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CA 2395029 C 2006/08/29

(11)(21) **2 395 029**

(12) **BREVET CANADIEN**
CANADIAN PATENT

(13) **C**

(22) **Date de dépôt/Filing Date:** 2002/07/25
(41) **Mise à la disp. pub./Open to Public Insp.:** 2003/03/07
(45) **Date de délivrance/Issue Date:** 2006/08/29
(30) **Priorité/Priority:** 2001/09/07 (JP2001-272568)

(51) **Cl.Int./Int.Cl.** *B62K 21/08* (2006.01)

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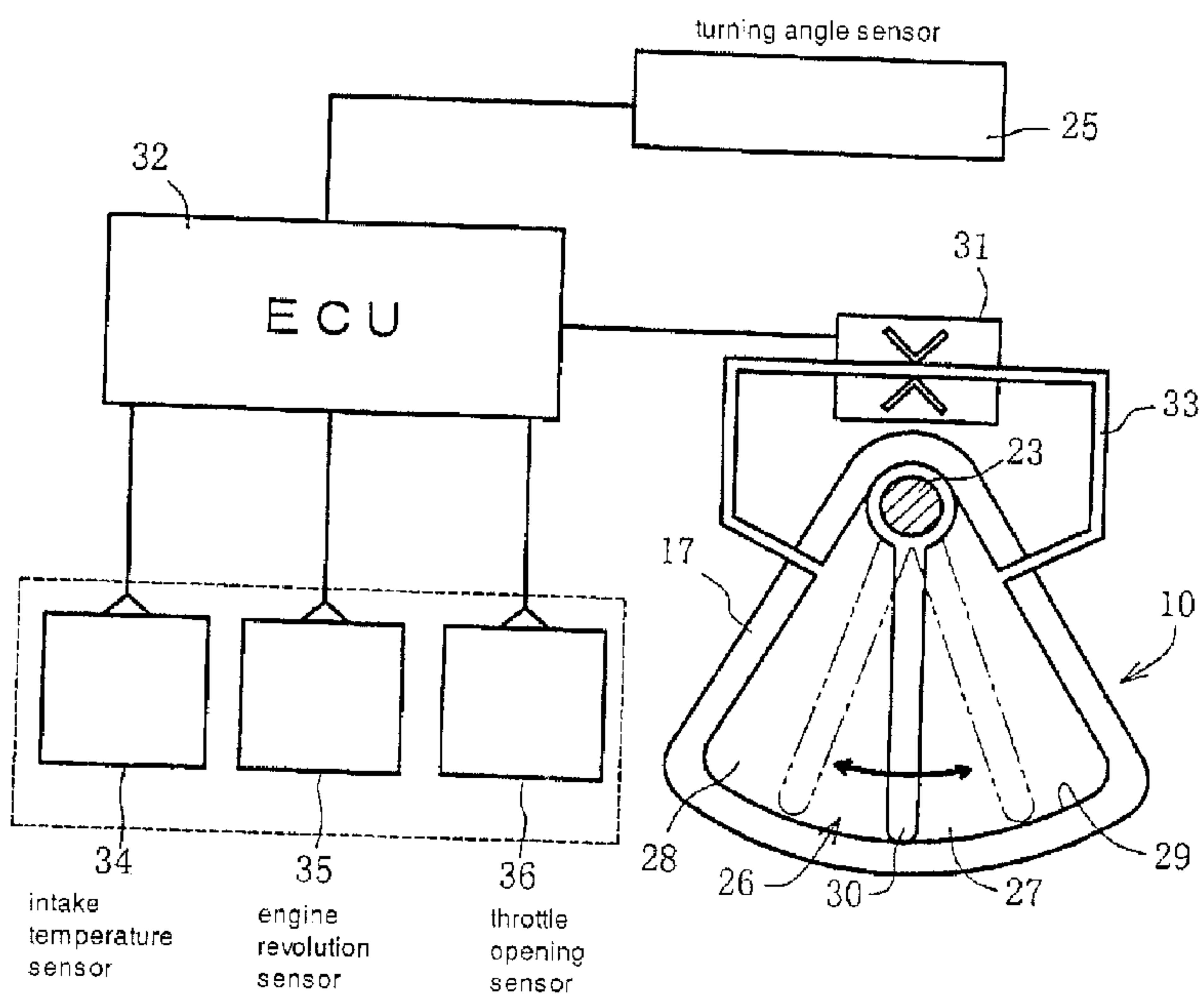
(54) **Titre :** AMORTISSEUR DE DIRECTION
(54) **Title:** STEERING DAMPER APPARATUS



(57) **Abrégé/Abstract:**
In a steering damper utilizing hydraulic pressure, even if generation of damping force is controlled in correspondence with external force inputted to a handle upon external perturbations and the like, the damping force changes due to change in liquid temperature of working liquid. Accordingly, to precisely control the damping force, correction based on change in liquid temperature of the working liquid is required. However, to measure the change in liquid temperature of the working liquid, it is necessary to provide particular measurement means requiring a complicated structure, which increases the number of parts and costs. Accordingly, the present invention has an object to provide a steering damper which can easily temperature-correct the damping force without such difficulty. A liquid chamber 26 is provided in a main body 17 of a steering damper 10, and its inside is partitioned into a right liquid chamber 27 and a left liquid chamber 28 by a rotatable partition wall 30 integral with a shaft 23 coaxial with a steering shaft 14. The both liquid chambers are connected with each other by a liquid passage 33, and a control valve 31 is provided in the middle of the passage such that the damping force is variable. A control device 32 drive-controls the control valve 31 in correspondence with a turning angle speed of the shaft 23 and the partition wall 30, thereby controls the damping force, and corrects the damping force based on intake temperature information detected by an intake temperature sensor 34.

ABSTRACT OF THE DISCLOSURE

In a steering damper utilizing hydraulic pressure, even if generation of damping force is controlled in correspondence with external force inputted to a handle upon external perturbations and the like, the damping force changes due to change in liquid temperature of working liquid. Accordingly, to precisely control the damping force, correction based on change in liquid temperature of the working liquid is required. However, to measure the change in liquid temperature of the working liquid, it is necessary to provide particular measurement means requiring a complicated structure, which increases the number of parts and costs. Accordingly, the present invention has an object to provide a steering damper which can easily temperature-correct the damping force without such difficulty. A liquid chamber 26 is provided in a main body 17 of a steering damper 10, and its inside is partitioned into a right liquid chamber 27 and a left liquid chamber 28 by a rotatable partition wall 30 integral with a shaft 23 coaxial with a steering shaft 14. The both liquid chambers are connected with each other by a liquid passage 33, and a control valve 31 is provided in the middle of the passage such that the damping force is variable. A control device 32 drive-controls the control valve 31 in correspondence with a turning angle speed of the shaft 23 and the partition wall 30, thereby controls the damping force, and corrects the damping force based on intake temperature information detected by an intake temperature sensor 34.

