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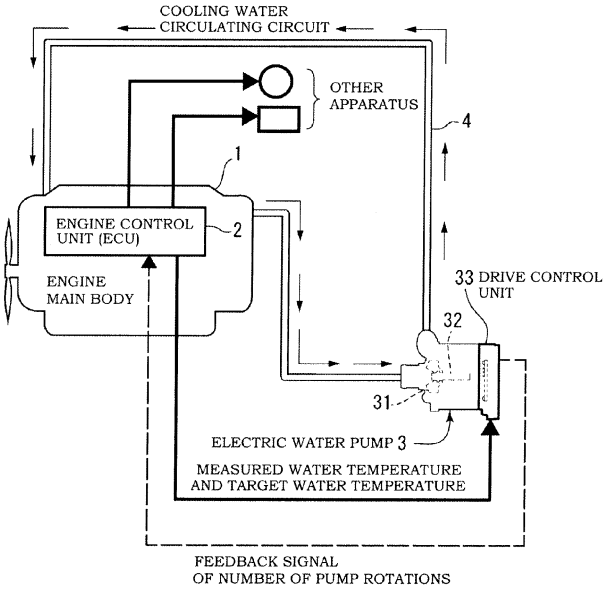
(54) Control apparatus of electric water pump

(57) A control apparatus of an electric water pump (3) of the present invention is configured by an engine control unit (2) on a side of an engine and an electric water pump in a cooling water circulating circuit of the engine. The engine control unit (2) transmits signals of a measured water temperature and a target water temperature of the engine, and the electric water pump (3) includes a drive control unit (33) for executing control of adjusting a flow rate of the water pump on the basis of the signals of the measured water temperature and the target water temperature.

Fig.1A



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Description

[0001] The present invention relates to a cooling apparatus of an engine which can alleviate a burden of an instruction concerning a control of an electric water pump by an engine control unit provided on an engine side, simplify a configuration of the engine control unit, and enable the engine control unit to be provided at a low price.

[0002] In a related art, a cooling water circulating circuit for cooling an engine is provided with an electric water pump. Further, the electric water pump is configured with a cooling temperature of the engine by a situation of operating a vehicle body mounted with the engine. The cooling temperature is controlled by, for example, a flow rate of cooling water flowing in the cooling water circulating circuit.

[0003] The electric water pump controls the flow rate of the cooling water by changing the number of rotations of the pump such that the cooling water of the engine is made to be proper in correspondence with a situation of the engine. Further, all controls in an operation of the water pump are carried out by the engine control unit mounted to the engine side. Japanese Patent Application Laid-open No. 2012-102639 is present as literature which discloses a configuration of this kind.

[0004] According to an electric water pump 6 described in Japanese Patent Application laid-open No. 2012-102639, when a control of a water temperature of cooling water of an engine is carried out, a flow rate necessary for circulating cooling water is determined by an engine control unit (ECU) 9 on a vehicle side at a higher order of the electric water pump 6, and a voltage is applied on the electric water pump 6 by an instruction signal of the ECU 9.

[0005] The electric water pump 6 receives the applied voltage, the electric water pump 6 is rotated, and outputs a signal (rotation signal) based on the actual number of rotations. It is general that the ECU 9 on the vehicle side receives the rotation signal of the electric water pump 6, determines an instruction signal of the ECU 9, and grasps an operation state of the electric water pump 6 based on a map previously recording a relationship between the number of rotations of the electric water pump 6 and an actual flowing flow rate as a table.

[0006] Meanwhile, in the configuration described above, control items of the ECU 9 on the vehicle side are increased and a load on the ECU 9 on the vehicle side is increased. Consequently, the ECU 9 needs an expensive element that is allowed some leeway in a processing speed and a memory capacity. Further, the ECU 9 needs to be adapted in accordance with an output characteristic of the electric water pump 6, and therefore, time and expense are needed for developing the ECU 9 on the vehicle side. In other words, the ECU 9 needs to be readjusted each time the model of the electric water pump 6 is changed, whereby an output characteristic of the electric water pump 6 is changed.

[0007] Hence, the inventors have resolved the problem described above as a result of intensively executing researches to resolve the problem by configuring a first embodiment of the present invention by a control apparatus of an electric water pump, including: in a cooling water circulating circuit of an engine, an engine control unit on a side of the engine; and an electric water pump, wherein the engine control unit transmits signals of a measured water temperature and a target water temperature of the engine, and the electric water pump includes a drive control unit for controlling to adjust a flow rate of the electric water pump on the basis of the signals of the measured water temperature and the target water temperature.

