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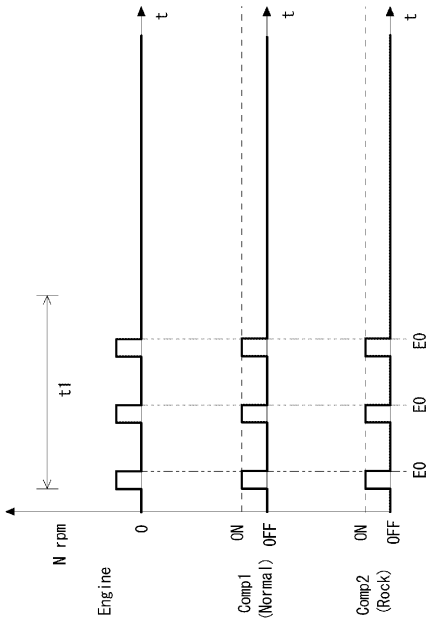
(54) ENGINE-DRIVEN HEAT PUMP

(57) An engine driven heat pump having a plurality of compressors, in which lock detection means can assuredly detect a lock of one compressor at the time of staring an air-conditioning operation. The engine driven heat pump (1) includes a plurality of compressors (10) via electromagnetic clutches (20). A slippage generating torque of the electromagnetic clutches (20) is set up to be a starting torque of an engine (2) or higher, and all of the electromagnetic clutches (20) are engaged at the time of starting the engine driven heat pump (1).

Fig.4



EP 2 184 562 A1

Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to an engine driven heat pump.

Related Art

[0002] Conventionally, there is well known an engine driven heat pump having a construction for driving a compressor by an engine. In the engine driven heat pump, the compressor is connected to the engine via a clutch. In other words, the compressor transmits or releases a driving power of the engine by an ON/OFF operation of the clutch.

[0003] There is also well known a technology of a compressor lock detection means. Compressor lock means an abnormal state where compression mechanism of the compressor is not movable due to liquid compression, rising of oil or incorporation of foreign material. When the compressor lock is caused, it is necessary that all devices of the engine driven heat pump are stopped, so as to repair and replace the compressor. In other words, the compressor lock is the abnormal state (urgent abnormality) having a great need for maintenance and repair, unlike another abnormal states (such as engine accident fire).

[0004] JP1994-213171 discloses a control technology that detects whether the compressor lock is caused under pressure condition after the elapse of a certain period of time after starting. However, in a high-capacity engine driven heat pump, a plurality of compressors are connected to one engine. The control technology disclosed in JP 1994-213171, when applied to an engine driven heat pump having a plurality of compressors, is disadvantageous in that there is a possibility of being unable to detect whether the compressors are locked or not during starting of an air conditioning operation, as it normally becomes a given pressure unless the compressor firstly driven during the engine driven heat pump start-up is locked.

Briefly, in the engine driven heat pump, one compressor is continuously operated on condition that it remains locked. As a result, when engaging the clutch so as to transmit the driving power to the compressor on a locked condition, spark is sometimes generated due to clutch slippage.

[0005] In the engine driven heat pump having the plurality of compressors, the construction that transmits the driving power to one or plurality of compressors less than the volume on board at the starting has a possibility of being unable to assuredly avoid the starting of the air conditioning operation with the compressor on the locked condition, at the starting of the air conditioning operation.

Disclosure of Invention

Problems to Be Solved By the Invention

[0006] It's an object of the present invention to provide an engine driven heat pump having a plurality of compressors, capable of avoiding the starting of the air conditioning operation with the compressor on the locked condition.

SUMMARY OF THE INVENTION

Means for Solving the Problem

[0007] In an engine driven heat pump of the present invention, which is an engine driven heat pump having a plurality of compressors via clutches for the compressors, a slippage generating torque of the clutches for the compressors is set up to be starting torque of the engine or higher, and all of the clutches for the compressors are engaged, at the time of starting the engine driven heat pump.

[0008] In the engine driven heat pump of the present invention, it is preferable to disengage at least one of the clutches for the compressors after finishing a starting of the engine.

