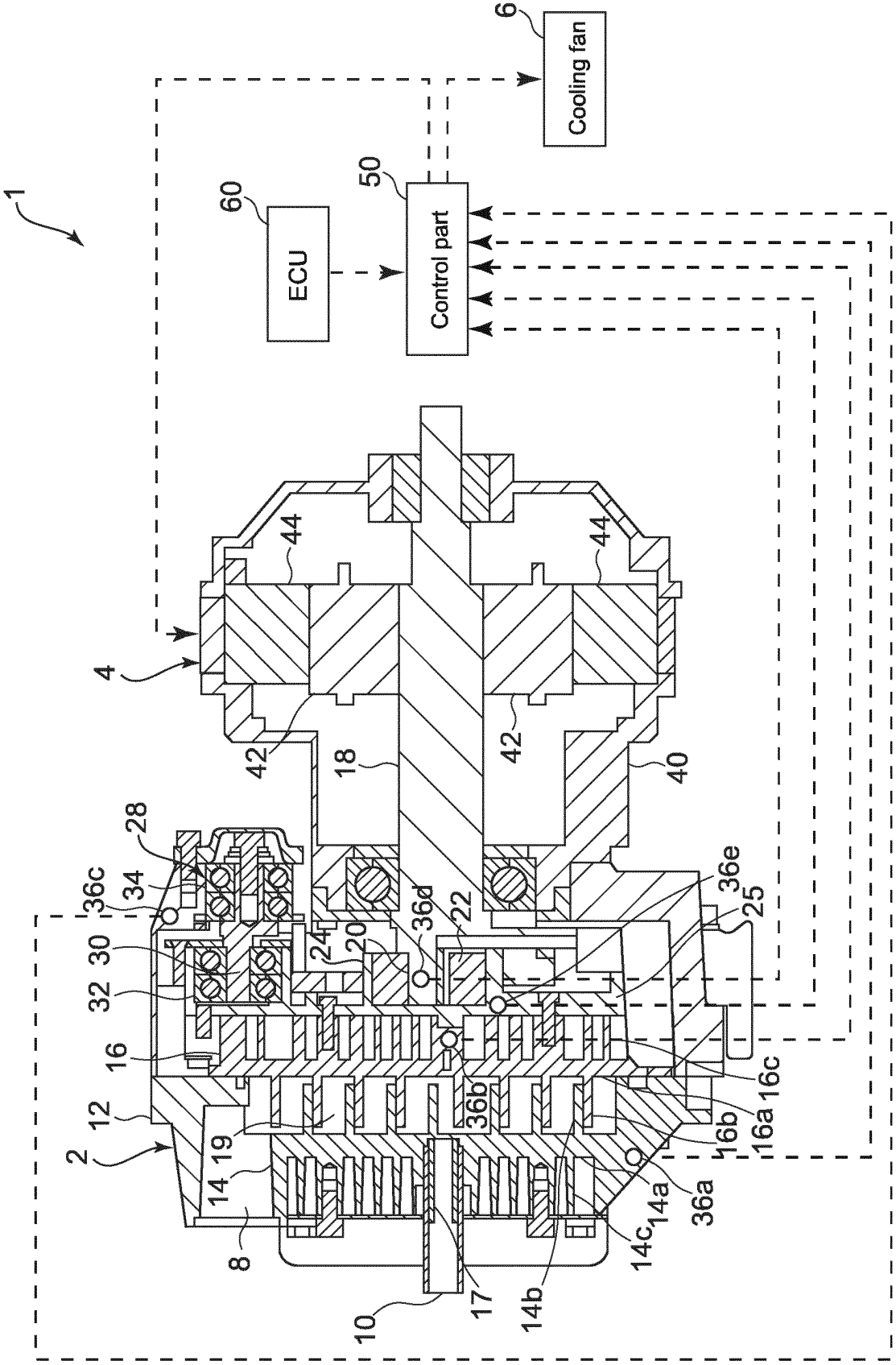

1
2
4
6
Cooling fan
8
10
12
14
14a
14b
14c
16
16a
16b
16c
17
18
19
20
22
24
25
28
30
32
34
36c
36d
36e
36a
36b
40
42
44
50
Control part
60
ECU

