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United States Patent	12391081
Kind Code	B2
Date of Patent	August 19, 2025
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Height sensor and vehicle comprising same

Abstract

A height sensor including a sensor body, a swing arm and a connecting rod. A first end of the swing arm is movably connected to the sensor body, and a second end of the swing arm is movably connected to the connecting rod. The swing arm is configured as a structure with an adjustable working length suitable for, and can be matched to, different chassis suspension structures, being highly versatile, with a low development cost and high development efficiency.

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Appl. No.: **18/145259**

Filed: **December 22, 2022**

Prior Publication Data

Document Identifier	Publication Date
US 20230202251 A1	Jun. 29, 2023

Foreign Application Priority Data

CN	202123289381.4	Dec. 24, 2021

Publication Classification

Int. Cl.: **B60G7/00** (20060101); **B60G17/019** (20060101)

U.S. Cl.:

CPC **B60G7/003** (20130101); B60G2204/1162 (20130101); B60G2400/25 (20130101)

Field of Classification Search

CPC: B60G (7/003); B60G (17/019); B60G (2204/116); B60G (2204/1162); B60G (2400/25); B60G (2500/30)

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS

(1) The present application claims priority under 35 U.S.C. § 119(a) from Chinese Patent Application No. 202123289381.4 filed on Dec. 24, 2021, in the Chinese Patent Office, the disclosure of which is herein incorporated by reference in its entirety.

BACKGROUND

1. Field

(2) The present application relates to the technical field of sensors, in particular to a height sensor for a motor vehicle and a vehicle comprising the height sensor.

2. Description of Related Art

(3) Height sensors are an important component of motor vehicle lamp or chassis control systems.

For example, in a vehicle lamp control system, the height of the vehicle's low beam lamps needs to be controlled promptly according to vehicle body height and the road surface conditions, to prevent the vehicle lamps from causing dazzle, which would compromise drivers' driving safety. Thus, a height sensor needs to be used to detect changes in the vehicle body height (chassis height) in real time. The height sensor is usually mounted at the motor vehicle chassis suspension; when the vehicle body height changes, a swing arm of the height sensor is driven to rotate by a connecting rod that moves in linkage with the suspension, thereby changing the strength of a magnetic field, and a height change signal is outputted after processing by the height sensor.

(4) In existing height sensors, the effective length of the swing arm is generally fixed, so it is not possible to match the sensor to different chassis suspension structures by changing the swing arm length. Swing arms of different lengths need to be developed for different chassis suspension structures, resulting in a large number of swing arm molds, high development costs and poor versatility.

SUMMARY

(5) To overcome the shortcomings in the prior art, the present application provides a height sensor and a vehicle comprising the height sensor. The height sensor is suitable for, and can be matched to, different chassis suspension structures, so is highly versatile with a low development cost.

(6) To achieve the above objective, the present application provides a height sensor, comprising a sensor body, a swing arm and a connecting rod, a first end of the swing arm being movably connected to the sensor body, and a second end of the swing arm being movably connected to the connecting rod; the swing arm is configured as a structure with an adjustable working length.

(7) Preferably, the swing arm further comprises a main arm and an auxiliary arm, one end of the main arm being connected to the auxiliary arm, another end of the main arm being movably connected to the sensor body, and the auxiliary arm also being movably connected to the connecting rod; and the working length of the swing arm is adjusted by adjusting a cooperative connection relationship between the main arm and the auxiliary arm.

(8) Preferably, the cooperative connection relationship between the main arm and the auxiliary arm is a relative assembly angle and/or assembly position between the main arm and the auxiliary arm.

(9) Preferably, a connecting end of the main arm that is connected to the auxiliary arm is provided with a mounting hole, and multiple limiting slots are provided around the mounting hole.

(10) Preferably, the multiple limiting slots are arranged to surround the mounting hole.

(11) Preferably, a fixing shaft and a limiting protrusion are provided on the auxiliary arm; the fixing shaft is connected to the mounting hole in the main arm in a cooperative manner, and the limiting protrusion is connected to the limiting slot on the main arm by engagement; and the working length of the swing arm is adjusted by adjusting an angle of rotation of the auxiliary arm relative to the main arm about the fixing shaft.

(12) Preferably, a ball head or a ball socket is further provided on the auxiliary arm, the ball head or ball socket being movably connected to a ball socket or ball head correspondingly provided on the connecting rod.