Effect of the Invention

[0009] According to the engine driven heat pump of the present invention, in the engine driven heat pump having a plurality of compressors, it can be assuredly detected whether the compressor on the locked condition at the starting of the air conditioning operation is present or not. More specifically, although the construction that transmits the driving power to all of the compressors at the starting also transmits the driving power to the compressor on the locked condition, the operation is locked without causing the clutch slippage since the starting torque is the slippage generating torque of the clutch or lower, whereby the engine driven heat pump is not driven with the compressor on the locked condition. As the causes why the operation is locked are limited to (1) the compressor lock, (2) abnormality of a starter and so on, an operator can easily specify the compressor lock when it is generated.

[0010] According to the engine driven heat pump of the present invention, driving for controlling compressor capacity corresponding to air-conditioning load can be performed, by disengaging at least one of the clutches for the compressors.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

Fig. 1 is a diagram of a lateral construction illustrating driving construction of a compressor according to an

embodiment of the present invention.

Fig. 2 is a diagram of a cross section structure along the line AA' in Fig. 1 according to an embodiment of the present invention.

Fig. 3 is a flow diagram illustrating a flow of a compressor lock detection control.

Fig. 4 is a graph chart illustrating a sequence when determined that the compressor is locked according to an embodiment of the present invention.

Fig. 5 is a graph chart illustrating a sequence when determined that the compressor is normal according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0012] Next, embodiments of the present invention will be described.

Fig. 1 is a diagram of a lateral construction illustrating driving construction of a compressor according to an embodiment of the present invention. Fig. 2 is a diagram of a cross section structure along the line AA' in Fig. 1 according to an embodiment of the present invention. Fig. 3 is a flow diagram illustrating a flow of a compressor lock detection control. Fig. 4 is a graph chart illustrating a sequence when determined that the compressor is locked according to an embodiment of the present invention. Fig. 5 is a graph chart illustrating a sequence when determined that the compressor is normal according to an embodiment of the present invention.

[0013] A driving construction of a compressor 10 in an engine driven heat pump 1 will be briefly described, with reference to Fig. 1.

As shown in Fig. 1, an engine 2 is connected to the compressor 10 via a belt 5.

The engine 2 is disposed on an installation board 3 via an elastic member or the like aimed at vibration insulation and sound insulation, and is incorporated into a casing of the engine driven heat pump 1. The engine 2 includes a starter 6 for starting the engine. The engine 2 includes an engine pulley 4 on an output shaft.

[0014] The compressor 10 includes a compressor pulley 11, an intake pipe 15 and a discharge pipe 16, and is incorporated into the casing of the engine driven heat pump 1 as with the engine 2. An input shaft 14 of the compressor 10 is rotatably driven by the driving transmission of the compressor pulley 11 via the belt 5 due to the engine pulley 4. The compressor 10 compresses an intake gas refrigerant at low temperature and low pressure inhaled from the intake pipe 15 into a discharge gas refrigerant at high temperature and high pressure, by rotating a scroll compression mechanism 13 due to the input shaft 14, and discharges the gas refrigerant from the discharge pipe 16.

[0015] An electromagnetic clutch 20 is interposed between the input shaft 14 and the compressor pulley 11 as a clutch for the compressor. The electromagnetic clutch 20 includes a coil 17 provided integral with (attached and fixed to the inside of, in the present embodiment,) the compressor pulley 11 and an armature 12 engaged to one end of the input shaft 14 (that does not relatively rotate with respect to the input shaft 14 and that is slidable in the axial direction of the input shaft 14).

[0016] An Electronic Control Unit (hereinafter, referred to as ECU 7) is connected to the respective systems and detection means (such as an ignition device, a temperature detection means and a rotation speed detection means 18) of the engine 2, the respective devices and detection means (an electronic expansion valve, an electromagnetic valve, a temperature detection means, a pressure detection means) of the engine drive heat pump 1 as well as the electromagnetic clutch 20, so as to control the operation of the engine drive heat pump 1.

