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ELECTRONIC CONTROL SHOCK ABSORBER HAVING COAXIAL DUAL SOLENOID VALVES

Abstract

The present disclosure provides an electronic control shock absorber having coaxial dual solenoid valves. The electronic control shock absorber includes a cylinder formed with a double structure having an internal space and an external space, the internal space being divided into a compression chamber and a rebound chamber, and a reservoir chamber being formed in the external space, a compression solenoid valve mounted on an outside of the cylinder, and a rebound solenoid valve mounted on the outside of the cylinder. The compression solenoid valve and the rebound solenoid valve are arranged on the same axis to face each other.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of and priority to Korean Patent Application No. 10-2024-0024699, filed on Feb. 21, 2024, the entire disclosure of which is hereby incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] The present disclosure relates to an electronic control shock absorber for vehicles, and more particularly relates to an electronic control shock absorber having coaxial dual solenoid valves.

BACKGROUND

[0003] While a vehicle is driven, the vehicle is constantly exposed to vibrations and shocks from a road surface through wheels. When the vibrations or the shocks transmitted through the wheels are directly transmitted to a vehicle body and a steering wheel, ride comfortability and driving stability may be significantly degraded. In order to alleviate the vibrations or the shocks, the vehicle needs to be equipped with a suspension system. A shock absorber, a spring, and a suspension arm are main components forming a suspension system.

[0004] The shock absorber includes a cylinder, a piston rod, a piston valve, and the like. The piston valve is located inside the cylinder in a state of being connected to the piston rod, and generates a damping force.

[0005] When the damping force of the shock absorber is set to a weak level, the shock absorber can improve the ride comfortability by absorbing the vibrations generated by uneven portions on the road surface. On the other hand, when the damping force is set to a high level, a posture change in the vehicle body is suppressed, thereby improving steering stability. Therefore, in the related art, it is common to select and apply shock absorbers in which different damping force characteristics are set depending on an intended use of the vehicle.

[0006] Recently, a damping force variable shock absorber has been developed as follows. A variable damping force valve which can appropriately adjust the damping force characteristics of the shock absorber is mounted on the shock absorber. In this manner, the damping force characteristics can be appropriately adjusted depending on the road surface and driving conditions by installing.

[0007] However, in the related art, according to an electronic control shock absorber on which the coaxial dual solenoid valves are mounted, two solenoid valves are arranged in series in an axial direction of the shock absorber. Consequently, there is a problem in that a mounting space is less likely to be secured. That is, in a situation where there is an increasing market demand for the electronic control shock absorber of the dual solenoid type, there is a problem in that an application of the coaxial dual solenoid valves to vehicles is limited due to a structural limitation.

[0008] In particular, in a case of a vehicle to which an air spring is applied, it is more difficult to apply the coaxial dual solenoid valves to the vehicle due to interference with the air spring. In addition, according to the electronic control shock absorber of the dual solenoid type in the related art, a separately processed housing block is welded to an outer tube to combine the dual solenoids. However, there is a disadvantage in that two separate upper and lower tubes need to be individually welded to form chambers separated by each stroke.

In addition, referring to FIG. **6**, assembly work is complicated in that the solenoid valve needs to be sealed with an O-ring **20** when the solenoid valve is fastened to a separation tube **15**. KR10-2023-0068294A is an example of the related art.

SUMMARY

[0009] The present disclosure is devised to solve the above-described problems in the related art, and aims to provide a new arrangement structure of coaxial dual solenoid valves in which an electronic control shock absorber to which the coaxial dual solenoid valves are applied is more freely mounted.

[0010] In addition, the present disclosure aims to provide a structure in which the coaxial dual solenoid valves are simply assembled.

[0011] According to one embodiment of the present disclosure, in order to solve the above-described problems, there is provided an electronic control shock absorber having coaxial dual solenoid valves. The electronic control shock absorber includes a cylinder formed with a double structure having an internal space and an external space, the internal space being divided into a compression chamber and a rebound chamber, and a reservoir chamber being formed in the external space, a compression solenoid valve mounted on an outside of the cylinder, and a rebound solenoid valve mounted on the outside of the cylinder. The compression solenoid valve and the rebound solenoid valve are arranged on the same axis to face each other.

[0012] In addition, the compression solenoid valve and the rebound solenoid valve may be located at the same height in an axial direction of the cylinder.

[0013] In addition, each of the compression solenoid valve and the rebound solenoid valve may be connected to a separation tube inside the cylinder.

[0014] In addition, the cylinder may include a base shell arranged on an outermost side, and an inner tube arranged on an innermost side, the rebound chamber may be formed in an upper portion inside the inner tube, the compression chamber may be formed in a lower portion inside the inner tube, and the separation tube may be arranged between the inner tube and the base shell.