TITLE: Steering Damper Apparatus

FIELD OF THE INVENTION

This invention relates to a hydraulic steering damper apparatus for motorcycle used for suppressing oscillation of handle upon running, and more particularly, to an apparatus which produces a variable damping force.

BACKGROUND OF THE INVENTION

To prevent oscillation of handle due to kick-back upon external perturbations, a hydraulic steering damper apparatus which produces a damping force to the oscillation is known (as an example, Japanese Patent No. 2593461). Further, an apparatus for producing a variable damping force arranged to produce a damping force only when necessary, while not to produce the damping force in other cases, is known. For example, an apparatus which performs control based on a steering angle and a running speed (Japanese Published Unexamined Patent Application No. Sho 63-64888) and an apparatus which performs control based on a change in load on a front wheel (Japanese Published Examined Patent Application No. Hei 7-74023) are known.

In the steering damper utilizing hydraulic pressure as described above, even if generation of damping force is controlled in correspondence with external force inputted to the handle upon external perturbations and the like, the damping force changes due to change in liquid temperature of working liquid. Accordingly, to precisely control the damping force, correction based on change in liquid temperature of the working liquid is required. However, any hydraulic steering damper in consideration of such correction has not been known. Further, to measure the change in liquid temperature of the working liquid, it is necessary to provide measurement means requiring a complicated structure, which increases the number of parts and costs. Accordingly, the present invention has an object to provide a steering damper which can easily temperature-correct the damping force without such difficulty.

SUMMARY OF THE INVENTION

To solve the above problem, the present invention is characterized by a steering damper apparatus in a hydraulic steering damper apparatus which applies a damping force to a rotation operation of a front wheel steering system supported by a vehicle body front part and which produces the damping force as a variable force, wherein a value of said damping force is corrected based on a temperature measured by a temperature sensor provided in a predetermined position of said vehicle body.

In an aspect, the present invention is characterized in the apparatus described above, said temperature sensor is provided for measurement of intake air temperature around an intake device.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention are shown in the drawings, wherein:

[Fig. 1] A perspective view of motorcycle to which the working example is applied

[Fig. 2] A side view of the vehicle front part showing the steering damper device portion

[Fig. 3] A plan view of the above portion

[Fig. 4] A diagram showing the schematic structure of the steering damper

[Fig. 5] A constructional diagram of the electronic fuel injection system

[Fig. 6] A graph showing the temperature correction method

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

According to the present invention, as the damping force can be temperature-controlled based on the temperature measured by the temperature sensor provided in the predetermined position of the vehicle body, the damping force can be corrected in correspondence with temperature change of the working liquid. Accordingly, the damping force can be more appropriate corresponding to an actual temperature.

In addition, the amount of heat generation of the steering damper itself is small, and the liquid temperature of the working liquid can be predicted from surrounding temperature outside the steering damper. Accordingly, as the liquid temperature of the working liquid in the steering damper is not directly measured but the temperature measured by the temperature sensor provided in a different place from that of the steering damper in the vehicle body can be used, the complicated particular measurement means can be omitted, and the temperature detection can be simplified.

According to the present invention, the intake temperature sensor which is indispensable in e.g. an electronic fuel injection system is utilized and its temperature information is used. Accordingly, any special temperature sensor for steering damper is not necessary. This improves the efficiency of use of parts, and reduces the number of parts and costs.

Hereinbelow, a first working example will be described with reference to the drawings. Fig. 1 is a perspective view of motorcycle to which the present working example is applied; Fig. 2, a structural side view of vehicle body front part where a steering damper is provided; Fig. 3, a plane view of the same part; Fig.

4, a diagram showing the schematic structure of the steering damper; Fig. 5, a constructional diagram of a fuel injection system; and Fig. 6, a graph showing a temperature correction method.

In Fig. 1, an upper part of a front fork 2 supporting a front wheel 1 at its lower end is coupled to a front part of a vehicle body frame 3 and is rotatable by a handle 4. A fuel tank 5 is supported on the vehicle body frame 3. Reference numeral 6 denotes a seat; 7, a rear cowl; 8, a rear swing arm; and 9, a rear wheel.

Next, the steering damper will be described. As shown in Figs. 2 and 3, a steering damper 10 is provided between a top bridge 11 to which the handle 4 is attached and a head 3a as a front end of the vehicle body frame 3. The top bridge 11 is integrated with a bottom bridge 12 in a lower position in pair, holding a steering shaft 14 supported by a head pipe 13 therebetween. These top bridge 11 and bottom bridge 12 and the steering shaft 14 integrally rotate.

Respective upper parts of pair of left and right front forks 2 are supported by the top bridge 11 and the bottom bridge 12. The head pipe 13 is a pipe-shaped part integrally formed with the head 3a of the vehicle body frame 3. Note that the vehicle body frame 3 has the head 3a and a main frame 3b as a pair of left and right parts extending left rearward and right rearward from left and right positions of the rear end of the head (Fig. 3). A stay 11a projecting frontward is provided integrally with a front central portion of the top bridge 11. A main switch 15 integral with a handle lock is supported here, and is turned ON/OFF and unlocked by a key 16.

The steering damper 10 of the present working example is a hydraulic damper to prevent kick back. It has a main body 17 and a lid 18 (Fig. 2), and its rear side is fastened to a boss 21, projecting above and integrally formed with an upper surface of the head 3a of the vehicle body frame 3 around the head pipe 13, by a bolt 20. At this time, the main body 17 and the lid 18 are integrated by fastening. The boss 21 is previously provided with a nut.

A step 3c which is one-level higher is formed in a rear upper surface of the head 3a in left and right positions of the boss 21, and a stay 5a formed in left and right positions in a front end of the fuel tank 5 is attached here via rubber 22a by a bolt 22b in vibration proof status. The stay 5a is projected toward the vehicle body central side from both sides of front end of a concave member 5b opened frontward and upward at a front center of the fuel tank 5, and overlapped with the step 3c around a position where the front end of the main frame 3b is connected.

An air cleaner 19 is provided under the fuel tank 5, and its front end is attached to an attachment member 3d at a rear end of the head 3a by a bolt 19a in a position below the concave member 5b. The attachment member 3d is projected continuously from the step 3c rearward and toward a position below the concave member 5b (Fig. 2).

A shaft 23 is provided with its axial line directed upward and downward in Fig. 2 through a front part of the steering damper 10. A lower end of the shaft 23 is projected downward from a main body 17 of the steering damper 10 and is engaged with an upper end of the steering shaft 14, and integrally rotatably coupled thereto. A shaft 23 is provided coaxially with the steering shaft 14. Numeral 24 is a steering nut which fastens the upper end of the steering shaft 14 to the top bridge 11. The lower end of the shaft 23 is passed through a hole formed in a central portion of the steering nut 24.