[0017] Moreover, the construction of the engine drive heat pump 1 equipped with two compressors 10 in one engine 2 will be briefly described, with reference to Fig. 2.

As shown in Fig, 2, the engine drive heat pump 1 of the present embodiment includes two compressors 10 of the first compressor 10a and the second compressor 10b. The belt 5 is provided and pulled so as to form as an approximately triangle with respect to the pulley 4 and the compressor pulleys 11a, 11b.

[0018] An ON/OFF action of the electromagnetic clutch 20 for driving the compressor 10 having the above construction will be described.

When the electromagnetic clutch 20 is engaged, the ECU 7 applies the current to the coil 17 provided inside of the compressor pulley 11 so as to excite it. The armature 12 slides and absorbs to the side of the compressor pulley 11, due to flux generated in the coil 17 of the compressor pulley 11. The armature 12 and the compressor pulley 11 become unified due to frictional engagement. Briefly, the electromagnetic clutch 20 is engaged, and the input shaft 14 of the compressor 10 is rotatably driven, so as to put the compressor 10 into operation.

Meanwhile, when the electromagnetic clutch 20 is disengaged, i.e., when the coil 17 is not excited, the armature 12 and the compressor pulley 11 are separated across a gap, and the compressor pulley 11 only ticks over. Briefly, the electromagnetic clutch 20 is disengaged, and the driving power of the engine 2 is not transmitted to the input shaft 14 of the compressor 10, so that the compressor 10 is stopped.

[0019] The compressor lock, and the electromagnetic clutch 20 on condition that the compressor is locked will be described.

The compressor lock means a state that the scroll compression mechanism 13 of the compression 10 is immovable, due to the liquid compression, rising of oil, or incorporation of foreign material. When the driving power of the belt 5 is transmitted to the compressor pulley 11 and the starting torque is beyond the given torque (the slippage generating torque), the belt 5 slides to the compressor pulley 11.

[0020] In the present embodiment, the slippage generating torque of the electromagnetic clutch 20 is set up to be the starting torque of the engine 2 (the starter) or

higher. In other words, during the staring on the compression locked condition, the slippage is not generated in the electromagnetic clutch 20 and the engine 2 and the compressor 10 can not be rotated even when the electromagnetic clutch 20 is engaged, so that the engine 2 can not be started and the operation is locked.

[0021] An avoidance control for the operation of the engine driven heat pump having the compressor on the locked condition according to the present invention will be described in detail, with reference to Fig. 3.

The ECU 7 starts the engine 2 (S, Step 110) by receiving ON command for starting the engine drive heat pump 1, or ON command for starting a thermostat when beyond the preset temperature after operating the heat pump (S, Step 100).

The ECU 7 turns s o n two electromagnetic clutches of the electromagnetic clutches 20a, 20b regardless of size of the air-conditioning load. The ECU 7 stops the driving of the starter 6 by outputting an abnormal code E0, when the starter 6 is driven and the rotation speed of the input shaft 14 does not reach the preset rotation speed. When the engine 2 is not continuously stopped at three times or more due to the Eo (S, Step 130) at the preset time t1, i.e., when the engine 2 is normally started, each one of the electromagnetic clutches 20a or 20b is turned off (S, Step 140), the operation for capacity control of the compression 10 is started (S, Step 150).

In this regard, Eo is an abnormal code when at least one compressor 10 is locked, or when the starter 6 cannot be started due to malfunction or the like.

[0022] Meanwhile, the ECU 7 evaluates that at least one compressor 10 is locked (or the starter is abnormal), when the engine 2 is continuously stopped at three times or more due to the Eo (S, Step 130) at the preset time t1. At this time, the ECU 7 evaluates that the operation gets stacked up and entirely stops the engine drive heat pump 1 (S, Step 210). The ECU 7 issues a warning by a warning device, so as to inform the operator of the abnormality. In this regard, the starting clog means a state that the rotating speed of the engine or the compressor does not reach the predetermined rotating speed at the preset time t1, after starting the starting command by the ECU 7.