[0008] The problem described above is resolved by a second embodiment of the present invention by the control apparatus of an electric water pump, in which the drive control unit of the electric water pump includes a flow rate map corresponding to the number of rotations of the electric water pump, and executes a control of determining the number of pump rotations with respect to a target flow rate on the basis of the flow rate map in the first embodiment.

[0009] The problem described above is resolved by configuring a third embodiment and a fourth embodiment of the present invention by the control apparatus of an electric water pump, in which the drive control unit of the electric water pump transmits the number of pump rotations and/or a signal of diagnosis information relating to the water pump in the respective first embodiment and the second embodiment.

[0010] According to the present invention, control items of the engine control unit on a vehicle side (engine side) can be reduced, and therefore, a load of the engine control unit is reduced. Consequently, a comparatively inexpensive element can be used for the engine control unit. Further, an adaptation (adjustment) of the engine control unit on the vehicle side in accordance with an output characteristic of the electric water pump is not needed, and therefore, time for developing the engine control unit on the vehicle side can be shortened.

[0011] Further, even when the machine kind of the electric water pump mounted to the engine is changed, and an output characteristic of the electric water pump is changed, the control drive unit on a side of the electric water pump can be used without adjusting the engine control unit at all by adjusting the control drive unit on a side of the electric water pump in accordance with the engine control unit.

[0012] Some examples of control apparatus according to the present invention will now be described with reference to the accompanying drawings, in which:-

FIG. 1A is a configuration diagram of a cooling water circulating circuit, an engine control unit, and a drive control unit of an electric water pump according to the present invention, and FIG. 1B is a configuration diagram of the engine control unit, and the drive con-

trol unit of the electric water pump;

FIG. 2 is a vertical sectional side view showing an example of an electric water pump used in the present invention; and

FIG. 3 is an outline diagram showing that electric water pumps of any of N1 through N3 having different machine kinds can be mounted to one engine control unit mounted to an engine as they are.

[0013] An explanation will be given of embodiments of the present invention in reference to the drawings as follows. A basic configuration of the present invention is shown in FIG. 1A. An engine 1 is a general automobile engine, a gasoline engine or a diesel engine. A cooling water circulating circuit 4 for circulating cooling water is provided at a cylinder head, a cylinder block or the like of the engine 1.

[0014] The cooling water circulating circuit 4 includes an electric water pump 3 for circulating cooling water to the engine 1. The electric water pump 3 carries out cooling or the like requested by the engine by an instruction signal of an engine control unit 2 (also referred to as ECU) described later.

[0015] The engine control unit 2 is mounted to a side of the engine 1. The engine control unit 2 is mainly configured by a processing controller, a memory and the like. The engine control unit 2 is mounted with various kinds of sensors, not illustrated, at prescribed portions of the engine 1, and information concerning a situation of the engine 1 is always transmitted to the engine control unit 2.

[0016] As shown in FIG. 2, the electric water pump 3 is configured by a pump unit 31, a motor unit 32, and a drive control unit 33. The drive control unit 33 is mainly configured by a circuit board and a power device of FET or the like. The drive control unit 33 per se adjusts an optimum delivery amount of the pump unit 31 by controlling the number of rotations of the motor unit 32 in accordance with a temperature situation of the engine 1.

[0017] The engine control unit 2 is electrically connected to the drive control unit 33 of the electric water pump 3. The engine control unit 2 transmits various pieces of information transmitted from the respective sensors of the engine 1 to various kinds of pumps around the engine 1.

[0018] The engine control unit 2 transmits signals of a measured water temperature and a target water temperature of the engine 1 to the drive control unit 33 of the electric water pump 3. Further, the drive control unit 33 of the electric water pump 3 controls to bring about an optimum flow rate of cooling water calculated from the measured water temperature and the target water temperature of the engine 1. Specifically, the drive control unit 33 of the electric water pump 3 includes a flow rate - rotation number map, and the drive control unit 33 per se is made to be able to determine the number of rotations which brings about a target flow rate.

[0019] That is, the engine control unit 2 detects measured water temperatures in various situations of the engine 1, and transmits signals of the measured water temperatures and the target water temperatures from the engine control unit 2 to the drive control unit 33 of the electric water pump 3.

[0020] Particularly, the engine control unit 2 only transmits the measured water temperatures and the target water temperatures to the drive control unit 33 of the electric water pump 3, and does not have a role of controlling the number of rotations of the electric water pump 3 (refer to FIG. 1B). Thereby, an operation burden of the engine control unit 2 is significantly reduced, and an engine control unit 2 is constructed by an extremely simple configuration.