The upper part side of the shaft 23 passes upward through the lid 18, and its upper end enters a turning angle sensor 25 fixed on the lid 18. The turning angle sensor 25 is a well known sensor using an electric resistor or the like. The sensor detects a turning angle of relative rotation of the shaft 23 to the main body 17 of the steering damper 10, thereby detects a turning angle of the steering shaft 14 which integrally rotates with the shaft 23, and outputs a detection signal to a control device to be described later.

The steering damper 10 in Fig. 3 shows the structure on the main body 17 side except the lid 18. Numeral 26 denotes an approximately sector-shaped liquid chamber formed by a concave member provided in the main body 17; 27, a right liquid chamber; 28, a left liquid chamber; 30, a partition wall separating these left and right liquid chambers with one end integrated with the shaft 23 to rotate integrally with the shaft 23; 31, a control valve; and 32, the above-described control device.

Note that the steering lock 15, the steering shaft 14 and the shaft 23 are positioned on approximately the same straight line to a vehicle body center line C. The steering lock 15, the control valve 31 and the control device 32 are positioned on opposite sides in frontward and rearward directions with the steering damper 10 therebetween. The control valve 31 and the control device 32 are provided in left and right positions with the vehicle body center line C therebetween, and the control valve 31 and the control device 32 are attached to a rear part of the main body 17.

Fig. 4 schematically shows the structure of the steering damper 10. Note that the figure is provided for explanation of principle, and for the sake of explanation, the arrangement of the control valve 31, the control device 32 and a liquid passage shown in this figure to be described later are opposite to the actual arrangement in Fig. 3, i.e., on the vehicle body front side to the liquid chamber 26. In this figure, in the steering damper 10, the sector-shaped liquid chamber 26 expanding rearward is provided, and the shaft 23 is positioned in the pivotal point of the sector. The inside of the liquid chamber 26 is separated into two parts, the right liquid chamber 27 and the left liquid chamber 28 by the partition wall 30 extending rearward in shape of wing integrally with the shaft 23.

An end of the partition wall 30 has a slide surface which rotates along an inner surface of an arc wall 29 of the liquid chamber 26. The right liquid chamber 27 and the left liquid chamber 28 are filled with non-compressive type liquid such as oil, and communicated with each other via a liquid passage 33. Accordingly, when the front wheel performs oscillation leftward and rightward, the working liquid moves from one liquid chamber, where the capacity is reduced by rotation of the partition wall 30 interlocked with the front wheel via the steering shaft 14 and the shaft 23 (phantom line in Fig. 3), through the liquid passage 33, to the opposite expanded liquid chamber in correspondence with the change in capacity of liquid chamber.

A control valve 31 is provided in a middle part of the liquid passage 33. The control valve 31 has a variable throttle passage to cause a damping force. By this arrangement, a variable damping force can be generated by limiting the liquid movement of the working liquid in accordance with change in capacity between the above-described left and right liquid chambers, by changing a cross-sectional area of the throttle passage. In the present working example a linear solenoid which linearly moves its driving member is used.

The throttle of the control valve 31 is controlled by the control device 32. The control device 32, comprising an ECU or the like, calculates a turning angle speed by differentiating a turning angle based on the detection signal from the turning angle sensor 25 by time, and controls the damping force to an appropriate value by changing the throttle of the control valve 31 in correspondence with the turning angle speed. Further, as described later, the control device inputs respective detection signals from e.g. an intake temperature sensor 34, a throttle opening sensor 35 and an engine revolution sensor 36 constructing a sensor group of an electronic fuel injection system as correction sensor signals, in accordance with necessity, and corrects the damping force.

Fig. 5 is a constructional diagram of the fuel injection system. An intake air temperature is detected by the intake temperature sensor 34 provided around a connection portion between an exit of an air cleaner 19 and an intake passage 40, the throttle opening sensor 35 is provided in an intermediate portion of the intake passage 40 to detect an opening of a throttle valve 41, and the engine revolution sensor 36 is provided around a crankshaft of the engine 42 for detection of the number of engine revolutions.

In the figure, reference numeral 43 denotes an injector for electronic fuel injection; 44, a fuel pump; 45, an ECU as a control device of the electronic fuel injection system; and 46, a vehicle body speed sensor.

Next, operations of the present working example will be described. Upon travel in a straight line, a rider holds the handle in a neutral position, however, when the front wheel 1 performs oscillation due to road surface condition, the control device 32 generates a damping force in proportional relation to the angle of oscillation from a normal set value as represented by a straight solid line in Fig. 6. Fig. 6 is a graph representing the turning angle speed of the steering shaft 14 on the horizontal axis while the damping force (damper torque) on the vertical axis, in which the normal set value represented by the solid line shows the turning angle speed of the steering shaft 14 and the value of damping force to be generated in the steering damper 10 when the working liquid of the steering damper 10 is at a reference temperature (e.g., a normal temperature).

Accordingly, when the turning angle speed of the steering shaft 14 is small, a small damping force is generated to attain agile handle operation. As the turning angle speed of the steering shaft 14 increases, a greater damping force is generated to appropriately regulate the rotation of the partition wall 30, further appropriately regulate the rotation of the steering shaft 14 via the shaft 23, thereby effectively prevent kick back.

Further, when the temperature of the working liquid changes, the concentration also changes, accordingly, even in the liquid movement amount of the same volume, the frequency of generation of damping force differs depending on the temperature of the working liquid. When the temperature of the working liquid is higher than the reference temperature, a high-temperature correction line having a slope less than the normal set value, as represented by a broken line in Fig. 6, is used so as to reduce the frequency of generation of damping force with respect to the turning angle speed, thereby correction can be made to an appropriate value so as to attain actually the same damping force to be generated at the reference temperature.

When the temperature of the working liquid is lower than the reference temperature, a low-temperature correction line having a slope greater than the normal set value, as represented by an alternate long and short dashed line in Fig. 6, is used so as to appropriately correct the damping force. In this manner, as the damping force can be corrected in correspondence with temperature change of the working liquid, an appropriate damping force can always be generated regardless of the temperature change of the working liquid.

This temperature correction is performed based on the temperature detected by the intake temperature sensor 34. That is, if the temperature detected by the intake temperature sensor 34 is shifted to a value higher or lower than the reference temperature, the control device 32 calculates an appropriate damping force by using one of the above-described high-temperature and low-temperature correction lines and drive-controls the control valve 31.

At this time, as the degree of heat generation by the steering damper 10 itself is negligible, the temperature of the working liquid can be estimated as about the same as the atmospheric temperature, and the atmospheric temperature can be regarded as similar to the intake air temperature detected by the intake temperature sensor 34. Accordingly, the temperature detected by the intake temperature sensor 34 can be utilized as the temperature of the working liquid. As the liquid temperature of the working liquid in the steering damper 10 is not directly measured but the temperature measured by the temperature sensor 34, provided around the connection portion between the air cleaner 19 and the intake passage 40 on the downstream in a position different from that of the steering damper 10 in the vehicle body, can be used, complicated particular measurement means can be omitted and the temperature detection can be simplified.