[0023] Explanation will be given on each sequence of the engine 2 and the compressors 10a, 10b with respect to the avoidance control for the operation of the engine drive heat pump having the compressor on the locked condition., with reference to Figs. 4 and 5.

Figs. 4 and 5 shows time series as the axis of abscissas, and shows the ON/OFF operation of the first compressor (Comp1), the ON/OFF operation of the second compressor (Comp2), and the engine rotation speed (Nrpm) of the engine (Engine) as axis of ordinate.

[0024] Each of the sequences by the compressor lock detection control when the second compressor 10b is locked (Rock) will be described in detail, with reference to Fig. 4.

As shown in Fig. 4, after the engine 2 receive s the starting command for the engine driven heat pump 1, the engine 2 (the starter) cannot start and stops by the Eo, because the second compressor 10b is locked. Since the stop/restart by the E0 is continuously performed at three times during the preset time t1, the engine driven heat pump 1 is totally stopped.

[0025] Thus, at the time of starting the air conditioning, it can be assuredly avoided that the engine driven heat pump 1 is driven with the compressor 10b on the locked condition. Specifically, due to the construction that the driving forces are transmitted to all of the compressors 10a, 10b at the starting, the driving force is also transmitted to the compressor 10b on the locked condition so as to generate the starting clog, thereby stopping the engine driven heat pump 1. Consequently, it can be prevented that the engine driven heat pump 1 is driven by the compressor 10a, with the compressor 10b on the locked condition. In other words, in the engine driven heat pump 1 equipped with two compressors 10a, 10b, the starting of the air conditioning operation can be avoided, if even one compressor is on the locked condition.

[0026] Each of the sequences by the compressor lock detection control when both of the first compressor 10a and the second compressor 10b are normal (Normal) will be described in detail, with reference to Fig. 5. As shown in Fig. 5, at this time, after the engine 2 receives the starting command for the engine driven heat pump 1, the engine 2 (the starter 6) is normally started, as both of the first compressor 10a and the second compressor 10b are normal. After that, since one electromagnetic clutch 20b is disengaged, the engine driven heat pump 1 is driven only by the first compressor 10a. The engine driven heat pump 1 starts the second compressor 10b, corresponding to size of the air-conditioning load, and can be driven by two compressors.

[0027] Thus, the operation can be started from one of the compressor 10a (10b), by disengaging the electromagnetic clutch 20b (20a) after the starting of the engine 2 has finished. Briefly, the capacity control for the compressor corresponding to the air conditioning load can be performed.

[Industrial applicability]

[0028] The present invention is applicable in the engine driven heat pump.

Claims

1. An engine driven heat pump having a plurality of compressors via clutches for the compressors,
   wherein a slippage generating torque of the clutches for the compressors is set up to be a starting torque of the engine or higher, and
   wherein all of the clutches for the compressors are engaged, at the time of starting the engine driven heat pump.

2. The engine driven heat pump as set forth in claim 1, wherein at least one of the clutches for the compressors are disengaged after finishing a starting of the engine.