(13) Preferably, the positions of the limiting protrusion and the ball head or ball socket on the auxiliary arm are at two sides of the fixing shaft respectively, and the protrusion direction of the ball head or ball socket on the auxiliary arm is opposite to the protrusion direction of the limiting protrusion and the fixing shaft on the auxiliary arm.

(14) Preferably, the fixing shaft passes through the mounting hole, and is connected to a fastener to fixedly connect the main arm to the auxiliary arm.

(15) To achieve the above objective, the present application further provides a vehicle, comprising the height sensor as described above.

(16) Compared with the prior art, because a structure enabling adjustment between the main arm and auxiliary arm is used in the height sensor and vehicle comprising same provided in the present application, different swing arms can share the same set of molds for producing the main arm and

auxiliary arm, so versatility is high. For different height sensors, all that need be done is to flexibly assemble the main arm and auxiliary arm according to different swing arm working length requirements, so configuration is flexible and the structure is simple and rational. Thus, the shortcomings of existing swing arms are avoided, namely, the fact that the length is fixed, and the need to develop different swing arms and molds for different vehicle models. Thus, the development costs are greatly reduced while the development efficiency is increased.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) FIG. **1** is a schematic drawing of an operating state of a height sensor in an embodiment of the present application.

(2) FIG. **2** is a schematic drawing of part of the structure at the back of the height sensor in FIG. **1**.

(3) FIG. **3** is a schematic drawing of the swing arm of the height sensor in an embodiment of the present application.

(4) FIG. **4**A is a structural schematic drawing of the end of the main arm in FIG. **3** that is connected to the auxiliary arm.

(5) FIG. **4**B is a structural schematic drawing of the auxiliary arm in FIG. **3**.

(6) FIGS. **5**A and **5**B are schematic drawings of the swing arm of the height sensor with different working lengths in embodiments of the present application.

DETAILED DESCRIPTION

(7) Embodiments of the present application are explained further below with reference to the drawings.

(8) Many specific details are expounded in the following description so that those skilled in the art can understand the present application more comprehensively. However, it will be understood to those skilled in the art that the present application can be realized without some of these specific details. In addition, it should be understood that the present application is not limited to the specific embodiments described. On the contrary, consideration may be given to the use of any combination of the following features and key elements to implement the present application, regardless of whether they relate to different embodiments. Therefore, the following aspects, characteristics, embodiments and advantages only serve an illustrative purpose, and should not be regarded as key elements or limitations of the claims, unless expressly specified in the claims. Furthermore, if words indicating direction such as up/down/left/right, upper side, lower side, etc. appear herein, this is purely for convenience of expression in accordance with the relative positions of components in the current drawings, and should not be interpreted as limiting the scope of protection.

(9) FIG. **1** is a schematic drawing of an operating state of a height sensor in an embodiment of the present application; FIG. **2** is a schematic drawing of part of the structure at the back of the height sensor in FIG. **1**.

(10) Referring to FIGS. **1** and **2**, the present application provides a height sensor **1**, mounted between a vehicle chassis and a chassis suspension **2** for example, and used to measure changes in motor vehicle chassis height. The height sensor **1** comprises a sensor body **10**, a swing arm **11** and a connecting rod **12**. A first end of the swing arm **11** is rotatably connected to the sensor body **10**, such that the swing arm **11** can swing relative to the sensor body **10**. A second end of the swing arm **11** is movably connected to the connecting rod **12**. As shown in FIG. **2**, in this embodiment, the second end of the swing arm **11** is connected to the connecting rod **12** via a ball joint formed by a movable ball head and ball socket. When the chassis height changes as the vehicle is driven, the chassis suspension **2** drives the connecting rod **12** to move; the movement of the connecting rod **12** drives the swing arm **11** to swing relative to the sensor body **10**; a detection element in the sensor

body **10** can measure chassis height change data according to the swing angle and direction of the swing arm **11**, and this data is provided to a vehicle control unit in order to implement further control of the vehicle.

(11) FIG. **3** is a schematic drawing of the swing arm of the height sensor in an embodiment of the present application; FIG. **4**A is a structural schematic drawing of the end of the main arm in FIG. **3** that is connected to the auxiliary arm; and FIG. **4**B is a structural schematic drawing of the auxiliary arm in FIG. **3**.