[0015] In addition, the rebound solenoid valve may be connected to the separation tube by a rebound inner sleeve mounted on the separation tube.

[0016] In addition, the compression solenoid valve may be connected to the separation tube by a compression inner sleeve mounted on the separation tube.

[0017] In addition, the compression inner sleeve may include a first opening open outward in a radial direction to communicate with the compression solenoid valve, and a second opening open downward of the separation tube.

[0018] In addition, the rebound inner sleeve may include a third opening open outward in the radial direction to communicate with the rebound solenoid valve, and a fourth opening open upward of the separation tube.

[0019] In addition, during a compression stroke, as a piston valve descends, a fluid inside the compression chamber may flow into the separation tube after passing through a first communication hole formed in a lower portion of the inner tube.

[0020] In addition, the fluid flowing into the separation tube may ascend and flow into the second opening of the compression inner sleeve.

[0021] In addition, the fluid flowing into the second opening of the compression inner sleeve may be discharged through the first opening open outward in the radial direction.

[0022] In addition, the discharged fluid may be discharged to the reservoir chamber after flowing into the compression solenoid valve.

[0023] In addition, during a rebound stroke, as the piston valve ascends, the fluid inside the rebound chamber may flow into the upper separation tube after passing through a second communication hole formed in an upper portion of the inner tube.

[0024] In addition, the fluid flowing into the separation tube may descend and flow into the fourth opening of the rebound inner sleeve.

[0025] In addition, the fluid flowing into the fourth opening may be discharged through the third opening open outward in the radial direction.
[0026] In addition, the discharged fluid may be discharged to the reservoir chamber after flowing into the rebound solenoid valve.
[0027] In addition, according to another embodiment of the present disclosure, there is provided an electronic control shock absorber having coaxial dual solenoid valves. The electronic control shock absorber includes a cylinder formed with a double structure having an internal space and an external space, the internal space being divided into a compression chamber and a rebound chamber, and a reservoir chamber being formed in the external space, a compression solenoid valve mounted on an outside of the cylinder, and a rebound solenoid valve mounted on the outside of the cylinder. The compression solenoid valve and the rebound solenoid valve are arranged on the same axis.
[0028] In addition, the compression solenoid valve may be fastened to the cylinder by the compression inner sleeve mounted on the separation tube inside the cylinder, may be compressed against the inner sleeve, and may be fastened by metal sealing.
[0029] In addition, a protrusion portion convexly protruded may be formed in an end portion of a compression port of the compression solenoid valve, and the metal sealing may be performed in such a manner that the protrusion portion is brought into contact with and compressed against a facing surface facing the protrusion portion in the compression inner sleeve.
[0030] In addition, the rebound solenoid valve may be fastened to the cylinder by the rebound inner sleeve mounted on the separation tube inside the cylinder, and may be fastened by the rebound inner sleeve and an O-ring.
[0031] In the electronic control shock absorber having the coaxial dual solenoid valves according to the present disclosure configured as described above, the coaxial dual solenoid valves are arranged on the same axis to avoid interference with other components when mounted. Therefore, there is an advantageous effect in that the electronic control shock absorber is more freely mounted.
[0032] In addition, there is an advantageous effect in that the coaxial dual solenoid valves are applicable to vehicles to which an air suspension is applied without interference with the air suspension located at an upper portion of the valves.
[0033] In addition, the solenoid valves are fastened by using the internally mounted inner sleeve without using a housing block. Therefore, there is an advantageous effect in that simple fastening is available.
[0034] In addition, the compression solenoid valve is fastened to the inner sleeve inside the cylinder by the metal sealing. Therefore, there is an advantageous effect in that simple fastening is available without using the O-ring.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0035] FIGS. **1** to **6** are diagrams for describing an operation of a working fluid of an electronic control shock absorber having coaxial dual solenoid valves of the present disclosure.
[0036] FIGS. **1** to **3** are diagrams for describing a flow of the fluid during a compression stroke in the electronic control shock absorber having the coaxial dual solenoid valves of the present disclosure.
[0037] FIGS. **4** and **5** are diagrams for describing a flow of the fluid during a rebound stroke in the electronic control shock absorber to which the coaxial dual solenoid valves of the present disclosure are applied.
[0038] FIG. **6** is a diagram showing a state where a solenoid valve of the present disclosure is fastened to a separation tube after being sealed with an O-ring.