Fig.1

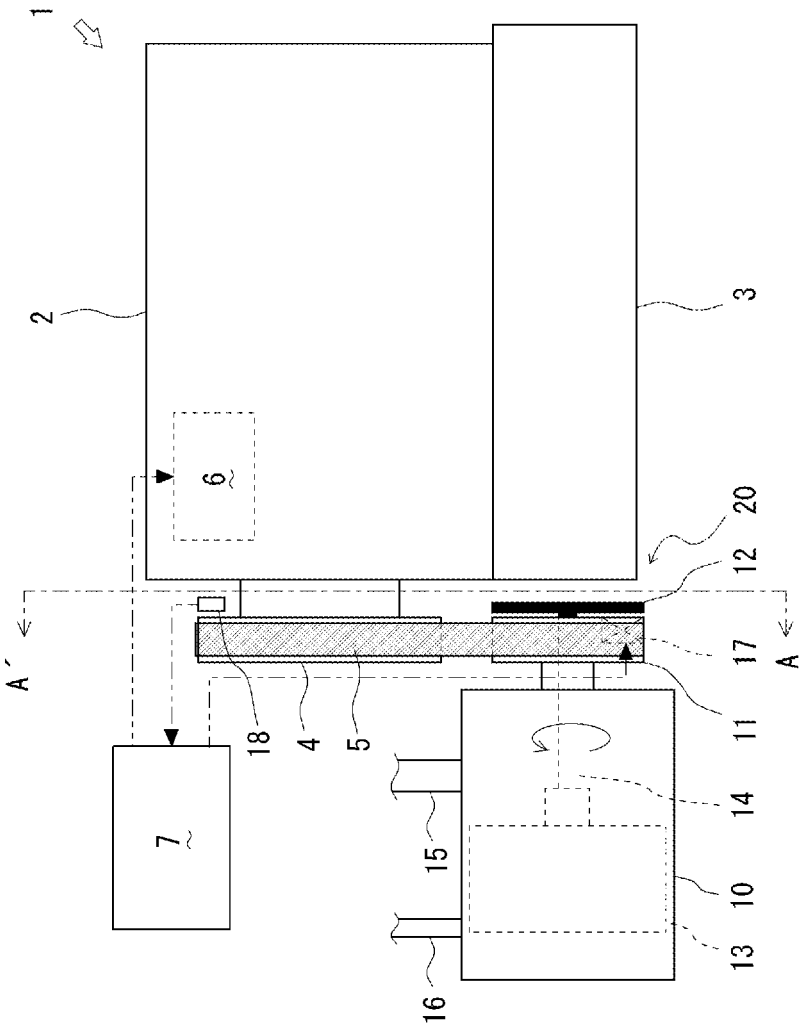


Fig.2

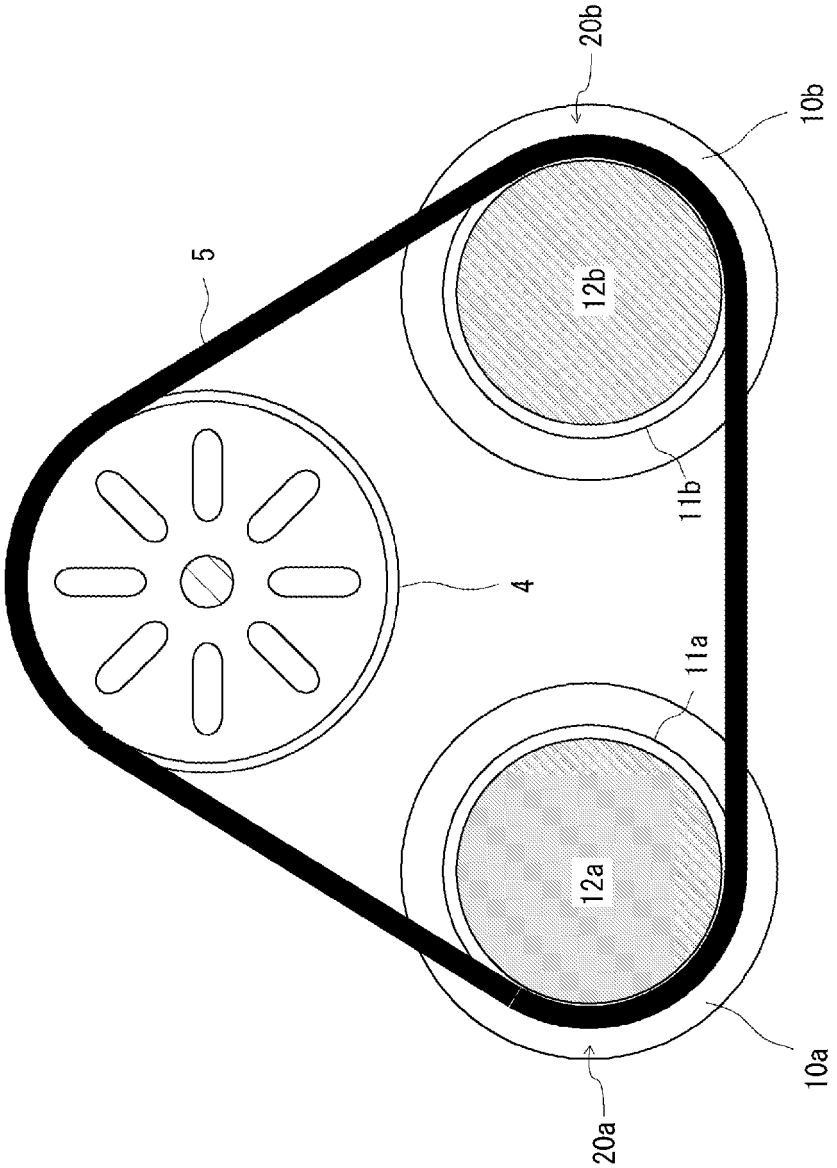


Fig.3

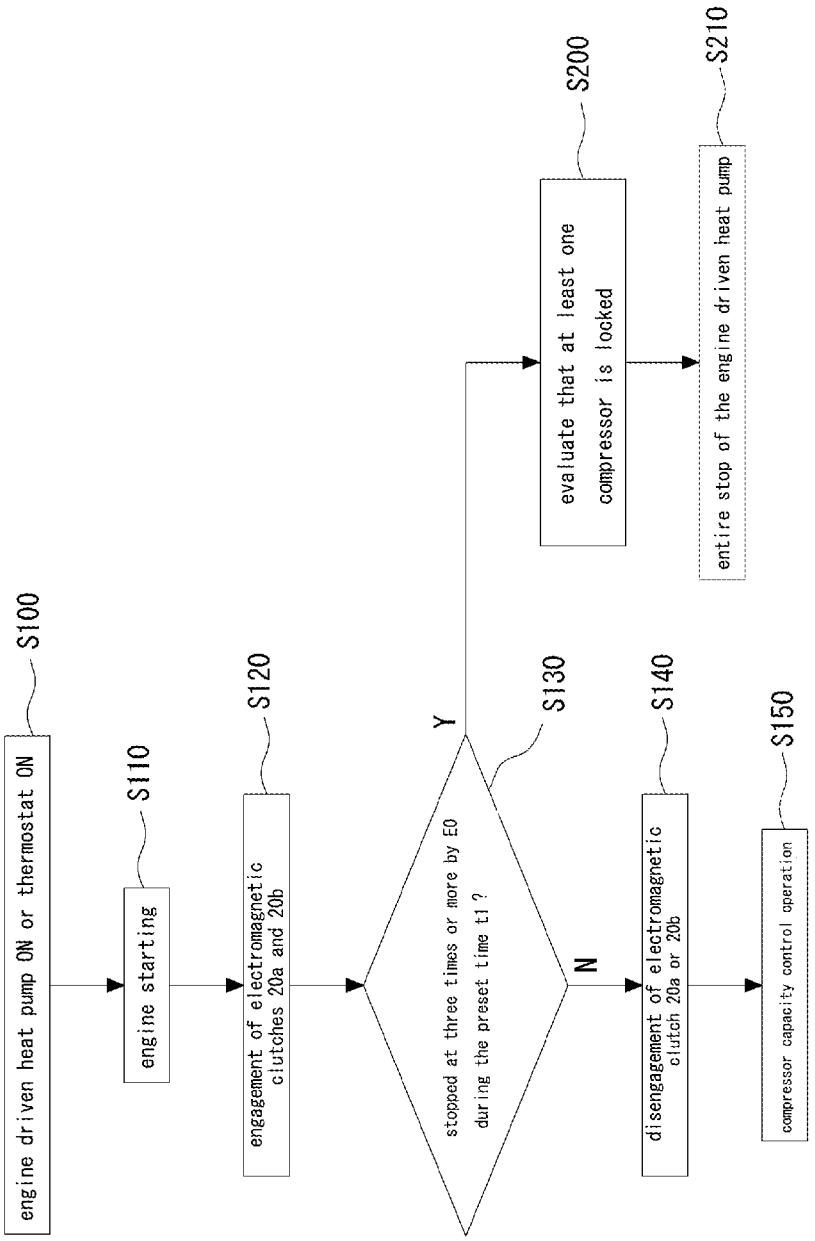

S100
engine driven heat pump ON or thermostat ON
S110
engine starting