(12) Referring to FIGS. **3**, **4**A and **4**B, furthermore, the swing arm **11** comprises a main arm **111** and an auxiliary arm **112**. One end of the main arm **111** is fixedly connected to the auxiliary arm **112**; the other end of the main arm **111** (i.e. the first end of the swing arm **11**) is rotatably connected to the sensor body **10**. The connecting end of the main arm **111** that is connected to the auxiliary arm **112** is provided with a mounting hole **1111**, and multiple limiting slots **1112** are provided around the mounting hole **1111**, the multiple limiting slots **1112** being arranged to surround the mounting hole **1111**. A fixing shaft **1121**, a limiting protrusion **1122** and a ball head **1123** are provided on the auxiliary arm **112**. The fixing shaft **1121** can be inserted into the mounting hole **1111** in the main arm **111**, and can rotate in the mounting hole **1111**. The limiting protrusion **1122** can be engaged in the limiting slots **1112** on the main arm **111**, to limit the angle and position of rotation of the auxiliary arm **112** around the axis along which the fixing shaft **1121** lies. That is to say, when the auxiliary arm **112** rotates to different positions, the limiting protrusion **1122** is engaged in the limiting slots **1112** at corresponding different positions, to limit rotation of the auxiliary arm **112**. The ball head **1123** is movably connected to a ball socket provided on the connecting rod **12**; in other embodiments, the positions where the ball head and ball socket are arranged may also be exchanged. Furthermore, the positions of the limiting protrusion **1122** and the ball head **1123** on the auxiliary arm **112** are at two sides of the fixing shaft **1121** respectively, and the protrusion direction of the ball head **1123** on the auxiliary arm **112** is opposite to the protrusion direction of the limiting protrusion **1122** and the fixing shaft **1121**.

(13) FIGS. **5**A and **5**B are schematic drawings of the swing arm of the height sensor with different working lengths in embodiments of the present application.

(14) Referring to FIG. **3**, the straight-line distance L between the center line of rotation of the swing arm **11** relative to the sensor body **10** and the center line of rotation of the connecting rod **12** relative to the swing arm **11** (i.e. the center line of the ball head on the auxiliary arm **112**) is defined as the working length L of the swing arm **11**. The working length L can be adjusted according to the requirements of different vehicle operating conditions, by adjusting the cooperative connection relationship between the auxiliary arm **112** and the main arm **111** on the swing arm **11**. For example, in this embodiment, referring to FIGS. **5**A and **5**B, the working length L of the swing arm **11** of the height sensor **1** used on the vehicle model is determined according to the requirements of the actual vehicle chassis mounting conditions, and the mounting position of the auxiliary arm **112** relative to the main arm **111** is determined according to the working length L of the swing arm **11**.

(15) FIG. **5**A corresponds to a height sensor configuration for one vehicle model, while FIG. **5**B corresponds to a height sensor configuration for another vehicle model. The swing arm working lengths L**1** and L**2** of the two vehicle models have different requirements, and the corresponding mounting angles and positions of the auxiliary arm **112** relative to the main arm **111** are different. That is to say, after the fixing shaft **1121** of the auxiliary arm **112** has been inserted into the mounting hole **1111** in the main arm **111**, the limiting protrusion **1122** on the auxiliary arm **112** is engaged in the limiting slot **1112** on the main arm **111** at different positions corresponding to the different working lengths L. The main arm **111** is then fixed to the auxiliary arm **112**; for example, in this embodiment, a fastener such as a nut is used for connection and fixing to the fixing shaft **1121**. In other embodiments, another method may be used to fix the main arm **111** to the auxiliary arm **112**.

(16) The use of a structural arrangement enabling adjustment between the main arm **111** and the

auxiliary arm **112** in the present application enables the working length L of the swing arm **11** to be flexibly configured according to the needs of actual operating conditions, thus greatly increasing the versatility of the height sensor. Different swing arms can share the same set of molds for producing the main arm and auxiliary arm, and all that need be done is to assemble them flexibly according to different required working lengths L, thus avoiding the shortcomings of existing swing arms, namely, the fact that the length is fixed, and the need to develop swing arms and moulds of different lengths for different vehicle model operating conditions.

(17) Although the present application has been described above through the embodiments, the present application is not limited to the embodiments. Various changes and modifications made by any person skilled in the art without departing from the spirit and scope of the present application shall be included in the scope of protection of the present application, and therefore the scope of protection of the present application shall be the scope defined by the claims.