Further, as the intake temperature sensor 34 is an indispensable constituent sensor in the electronic fuel injection system, by utilizing this sensor, a particular sensor for detection of working liquid temperature can be omitted and the efficiency of use of parts can be improved, further, the sensor structure in the hydraulic steering damper 10 can be simplified, and the number of parts and costs can be reduced.

Note that further various corrections can be applied in addition to the above-described temperature correction. For example, if correction is performed based on a throttle opening speed obtained by differentiating the throttle opening detected by the throttle opening sensor 35 by time, the damping force can be corrected in correspondence with change in acceleration of vehicle body. Further, if the throttle opening is added to it, further precise correction can be made.

Further, with the above-described throttle opening speed and throttle opening, the number of engine revolutions detected by the engine revolution sensor 36 can be applied, and further, a gear position signal detected by a gear position switch (not shown) can be applied. This enables correction more precisely corresponding to actual running status.

Note that the present invention is not limited to the above-described working examples but various modifications and applications can be made within the same principle of the invention. For example, any other temperature sensor than the intake temperature sensor 34 may be used as long as it is provided on the vehicle body outside the steering damper 10. Further, even if the intake temperature sensor 34 is utilized, the intake device provided around it is not necessarily the electronic fuel injection system but may be a natural intake type device such as a carburetor.

Although various preferred embodiments of the present invention have been described herein in detail, it will be appreciated by those skilled in the art, that variations may be made thereto without departing from the spirit of the invention or the scope of the appended claims.

What is claimed is:

1. A hydraulic steering damper apparatus which applies a damping force to a rotation operation of a front wheel steering system supported by a vehicle body front part and which produces the damping force as a variable force, wherein a value of said damping force is corrected based on a temperature measured by a temperature sensor provided in a predetermined position of the vehicle body.

2. The hydraulic steering damper apparatus according to claim 1, wherein said temperature sensor is provided for measurement of intake air temperature around an intake device.

3. The hydraulic steering damper apparatus according to claim 1, wherein when the measured temperature is higher than a reference temperature, a high-temperature correction line having a slope less than a normal set value is used so as to reduce a frequency of generation of the damping force with respect to a turning angle speed.

4. The hydraulic steering damper apparatus according to claim 1, wherein when the measured temperature is lower than a reference temperature, a low-temperature correction line having a slope greater than a normal set value is used so as to increase a frequency of generation of the damping force with respect to a turning angle speed.

5. The hydraulic steering damper apparatus according to

claim 2, wherein when the measured temperature is higher than a reference temperature, a high-temperature correction line having a slope less than a normal set value is used so as to reduce a frequency of generation of the damping force with respect to a turning angle speed.

6. The hydraulic steering damper apparatus according to claim 2, wherein when the measured temperature is lower than a reference temperature, a low-temperature correction line having a slope greater than a normal set value is used so as to increase a frequency of generation of the damping force with respect to a turning angle speed.

7. A vehicle, comprising:

a vehicle body frame;

a front fork, said front fork supporting a front wheel at a lower end thereof, said front fork being coupled to a front part of said vehicle body frame and rotatable by a handle; and

a steering damper, said steering damper being provided between a top bridge to which the handle is attached and a front of said vehicle body frame, said top bridge being integrated with a bottom bridge, holding a steering shaft supported by a head pipe therebetween, said top bridge, said bottom bridge and the steering shaft being integrally rotatable, said steering damper applies a variable damping force to a rotation operation of said top bridge, said bottom bridge and said steering shaft,

wherein a value of said damping force is corrected based on a temperature measured by a temperature sensor provided in a predetermined position of said vehicle body.

8. The vehicle according to claim 7, wherein said temperature sensor is provided for measurement of intake air temperature around an intake device.

9. The vehicle according to claim 7, wherein when the measured temperature is higher than a reference temperature, a high-temperature correction line having a slope less than a normal set value is used so as to reduce a frequency of generation of the damping force with respect to a turning angle speed.

10. The vehicle according to claim 7, wherein when the measured temperature is lower than a reference temperature, a low-temperature correction line having a slope greater than a normal set value is used so as to increase a frequency of generation of the damping force with respect to a turning angle speed.

11. The vehicle according to claim 8, wherein when the measured temperature is higher than a reference temperature, a high-temperature correction line having a slope less than a normal set value is used so as to reduce a frequency of generation of the damping force with respect to a turning angle speed.

12. The vehicle according to claim 8, wherein when the

measured temperature is lower than a reference temperature, a low-temperature correction line having a slope greater than a normal set value is used so as to increase a frequency of generation of the damping force with respect to a turning angle speed.

13. The vehicle according to claim 7, wherein a rear side of said steering damper is fastened to a boss projecting above and integrally formed with an upper surface of said front of said vehicle body frame by a bolt, said steering damper further comprising a main body and a lid integrated together by fastening with said bolt.

14. A steering damper assembly for a vehicle, comprising:

a steering damper, said steering damper being mounted between a top bridge and a front of a vehicle body frame of the vehicle, said top bridge being integrated with a bottom bridge, holding a steering shaft supported by a head pipe therebetween, said top bridge, said bottom bridge and the steering shaft being integrally rotatable, said steering damper applying a variable damping force to a rotation operation of said top bridge, said bottom bridge and said steering shaft,

wherein a value of said damping force is corrected based on a temperature measured by a temperature sensor provided in a predetermined position of said vehicle body.

15. The steering damper assembly according to claim 14, wherein said temperature sensor is provided for measurement of intake air temperature around an intake device.

16. The steering damper assembly according to claim 14, wherein when the measured temperature is higher than a reference temperature, a high-temperature correction line having a slope less than a normal set value is used so as to reduce a frequency of generation of the damping force with respect to a turning angle speed.

17. The steering damper assembly according to claim 14, wherein when the measured temperature is lower than a reference temperature, a low-temperature correction line having a slope greater than a normal set value is used so as to increase a frequency of generation of the damping force with respect to a turning angle speed.

18. The steering damper assembly according to claim 15, wherein when the measured temperature is higher than a reference temperature, a high-temperature correction line having a slope less than a normal set value is used so as to reduce a frequency of generation of the damping force with respect to a turning angle speed.

19. The steering damper assembly according to claim 15, wherein when the measured temperature is lower than a reference temperature, a low-temperature correction line having a slope greater than a normal set value is used so as to increase a frequency of generation of the damping force with respect to a turning angle speed.