[0021] Further, the drive control unit 33 of the electric water pump 3 which receives a transmission of signals of the measured water temperature and the target water temperature determines the optimum number of rotations or the like for reaching the target water temperature based on the measured water temperature and the target water temperature, controls the number of rotations of the motor unit 32, and operates the cooling water delivered to the engine 1 by a cooling water circulating circuit 4 to reach the target water temperature.

[0022] According to the present invention, the engine control unit 2 includes a control apparatus for detecting the actual number of pump rotations by the drive control unit 33 of the electric water pump 3 and/or diagnosis information relating to the pump unit 31, the motor unit 32, and the drive control unit 33 of the electric water pump 3, and reaching the target water temperature.

[0023] Thereby, also the diagnosis of a failure or the like of the electric water pump 3 which has been carried out in the engine control unit 2 conventionally is made to be able to carry out on a side of the drive control unit 33. Therefore, an operation burden of the engine control unit 2 is significantly reduced, and the engine control unit 2 is constructed by an extremely simple configuration.

[0024] Further, when the cooling water circulating circuit 4 does not reach the target water temperature, a control of the number of rotations of the motor unit 32 is carried out until reaching the target water temperature by a determination on a side of the drive control unit 33 of the electric water pump 3. Thereby, the preset target water temperature can further accurately be reached by means of the engine control unit 2 and the drive control unit 33 of the electric water pump 3.

[0025] According to the present invention, even when a machine kind of the electric water pump 3 is changed and a performance or an output characteristic thereof is changed, the electric water pump 3 can be mounted to the engine without adjusting the engine control unit (ECU) 2 at all by adjusting the drive control unit 33 to adapt to the engine control unit (ECU) 2.

[0026] For example, in a case where a plurality of the electric water pumps 3 of different models with different characteristics as in, for example, N1 through N3 are present as shown in FIG. 3, even the electric water pump 3 of the machine kind of any of N1 through N3 can be

mounted to the engine without readjusting the engine control unit (ECU) 2 by only adjusting the drive control unit 33 of the electric water pump 3 to adapt thereto. Consequently, labor and cost for readjusting the engine control unit (ECU) 2 is not needed at all.

[0027] According to a second embodiment, the drive control unit of the electric water pump includes a flow rate map corresponding to the number of rotations of the electric water pump, a control of determining the number of pump rotations with respect to the target flow rate is carried out based on the flow rate map. Consequently, the stable control can be carried out consistently without being influenced by a dispersion in a delivery performance of the electric water pump, and a processing burden of the engine control unit on the vehicle side can be alleviated.

[0028] According to a third embodiment and a fourth embodiment, the drive control unit of the electric water pump transmits the number of pump rotations and/or a signal of diagnosis information relating to the pump unit or the motor unit of the electric water pump is (are) transmitted to the side of the engine control unit. Thereby, the engine control unit can always monitor the electric water pump, and therefore, a reliability of the control can be improved.

1 engine
2 engine control unit
3 electric water pump
33 drive control unit
4 cooling water circulating circuit

Claims

1. A control apparatus of an electric water pump, comprising: in a cooling water circulating circuit of an engine,
an engine control unit on a side of the engine; and
an electric water pump, wherein
the engine control unit transmits signals of a measured water temperature and a target water temperature of the engine, and
the electric water pump has a drive control unit for controlling to adjust a flow rate of the electric water pump on the basis of the signals of the measured water temperature and the target water temperature.

2. The control apparatus of an electric water pump according to claim 1, wherein the drive control unit of the electric water pump includes a flow rate map corresponding to the number of rotations of the electric water pump, and executes a control of determining the number of pump rotations with respect to a target flow rate on the basis of the flow rate map.

3. The control apparatus of an electric water pump according to claim 1 or 2, wherein the drive control unit of the electric water pump transmits the number of pump rotations and/or a signal of diagnosis information relating to the water pump.