FIG. 3

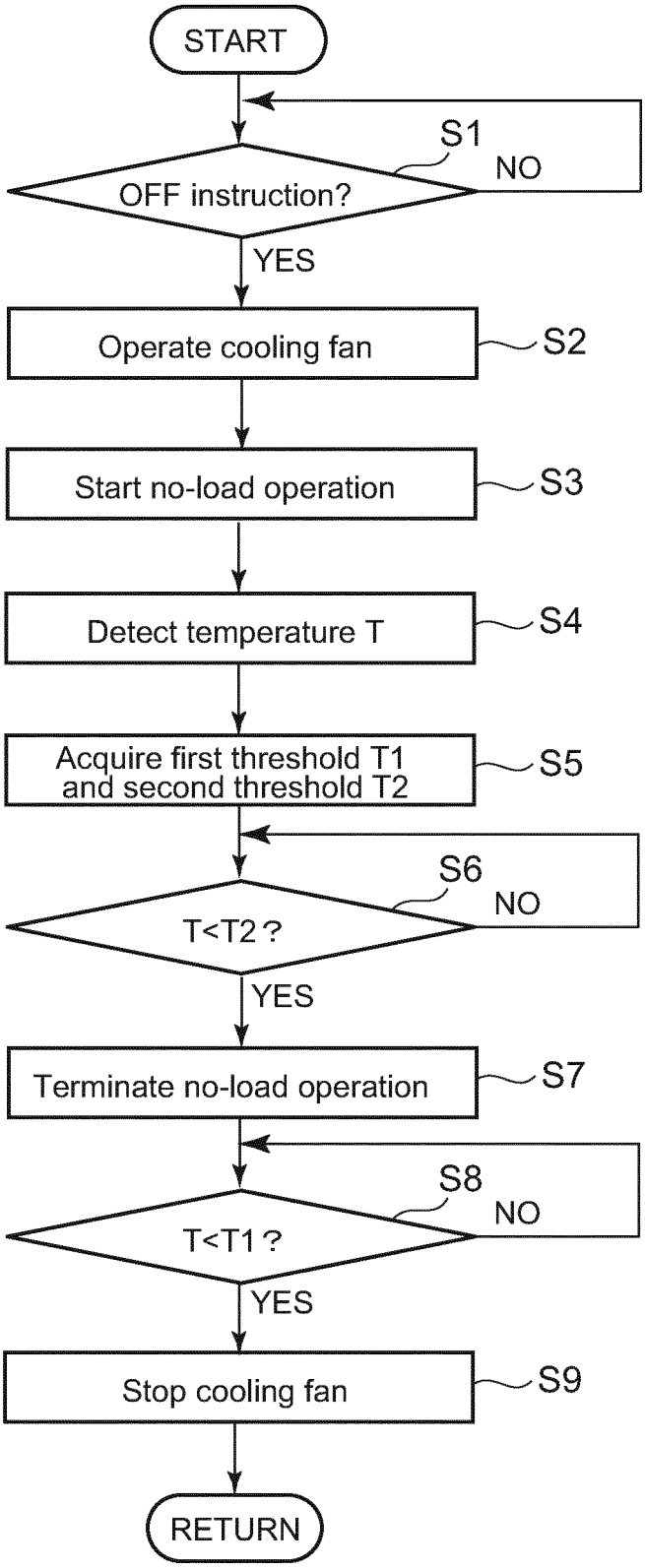

START
S1
OFF instruction?
NO
YES
Operate cooling fan
S2
Start no-load operation
S3
Detect temperature T
S4
Acquire first threshold T1 and second threshold T2
S5
S6
T<T2?
NO
YES
Terminate no-load operation
S7
S8
T<T1?
NO
YES
Stop cooling fan
S9
RETURN