[0039] FIG. **7** is a diagram showing a structure of the electronic control shock absorber having the coaxial dual solenoid valves according to one embodiment of the present disclosure.
[0040] FIG. **8** is a partially enlarged view of a compression solenoid valve side in the electronic control shock absorber in FIG. **7**.
[0041] FIG. **9** is a partially enlarged view showing a state where the compression solenoid valve is fastened by metal sealing in the electronic control shock absorber in FIG. **7**.
[0042] FIG. **10** is a partially enlarged view of a rebound solenoid valve side in the electronic control shock absorber in FIG. **7**.
[0043] FIG. **11** is a diagram showing a flow of the fluid during the compression stroke in the electronic control shock absorber in FIG. **7**.
[0044] FIG. **12** is a diagram showing a flow of the fluid during the rebound stroke in the electronic control shock absorber in FIG. **7**.

DETAILED DESCRIPTION

[0045] Hereinafter, referring to FIGS. **1** to **6**, a flow route of a working fluid during compression and rebound strokes of coaxial dual solenoid valves according to one embodiment of the present disclosure will be described. FIGS. **1** to **6** are diagrams for facilitating understanding of the flow route of the working fluid inside a damping force variable shock absorber according to one embodiment of the present disclosure, and do not directly reflect an arrangement and a structure of components of the damping force variable shock absorber of the present disclosure.
[0046] Referring to FIG. **1**, the damping force variable shock absorber of the present disclosure includes a rebound solenoid valve **90** for adjusting a damping force during a rebound stroke, and a compression solenoid valve **80** for adjusting a damping force during a compression stroke. An internal space of a cylinder forming a shock absorber is divided into a compression chamber and a rebound chamber by a piston valve, and each of the chambers is filled with a fluid such as oil.
[0047] During the compression stroke, the piston valve pressurizes the fluid inside the compression chamber. In this manner, the compression chamber is brought into a high pressure state, and the rebound chamber is brought into a relatively low pressure state. During the rebound stroke, the piston valve pressurizes the fluid inside the rebound chamber. In this manner, the rebound chamber is brought into the high pressure state, and the compression chamber is brought into the relatively low pressure state.
[0048] During the compression stroke in FIGS. **2** and **3**, the fluid inside a compression chamber **13** flows into a compression separation tube **15**, and moves to a reservoir chamber **17** through a compression solenoid valve **80**. Some of the fluid moves to a rebound chamber **14** through a bypass flow path of a piston valve.
[0049] During the rebound stroke in FIGS. **4** and **5**, the fluid inside the rebound chamber **14** flows into a rebound separation tube **16**, passes through a rebound solenoid valve **90** and a communication hole **103***a* of a connection portion **103**, and moves into a compression chamber **13** through the compression solenoid valve **80**. Some of the fluid moves to the compression chamber **13** through a bypass flow path of the piston valve.
[0050] Hereinafter, an electronic control shock absorber having coaxial dual solenoid valves according to the present disclosure will be described in detail with reference to FIGS. **7** to **12**.
[0051] FIG. **7** shows a structure of the electronic control shock absorber having the coaxial dual solenoid valves according to one embodiment of the present disclosure.
[0052] The electronic control shock absorber according to one embodiment of the present disclosure includes a cylinder **110**, a piston valve **120**, a piston rod (not shown), a body valve (not shown), a compression solenoid valve **180**, and a rebound solenoid valve **190**.
[0053] The compression solenoid valve **180** and the rebound solenoid valve **190** are arranged on a central axis of the solenoid valves without being arranged in series in an axial direction of the cylinder **110** of the shock absorber. In other words, the compression solenoid valve **180** and the rebound solenoid valve **190** are arranged on the same axis, and are arranged at the same height to