Fig. 1A

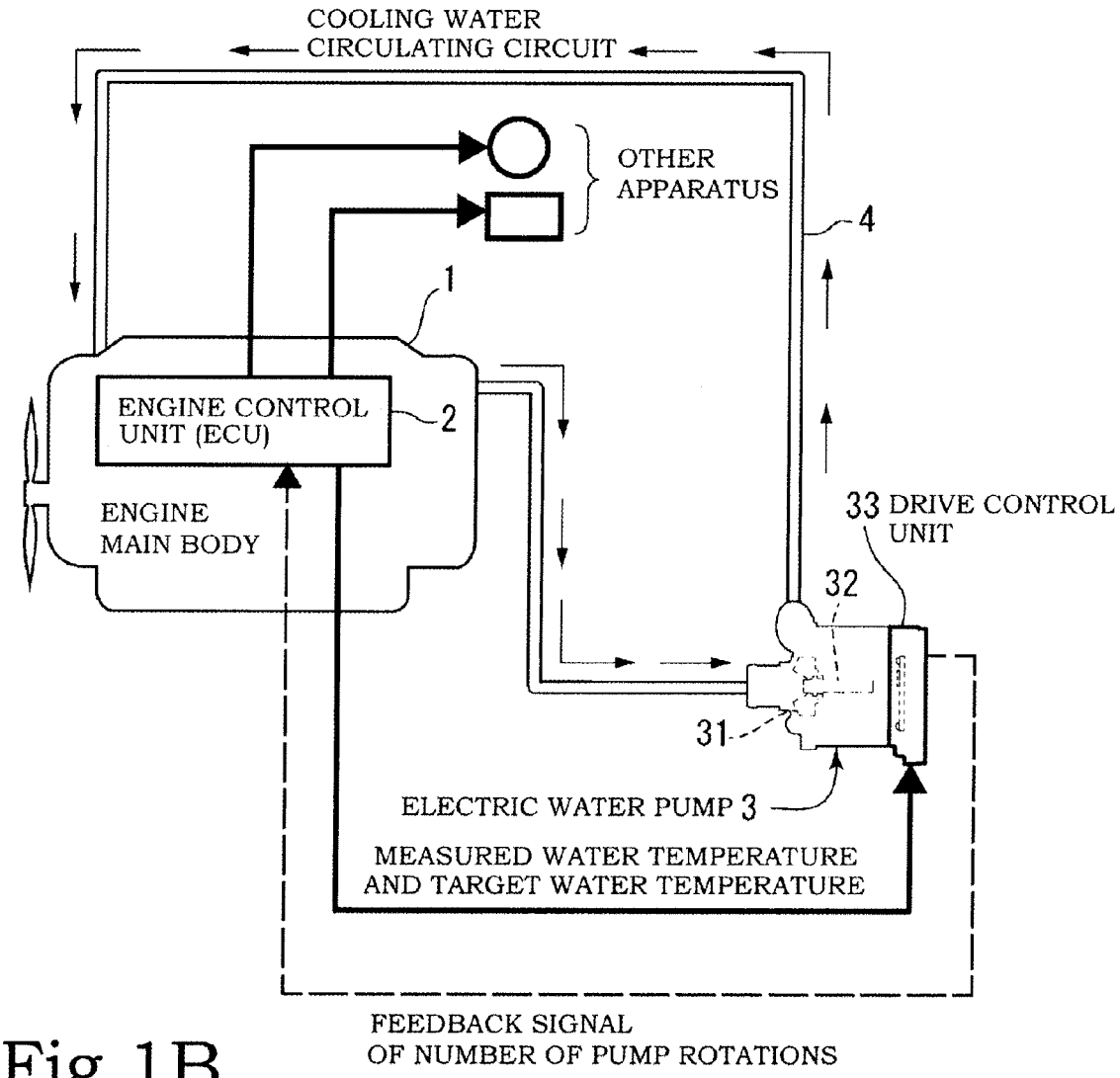

COOLING WATER
CIRCULATING CIRCUIT
OTHER
APPARATUS
4
1
ENGINE CONTROL
UNIT (ECU)
2
ENGINE
MAIN BODY
33 DRIVE CONTROL
UNIT
32
31
ELECTRIC WATER PUMP 3
MEASURED WATER TEMPERATURE
AND TARGET WATER TEMPERATURE
FEEDBACK SIGNAL
OF NUMBER OF PUMP ROTATIONS