Fig. 1

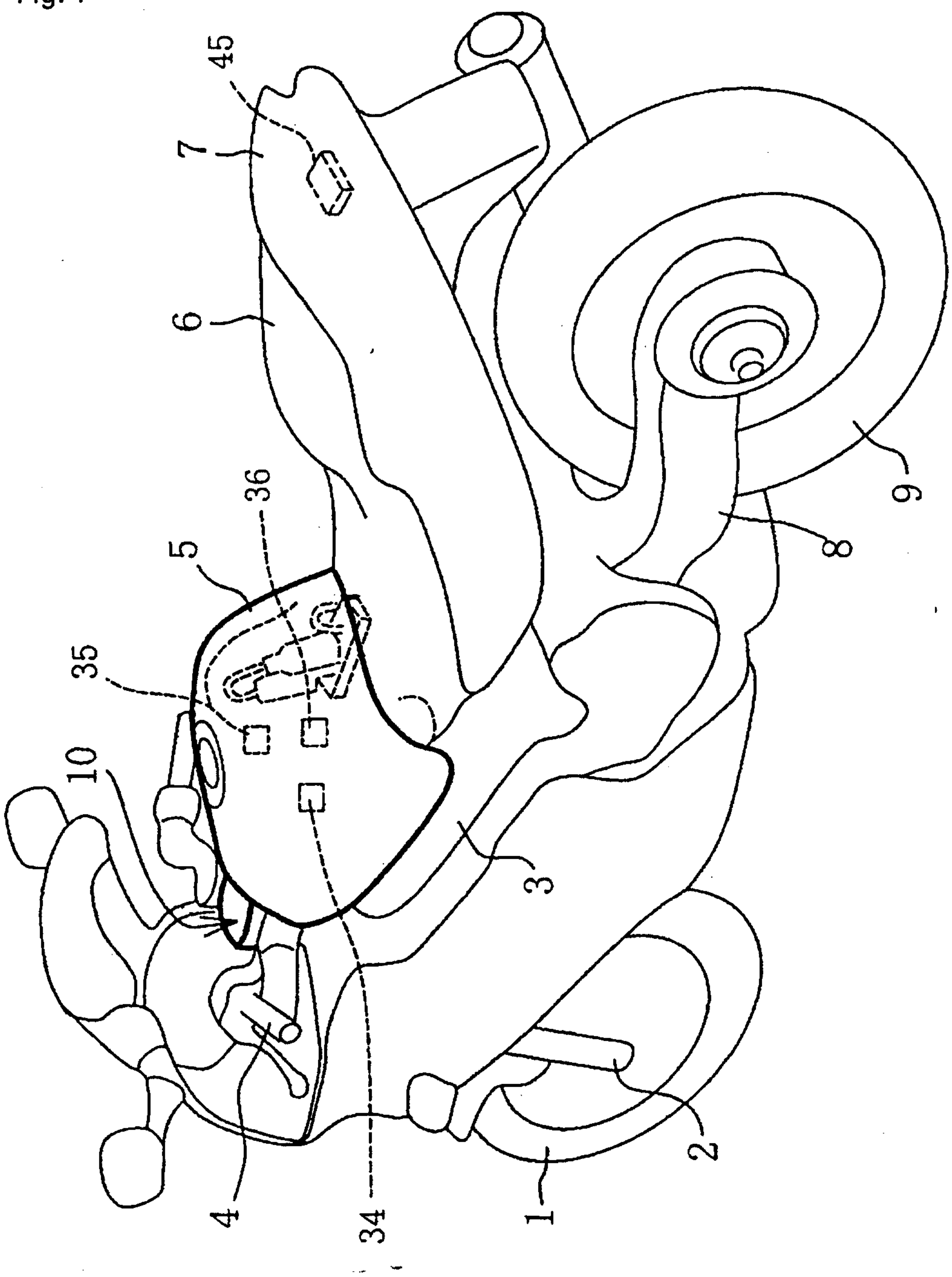


Fig. 2

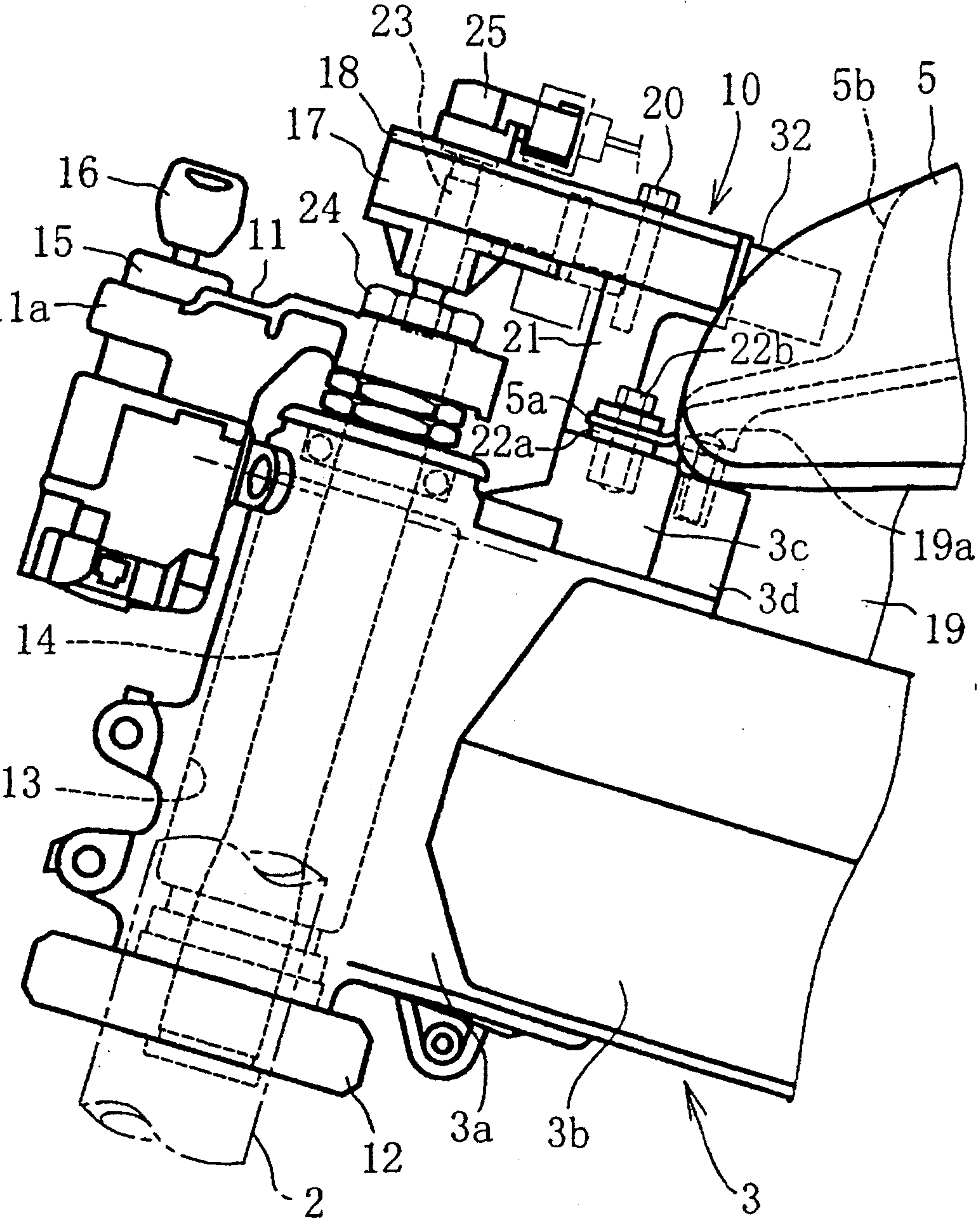

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Fig. 3