Claims

1. A height sensor, comprising: a sensor body; a swing arm comprising a main arm and an auxiliary arm rotatably coupled to the main arm; and a connecting rod, wherein a first end of the main arm is movably connected to the sensor body, wherein an end of auxiliary arm is movably connected to the connecting rod, and wherein the auxiliary arm comprises a structure configured to rotatably couple the auxiliary arm to the main arm and provide an adjustable working length of the swing arm by rotatably adjusting a second end of the auxiliary arm relative to the first end of the main arm, a limiting protrusion disposed at the second end of the auxiliary arm, the limiting protrusion configured to engage with multiple limiting slots to set a position of rotation of the auxiliary arm relative to the main arm.

2. The height sensor as claimed in claim 1, wherein the main arm comprises a mounting hole provided at the first end of the main arm; and the multiple limiting slots are provided around the mounting hole.

3. The height sensor as claimed in claim 2, wherein the multiple limiting slots are arranged to surround the mounting hole.

4. A height sensor, comprising: a sensor body; a swing arm; and a connecting rod, wherein a first end of the swing arm is movably connected to the sensor body, wherein a second end of the swing arm is movably connected to the connecting rod, wherein the swing arm comprises a structure with an adjustable working length, wherein the swing arm further comprises: a main arm; an auxiliary arm; and a cooperative connection relationship between the main arm and the auxiliary arm configured to adjust the working length of the swing arm, wherein a first end of the main arm is connected to the auxiliary arm, a second end of the main arm is connected to the sensor body, wherein the auxiliary arm is movably connected to the connecting rod, wherein the cooperative connection relationship comprises a relative assembly angle or assembly position between the main arm and the auxiliary arm, wherein the first end of the main arm connected to the auxiliary arm is provided with a mounting hole, wherein the main arm comprises multiple limiting slots provided around the mounting hole wherein the first end of the main arm connected to the auxiliary arm is provided with a mounting hole, wherein the main arm comprises multiple limiting slots provided around the mounting hole, wherein the multiple limiting slots are arranged to surround the mounting hole, wherein the auxiliary arm comprises: a fixing shaft; and a limiting protrusion, wherein the fixing shaft is connected to the mounting hole in the main arm in a cooperative manner, wherein the limiting protrusion is connected to one of the multiple limiting slots on the main arm by engagement, and wherein the working length of the swing arm is adjustable by adjusting an angle of rotation of the auxiliary arm relative to the main arm about the fixing shaft.

5. The height sensor as claimed in claim 4, wherein the auxiliary arm comprises one of a ball head or a ball socket, wherein the connecting rod comprises one of the ball head or the ball socket that is

not provided on the auxiliary arm, and wherein the ball head or ball socket of the auxiliary arm is movably connected to the one of the ball socket or ball head correspondingly provided on the connecting rod.

6. The height sensor as claimed in claim 5, wherein the positions of the limiting protrusion and the ball head or ball socket on the auxiliary arm are at two sides of the fixing shaft respectively, and the protrusion direction of the ball head or ball socket on the auxiliary arm is opposite to the protrusion direction of the limiting protrusion and the fixing shaft on the auxiliary arm.

7. The height sensor as claimed in claim 4, wherein the fixing shaft passes through the mounting hole, and the fixing shaft is connected to a fastener to fixedly connect the main arm to the auxiliary arm.

8. A height sensor, comprising: a sensor body; a swing arm, the swing arm comprising: a main arm, the main arm comprising: a first end of the main arm rotatably connected to the sensor body; and a second end of the main arm, the second end of the main arm comprising: a mounting hole disposed within a central portion of the second end of the main arm; and a plurality of limiting slots disposed around a periphery of the second end of the main arm surrounding the mounting hole; and an auxiliary arm, the auxiliary arm comprising: a fixing shaft disposed at a first end of the auxiliary arm, the fixing shaft extending perpendicularly away from the auxiliary arm and through the mounting hole; and a limiting protrusion disposed at the first end of the auxiliary arm, the limiting protrusion configured to engage with the plurality of limiting slots to set a position of rotation of the auxiliary arm around a rotation axis of the fixing shaft; and a connecting rod rotatably connected to a second end of the auxiliary arm.

9. The height sensor as claimed in claim 8, wherein the auxiliary arm further comprises a ball head disposed at a second end of the auxiliary arm, and wherein the connecting rod comprises a ball socket movably connected to the ball head.

10. The height sensor as claimed in claim 8, wherein the auxiliary arm further comprises a ball socket disposed at a second end of the auxiliary arm, and wherein the connecting rod comprises a ball head movably connected to the ball socket.

11. The height sensor as claimed in claim 8, wherein the auxiliary arm further comprises a fastener connected to the fixing shaft to fixedly couple the main arm to the auxiliary arm.