Fig. 1B

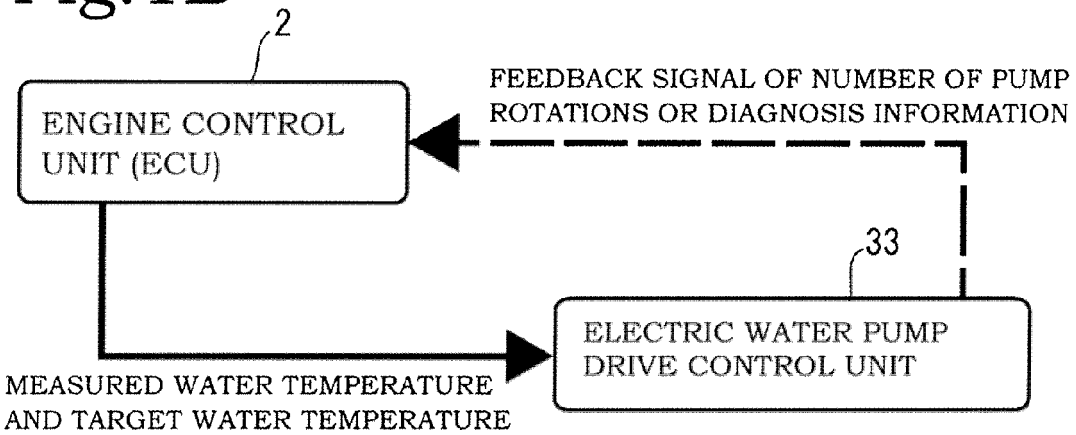

2
ENGINE CONTROL
UNIT (ECU)
FEEDBACK SIGNAL OF NUMBER OF PUMP
ROTATIONS OR DIAGNOSIS INFORMATION
33
ELECTRIC WATER PUMP
DRIVE CONTROL UNIT
MEASURED WATER TEMPERATURE
AND TARGET WATER TEMPERATURE