FIG. 4

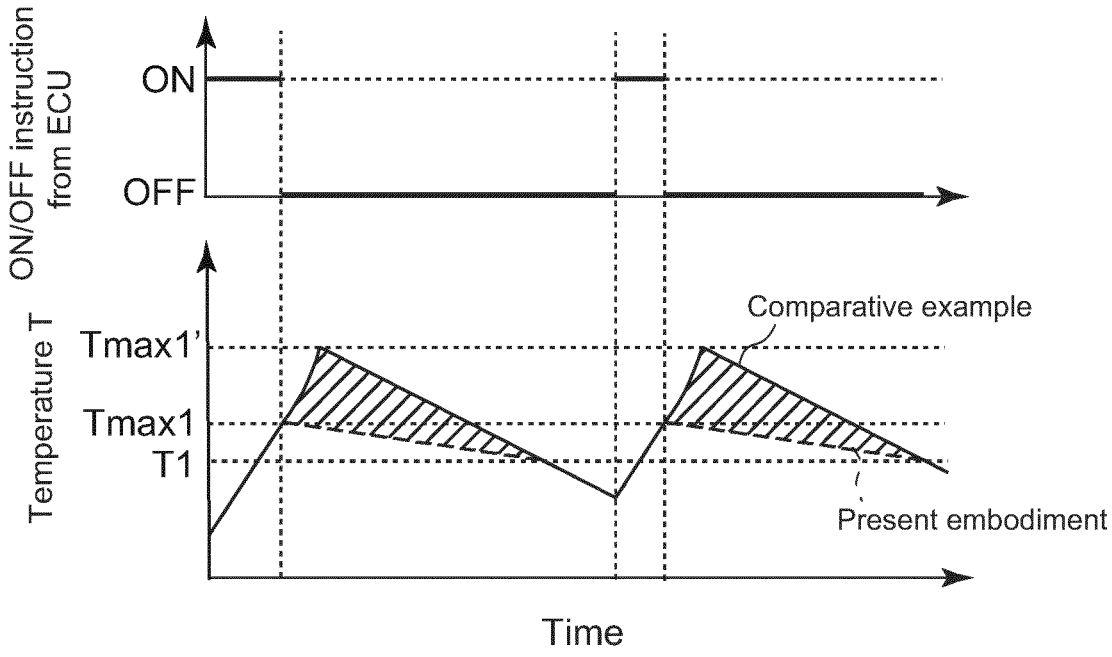
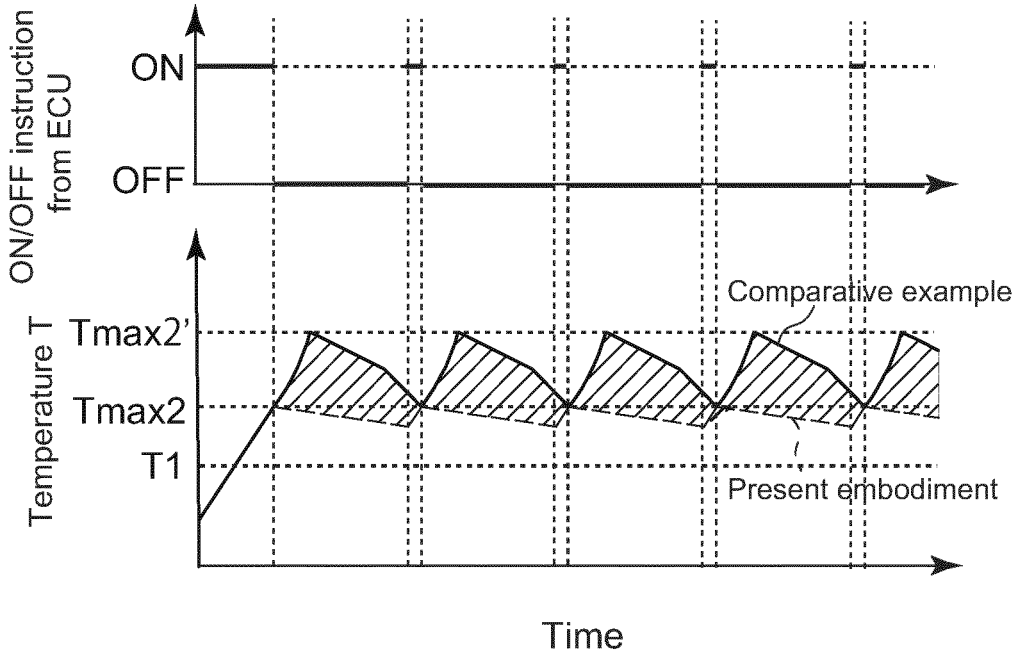

ON/OFF instruction from ECU
ON
OFF
Temperature T
Tmax1'
Tmax1
T1
Comparative example
Present embodiment
Time

FIG. 5


ON/OFF instruction from ECU
ON
OFF
Temperature T
Tmax2'
Tmax2
T1
Comparative example
Present embodiment
Time

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2018/037669

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. F04C18/02(2006.01)i, F04C28/06(2006.01)i, F04C29/04(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl. F04C18/02, F04C28/06, F04C29/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2018
Registered utility model specifications of Japan	1996-2018
Published registered utility model applications of Japan	1994-2018

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2008-157179 A (ANEST IWATA CORPORATION) 10 July 2008, paragraphs [0019]-[0034], fig. 1-5, 7 & US 2008/0152525 A1, paragraphs [0018]-[0036], fig. 1-5, 7 & EP 1939453 A2 & CN 101210555 A	1-9
Y A	JP 2007-205206 A (HITACHI, LTD.) 19 August 2007, paragraphs [0029]-[0114], fig. 9 (Family: none)	1-7, 9 8
Y	JP 2007-278147 A (EBARA CORPORATION) 25 October 2007, paragraph [0005] (Family: none)	2-9
Y	JP 59-21252 A (TOYOTA MOTOR CORP.) 03 February 1984, page 1, lower left column, line 15 to lower right column, line 11 (Family: none)	2-9
Y	JP 2015-25387 A (MITSUBISHI HEAVY INDUSTRIES, LTD.) 05 February 2015, paragraph [0025] & EP 2998585 A1, paragraph [0054]	9

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
04 December 2018 (04.12.2018)	18 December 2018 (18.12.2018)

Name and mailing address of the ISA/	Authorized officer
Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2017053286 A **[0004]**