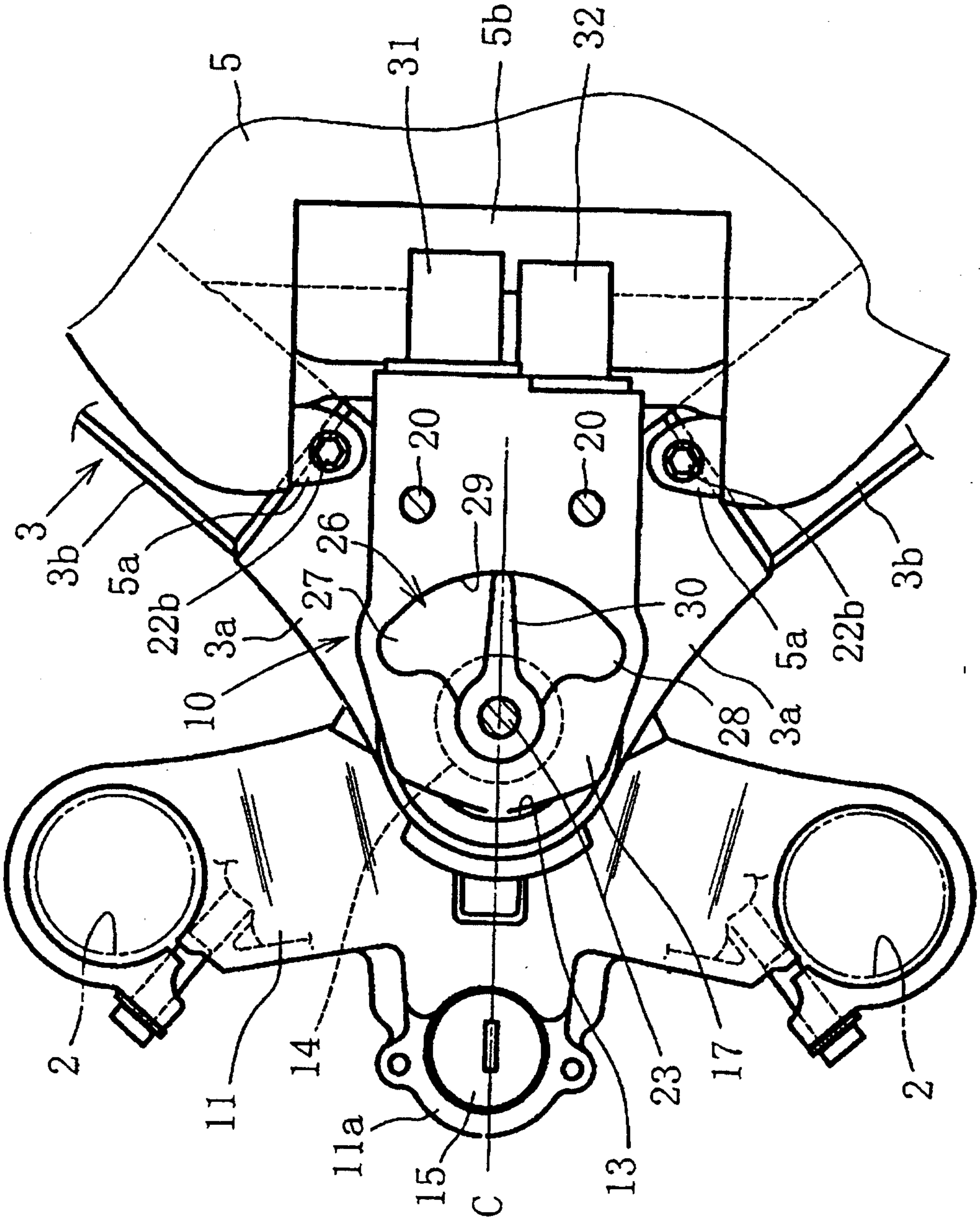
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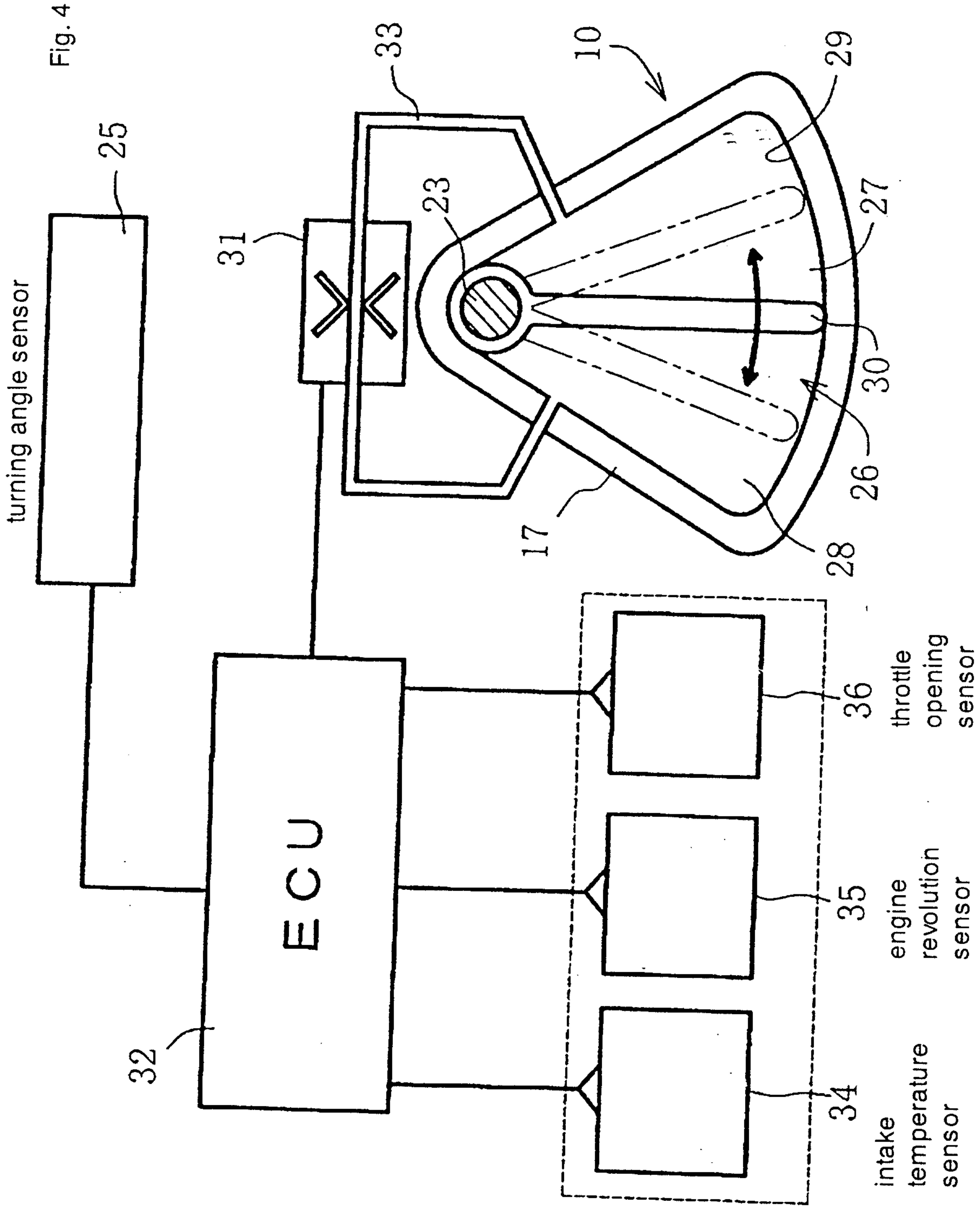
Fig. 4