S120
engagement of electromagnetic clutches 20a and 20b
S130
stopped at three times or more by EO during the preset time t1 ?
Y
N
S200
evaluate that at least one compressor is locked
S210
entire stop of the engine driven heat pump
S140
disengagement of electromagnetic clutch 20a or 20b
S150
compressor capacity control operation

Fig.4

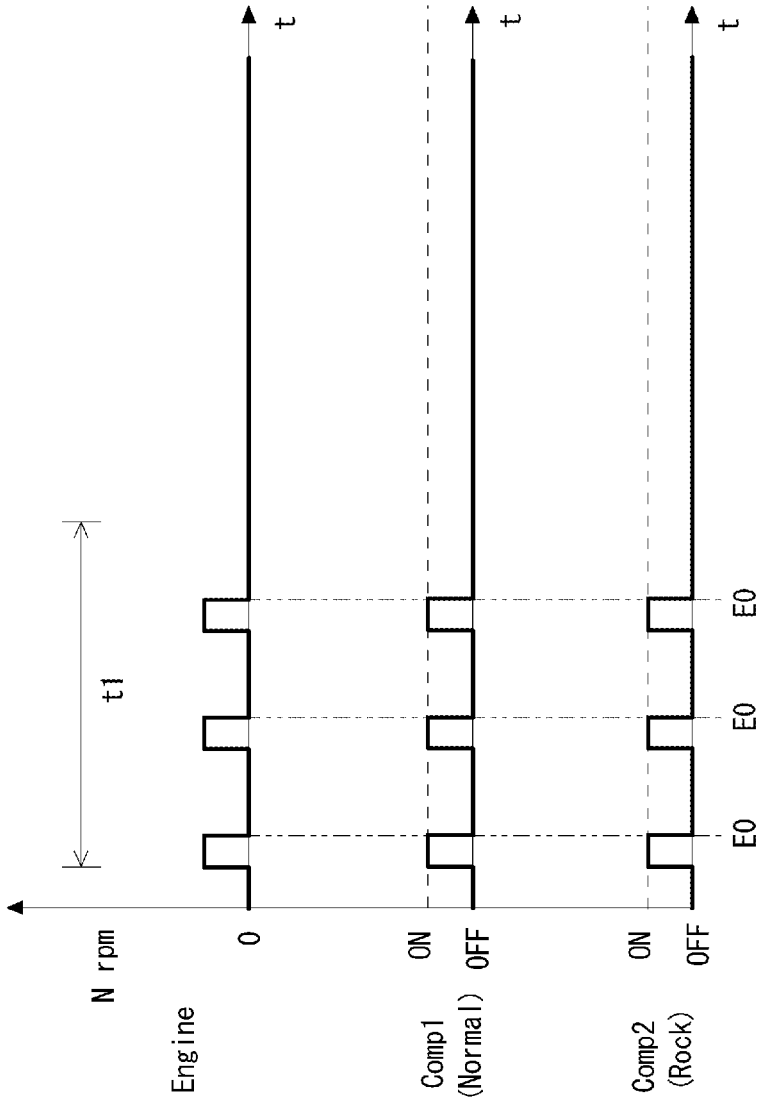
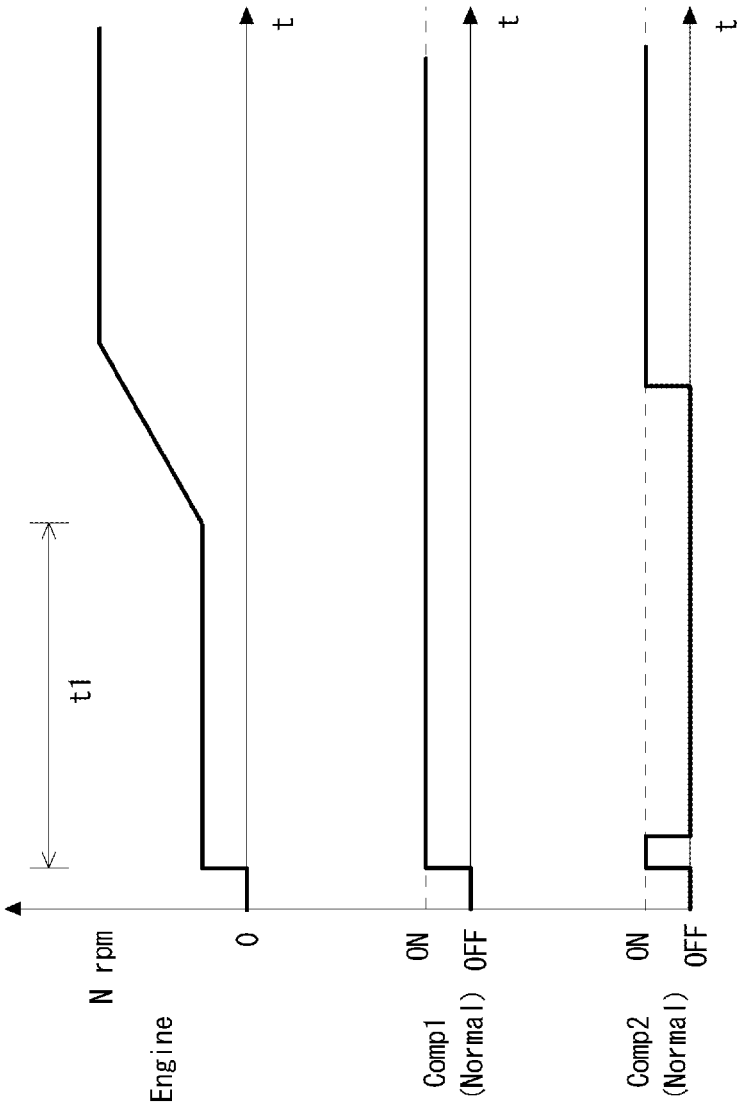