Fig. 2

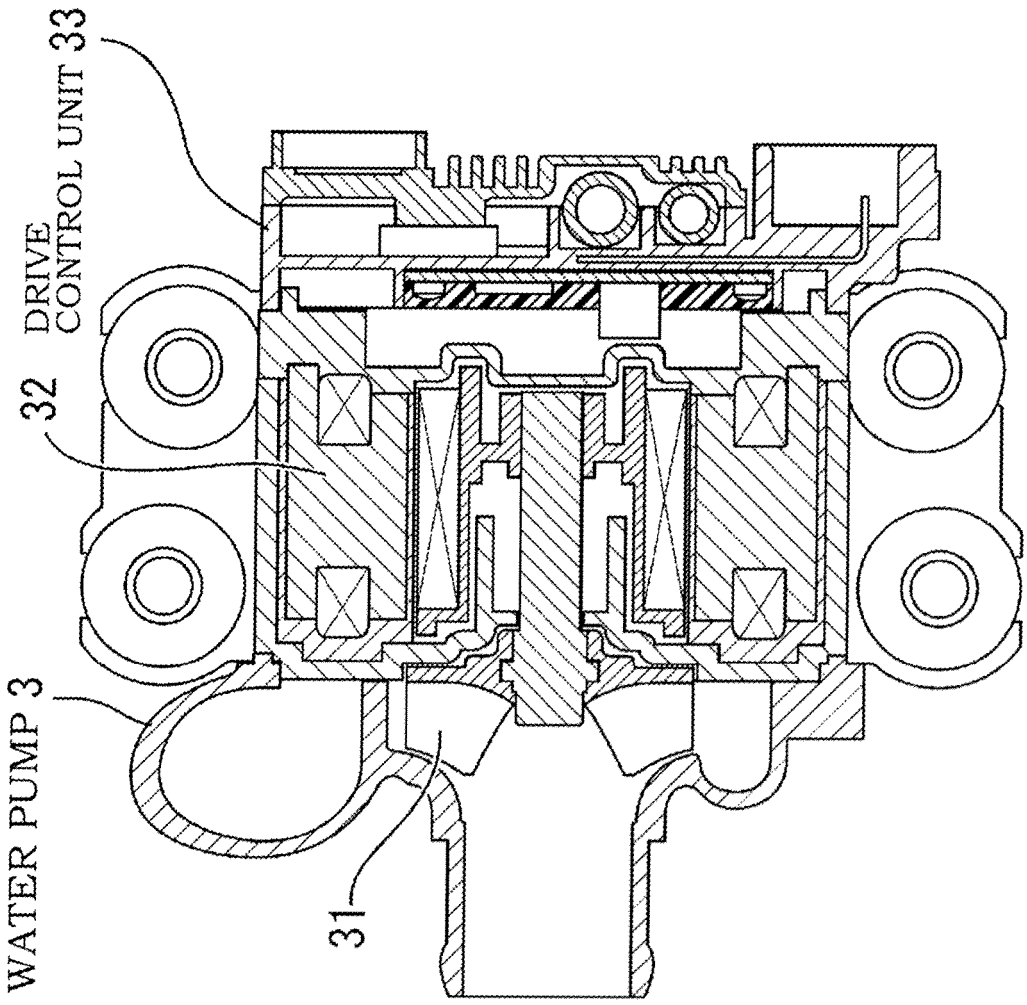
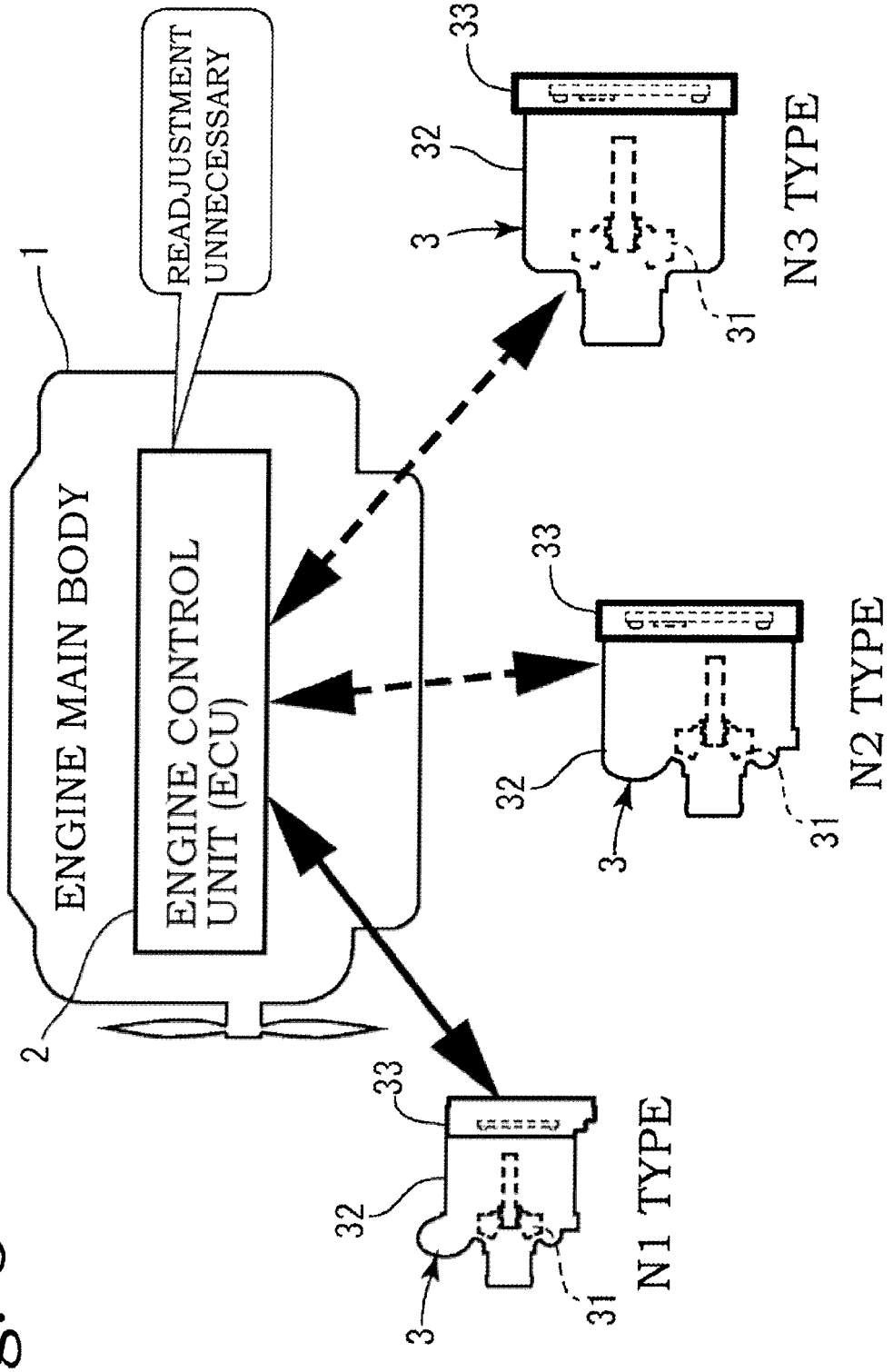


Fig. 3


ENGINE MAIN BODY
ENGINE CONTROL UNIT (ECU)
READJUSTMENT UNNECESSARY
1
2
3
31
32
33
N1 TYPE
N2 TYPE
N3 TYPE

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2012102639 A **[0003] [0004]**