turning angle sensor
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ECU
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throttle opening sensor
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engine revolution sensor
35
intake temperature sensor
34

Fig. 5

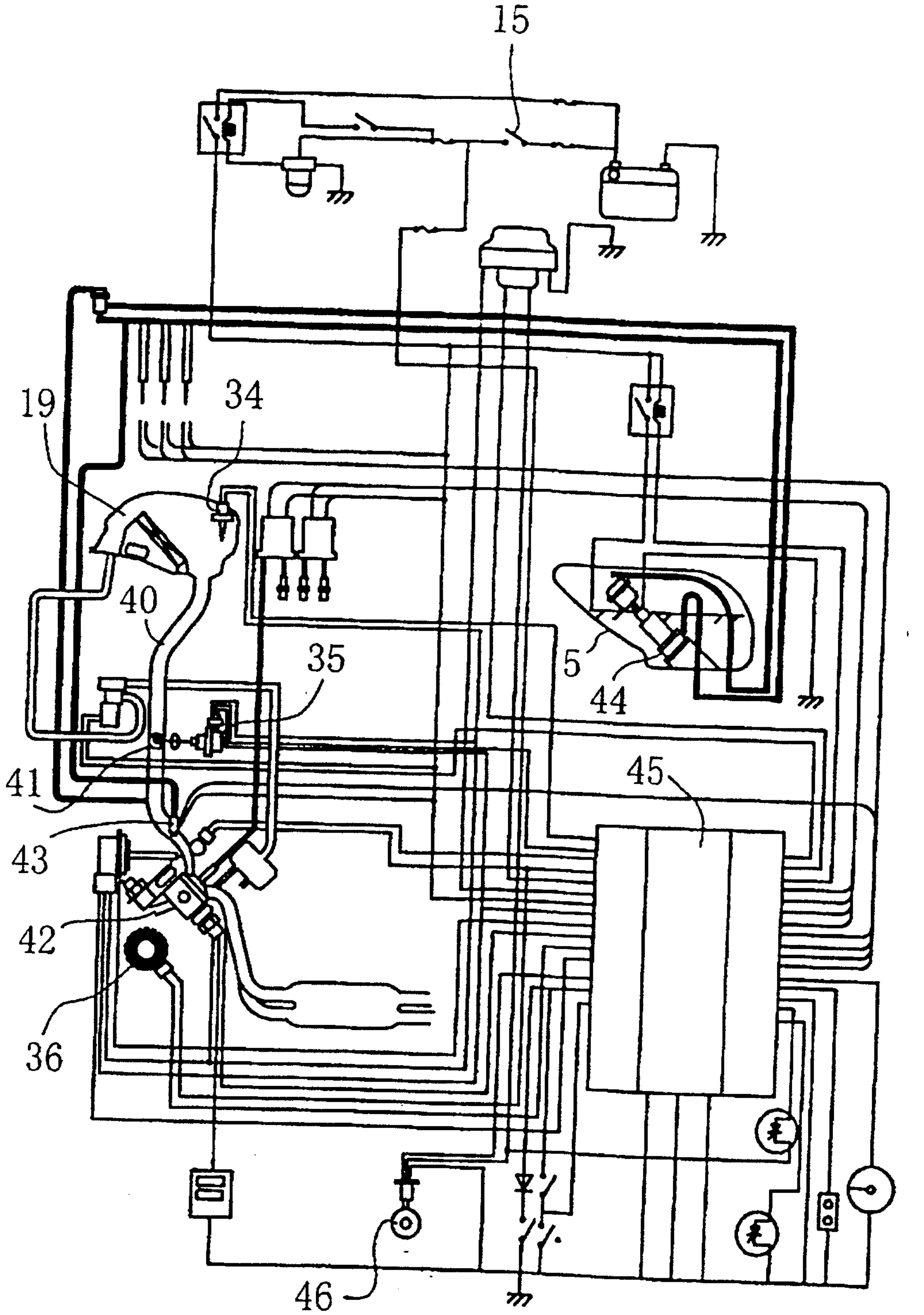
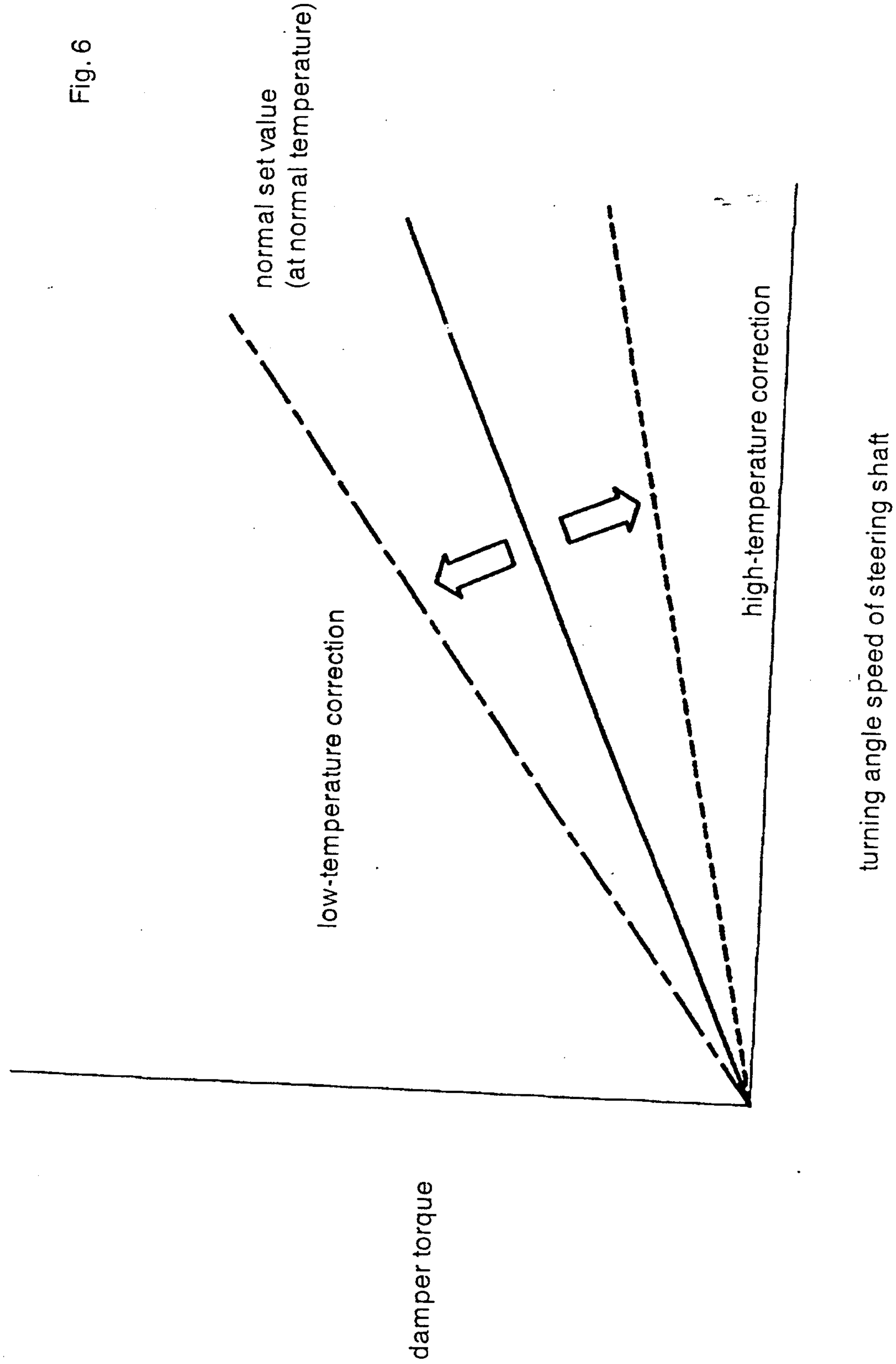