t
t
t
t1
EO
EO
EO
N rpm
0
ON
OFF
ON
OFF
Engine
Comp1
(Normal)
Comp2
(Rock)

Fig.5



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2008/063390

A. CLASSIFICATION OF SUBJECT MATTER
F25B27/00(2006.01)i, *F04B35/00*(2006.01)i, *F24F11/02*(2006.01)i, *F25B1/00*(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)
F25B27/00, F04B35/00, F24F11/02, F25B1/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2008
Kokai Jitsuyo Shinan Koho 1971-2008 Toroku Jitsuyo Shinan Koho 1994-2008

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 4-13059 A (Yamaha Motor Co., Ltd.), 17 January, 1992 (17.01.92), Page 3, lower right column, line 7 to page 4, upper left column, line 11; Fig. 2 (Family: none)	1-2
Y	JP 2000-274455 A (Toyoda Automatic Loom Works, Ltd.), 03 October, 2000 (03.10.00), Claims; Par. Nos. [0001] to [0030]; Figs. 1 to 3 & EP 1039164 A2	1-2
Y	JP 2005-351307 A (Sanden Corp.), 22 December, 2005 (22.12.05), Claims; Par. Nos. [0001] to [0025]; Figs. 1 to 5 (Family: none)	1-2

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

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Date of the actual completion of the international search	Date of mailing of the international search report
28 August, 2008 (28.08.08)	09 September, 2008 (09.09.08)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2008/063390

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 6-213171 A (Daikin Industries, Ltd.), 02 August, 1994 (02.08.94), Full text; all drawings (Family: none)	1-2

Form PCT/ISA/210 (continuation of second sheet) (April 2007)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 6213171 A **[0004]**