face each other around the cylinder.
[0054] In this way, since the coaxial dual solenoid valves are arranged on the same axis, interference with other components may be avoided when mounted. Accordingly, the coaxial dual solenoid valves may be more freely mounted. In particular, the coaxial dual solenoid valves may be applied to vehicles to which an air suspension is applied without interference with the air suspension located at an upper portion of the valves.
[0055] Each of the compression solenoid valve **180** and the rebound solenoid valve **190** is connected to a separation tube **116** inside the cylinder **110**.
[0056] Hereinafter, referring to FIG. **7**, a structure in which the compression solenoid valve **180** and the rebound solenoid valve **190** are connected to the separation tube **116** will be described in detail.
[0057] The cylinder **110** includes a base shell **111** on an outermost side, and an inner tube **112** on an innermost side. The inside of the inner tube **112** is formed by the piston valve **120** to separately form the rebound chamber in an upper portion and the compression chamber in a lower portion. The separation tube **116** is located between the inner tube **112** and the base shell **111**.
[0058] The rebound solenoid valve **190** is connected to the separation tube **116** through a rebound inner sleeve **193**.
[0059] The compression solenoid valve **180** includes a compression valve housing **181** and a compression port **182** connected to one end of the compression valve housing **181**. The compression port **182** is connected to the compression inner sleeve **183**, and the compression solenoid valve **180** is ultimately connected to the separation tube **116**.
[0060] The rebound solenoid valve **190** includes a rebound valve housing **191** and a rebound port **192** connected to one end of the rebound valve housing **191**. The rebound port **192** is connected to the rebound inner sleeve **193**, and the rebound solenoid valve **190** is ultimately connected to the separation tube **116**.
[0061] Referring to FIG. **8**, a structure of the compression inner sleeve **183** will be described.
[0062] The compression inner sleeve **183** includes a first opening **183***a* connected to the compression port **182**, and open in a radial direction to communicate with the compression port **182**, and a second opening **183***b* open downward of the separation tube **116**.
[0063] The fluid inside the separation tube **116** flows into the second opening **183***b*, and is discharged through the first opening **183***a*.
[0064] FIG. **9** shows a state where the compression solenoid valve **180** is fastened by metal sealing. A protrusion portion **182***a* protruded convexly is formed in an end portion of the compression port **182** of the compression solenoid valve **180**. The protrusion portion **182***a* is brought into contact with and compressed against a facing surface **183***c* facing the protrusion portion **182***a* in the compression inner sleeve **183**. In this manner, sealing is performed. Since the compression port **182** and the compression inner sleeve **183** are made of a metal material, compression sealing is available. This sealing is referred to as metal sealing. Compared to sealing using an O-ring, the metal sealing enables simple sealing without requiring an additional component such as the O-ring.
[0065] FIG. **10** is a partially enlarged view of the rebound solenoid valve **190**. Referring to FIG. **10**, the rebound inner sleeve **193** includes a third opening **193***a* connected to the rebound port **192** and open in the radial direction to communicate with the rebound port **192**, and a fourth opening **193***b* open upward of the separation tube **116**.
[0066] The fluid inside the separation tube **116** flows into the fourth opening **193***b*, and is discharged through the third opening **193***a*.
[0067] In a state where an end of the rebound port **191** of the rebound solenoid valve **190** is inserted into the third opening **193***a* of the rebound inner sleeve **193**, an inner peripheral surface of the third opening **193***a* and an outer peripheral surface of the rebound port **191** are fastened by an O-ring **195**.
[0068] Hereinafter, a flow of a fluid during the compression stroke and the rebound stroke will be

described with reference to FIGS. **11** and **12**.
[0069] Referring to FIG. **11**, during the compression stroke, as the piston valve **120** descends, the fluid inside the compression chamber **113** flows into the separation tube **116** after passing through a first communication hole **112***a* formed in a lower portion of the inner tube **112**. The fluid flowing into the separation tube **116** ascends and flows into the second opening **183***b* of the compression inner sleeve **183**, and is discharged through the first opening **183***a* open outward in the radial direction. The discharged fluid is discharged to the reservoir chamber **117** after flowing into the compression solenoid valve **180** through the compression port **182**. Referring to FIG. **12**, during the rebound stroke, as the piston valve **120** ascends, the fluid inside the rebound chamber flows into the separation tube **116** in the upper portion after passing through a second communication hole (not shown) formed in an upper portion of the inner tube **112**. The fluid flowing into the separation tube **116** descends and flows into a fourth opening **194***b* of the rebound inner sleeve **193**, and is discharged through a third opening **194***a* open outward in the radial direction. The discharged fluid is discharged to the reservoir chamber **117** after flowing into the rebound solenoid valve **190** through the rebound port **192**.
[0070] The above-described configuration is only an example of the technical idea of the present disclosure, and those skilled in the art to which the present disclosure belongs may perform various corrections, modifications, and substitutions within the scope not departing from the essential characteristics of the present disclosure. Therefore, the present embodiment is provided to describe the technical idea of the present disclosure without being intended to limit the technical idea of the present disclosure. The scope of the technical idea of the present disclosure is not limited by the embodiment. The protection scope of the present disclosure should be interpreted by the appended claims, and all technical ideas within the scope equivalent thereto should be interpreted as being included in the scope of the rights of the present disclosure.
DETAILED DESCRIPTION OF MAIN ELEMENTS
[0071] **110** cylinder [0072] **111** base shell [0073] **112** inner tube [0074] **113** compression chamber [0075] **116** separation tube [0076] **117** reservoir chamber [0077] **120** piston valve [0078] **180** compression solenoid valve [0079] **181** compression valve housing [0080] **182** compression port [0081] **182***a* protrusion portion [0082] **183** compression inner sleeve [0083] **183***a* first opening [0084] **183***b* second opening [0085] **183***c* facing surface [0086] **190** rebound solenoid valve [0087] **191** rebound valve housing [0088] **192** rebound port [0089] **193** rebound inner sleeve [0090] **193***a* third opening [0091] **193***b* fourth opening [0092] **195** O-ring [0093] **112***a* first communication hole