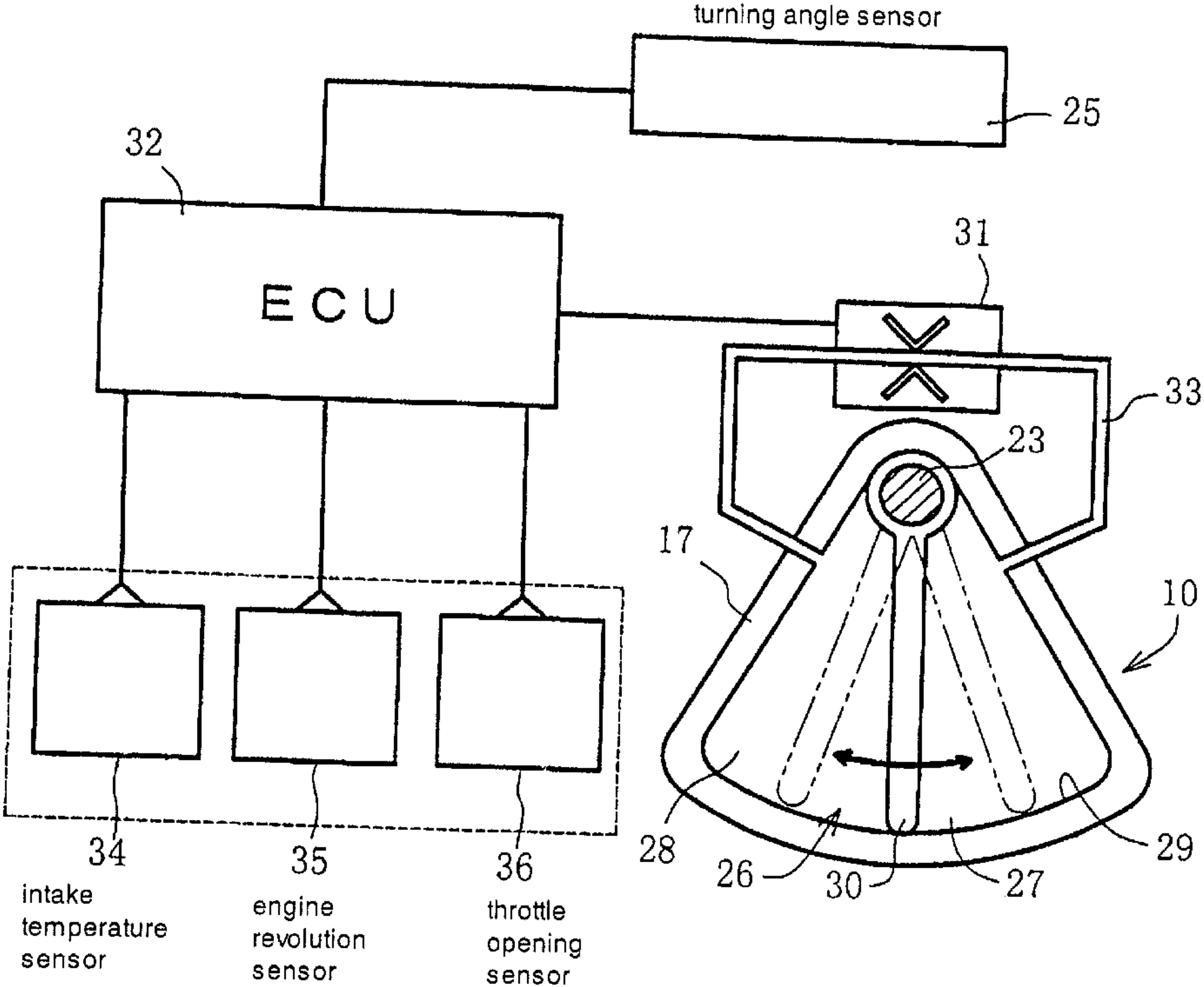


Fig. 6


normal set value
(at normal temperature)
high-temperature correction
low-temperature correction
turning angle speed of steering shaft
damper torque



turning angle sensor
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intake temperature sensor
engine revolution sensor
throttle opening sensor