Claims

1. An electronic control shock absorber having coaxial dual solenoid valves, comprising: a cylinder formed with a double structure having an internal space and an external space, the internal space being divided into a compression chamber and a rebound chamber, and a reservoir chamber being formed in the external space; a compression solenoid valve mounted on an outside of the cylinder; and a rebound solenoid valve mounted on the outside of the cylinder, wherein the compression solenoid valve and the rebound solenoid valve are arranged on the same axis to face each other.
2. The electronic control shock absorber having coaxial dual solenoid valves of claim 1, wherein the compression solenoid valve and the rebound solenoid valve are located at the same height in an axial direction of the cylinder.
3. The electronic control shock absorber having coaxial dual solenoid valves of claim 2, wherein each of the compression solenoid valve and the rebound solenoid valve is connected to a separation tube inside the cylinder.
4. The electronic control shock absorber having coaxial dual solenoid valves of claim 3, wherein the cylinder includes a base shell arranged on an outermost side, and an inner tube arranged on an innermost side, the rebound chamber is formed in an upper portion inside the inner tube, the

compression chamber is formed in a lower portion inside the inner tube, and the separation tube is arranged between the inner tube and the base shell.
5. The electronic control shock absorber having coaxial dual solenoid valves of claim 4, wherein the rebound solenoid valve is connected to the separation tube by a rebound inner sleeve mounted on the separation tube.
6. The electronic control shock absorber having coaxial dual solenoid valves of claim 5, wherein the compression solenoid valve is connected to the separation tube by a compression inner sleeve mounted on the separation tube.
7. The electronic control shock absorber having coaxial dual solenoid valves of claim 6, wherein the compression inner sleeve includes a first opening open outward in a radial direction to communicate with the compression solenoid valve, and a second opening open downward of the separation tube.
8. The electronic control shock absorber having coaxial dual solenoid valves of claim 7, wherein the rebound inner sleeve includes a third opening open outward in the radial direction to communicate with the rebound solenoid valve, and a fourth opening open upward of the separation tube.
9. The electronic control shock absorber having coaxial dual solenoid valves of claim 8, wherein during a compression stroke, as a piston valve descends, a fluid inside the compression chamber flows into the separation tube after passing through a first communication hole formed in a lower portion of the inner tube.
10. The electronic control shock absorber having coaxial dual solenoid valves of claim 9, wherein the fluid flowing into the separation tube ascends and flows into the second opening of the compression inner sleeve.
11. The electronic control shock absorber having coaxial dual solenoid valves of claim 10, wherein the fluid flowing into the second opening of the compression inner sleeve is discharged through the first opening open outward in the radial direction.
12. The electronic control shock absorber having coaxial dual solenoid valves of claim 11, wherein the discharged fluid is discharged to the reservoir chamber after flowing into the compression solenoid valve.
13. The electronic control shock absorber having coaxial dual solenoid valves of claim 8, wherein during a rebound stroke, as the piston valve ascends, the fluid inside the rebound chamber flows into the upper separation tube after passing through a second communication hole formed in an upper portion of the inner tube.
14. The electronic control shock absorber having coaxial dual solenoid valves of claim 13, wherein the fluid flowing into the separation tube descends and flows into the fourth opening of the rebound inner sleeve.
15. The electronic control shock absorber having coaxial dual solenoid valves of claim 14, wherein the fluid flowing into the fourth opening is discharged through the third opening open outward in the radial direction.
16. The electronic control shock absorber having coaxial dual solenoid valves of claim 15, wherein the discharged fluid is discharged to the reservoir chamber after flowing into the rebound solenoid valve.
17. The electronic control shock absorber having coaxial dual solenoid valves of claim 1, wherein the compression solenoid valve is fastened to the cylinder by the compression inner sleeve mounted on the separation tube inside the cylinder, is compressed against the inner sleeve, and is fastened by metal sealing.
18. The electronic control shock absorber having coaxial dual solenoid valves of claim 17, wherein a protrusion portion convexly protruded is formed in an end portion of a compression port of the compression solenoid valve, and the metal sealing is performed in such a manner that the

protrusion portion is brought into contact with and compressed against a facing surface facing the protrusion portion in the compression inner sleeve.