United States Patent	12392410
Kind Code	B2
Date of Patent	August 19, 2025
Inventor(s)	Ryba; Jürgen et al.

Piston, gear-change selector module and mounting method

Abstract

A piston for a gear-change selector module of a gearshift has a piston body, at least one sealing element, and a cap which is attached to the piston body by means of a clip connection. Furthermore, the sealing element is here attached to the piston body by means of the cap. Also a gear-change selector module with a piston, and a method for mounting a piston, are provided.

Inventors: **Ryba; Jürgen (Ebern, DE), Warmuth; Gerhard (Ebern, DE), Grimmer; Dieter (Ebern, DE), Berger; Ralph (Ebern, DE)**

Applicant: **Valeo Powertrain GmbH** (Ebern, DE)

Family ID: **1000008763951**

Assignee: **Valeo Powertrain GmbH (Ebern, DE)**

Appl. No.: **18/709559**

Filed (or PCT Filed): **December 13, 2022**

PCT No.: **PCT/EP2022/085580**

PCT Pub. No.: **WO2023/110848**

PCT Pub. Date: June 22, 2023

Prior Publication Data

Document Identifier	Publication Date
US 20250003490 A1	Jan. 02, 2025

Foreign Application Priority Data

DE	10 2021 133 069.6	Dec. 14, 2021

Publication Classification

Int. Cl.: **F16H63/30** (20060101); **F16J1/00** (20060101)

U.S. Cl.:

CPC **F16H63/3023** (20130101); **F16J1/008** (20130101);

Field of Classification Search

CPC: F16J (1/001); F16J (1/003); F16J (1/008); F16H (63/3023)

References Cited

U.S. PATENT DOCUMENTS

Patent No.	Issued Date	Patentee Name	U.S. Cl.	CPC
3802323	12/1973	Suechting	92/187	F16J 1/22
6766710	12/2003	Reul	74/473.11	F16H 63/3023
6813990	12/2003	Shiina	92/172	F16J 15/3244
11905979	12/2023	Schorn	N/A	F16H 63/3023
2016/0363233	12/2015	McAuliffe et al.	N/A	N/A

FOREIGN PATENT DOCUMENTS

Patent No.	Application Date	Country	CPC
41 10 542	12/1991	DE	N/A
1 164 316	12/2000	EP	N/A
2 006 548	12/2007	EP	N/A
981607	12/1964	GB	N/A

OTHER PUBLICATIONS

International Search Report issued Feb. 17, 2023 in PCT/EP2022/085580, filed on Dec. 13, 2022, 4 pages. cited by applicant
German Search Report issued Aug. 24, 2022 in DE application 10 2021 133 069.6, filed on Dec. 14, 2021, 7 pages (with English translation of Categories of Cited Documents). cited by applicant

---

Primary Examiner: Leslie; Michael

Attorney, Agent or Firm: Oblon, McClelland, Maier & Neustadt, L.L.P.

Background/Summary

BACKGROUND OF THE INVENTION
Field of the Invention
(1) The invention concerns a piston for a gear-change selector module of a gearshift, with a piston body and at least one sealing element. The invention furthermore concerns a gear-change selector module for a gearshift of a motor vehicle with at least one such piston, and a method for mounting a piston of a gear-change selector module.

Description of the Related Art

(2) Gear-change selector modules are parts of a transmission mechanism. They serve to create the adjustment movements for shifting between different gears of the transmission. A hydraulically actuated gear-change selector usually has several hydraulic cylinders which are adjusted when a gear is to be selected. The stroke of the pistons is transferred to different shift forks. The pistons of the hydraulic cylinders are pressurized with hydraulic fluid in order to assume predefined piston positions corresponding to different shift positions.

(3) For this, the pistons comprise sealing elements which guarantee that the pistons lie tightly against the cylinder wall and thus form chambers in the cylinders which can be reliably pressurised. In order to ensure a defined seat of the sealing elements and avoid the sealing elements being lost during logistics or mounting, the sealing elements are usually attached to the piston body.

BRIEF SUMMARY OF THE INVENTION

(4) The production of such pistons is therefore associated with high cost in order to meet the high requirements for reliability and quality.

(5) The object of the invention is to provide a piston and a gear-change selector module with such a piston, which can be produced at low cost. Another object of the invention is to provide a method for mounting a piston of a gear-change selector module.

(6) This object is achieved by a piston for a gear-change selector module of a gearshift, with a piston body and at least one sealing element. The piston furthermore has a cap which is attached to the piston body by means of a clip connection. Here, the sealing element is attached to the piston body by means of the cap, whereby the sealing element can be reliably attached to the piston body at low cost. The clip connection here comprises corresponding latching elements which ensure an effective connection of the cap to the piston body so that the sealing element is captively attached. Furthermore, during mounting, the sealing element must not be excessively stretched in order to reach its receiver. This prevents an undesirable deterioration of the material properties.

(7) In particular, the clip connection is play-free, i.e. the cap is attached to the piston body play-free by means of the clip connection.

(8) According to one embodiment, the cap is part of a piston end face of the piston which can be pressurised with a working fluid, in particular wherein the cap can be attached to the piston body in the axial direction by means of the clip connection. In this way, during operation of the piston, the cap is pressed by the pressure loading the piston end face into a closed position of the clip connection, i.e. a position in which the latching elements of the clip connection are in mutual engagement. Thus even under high pressures during operation, it is guaranteed that the cap and hence the sealing element are securely attached to the piston body.

(9) According to a further embodiment, the at least one sealing element is an inner sealing element which is received in an inner receiver of the piston body, and/or an outer sealing element which is received in an outer receiver of the piston body. In the sense of the invention, the terms “inner” and “outer” refer in particular to the radial distance of the sealing element from a centre longitudinal axis of the piston.

(10) Here, the inner sealing element and/or the outer sealing element may be attached to the piston body by means of the cap. Thus the inner sealing element, the outer sealing element, or both the inner and the outer sealing elements are attached to the piston body by means of the cap. This has the advantage that the corresponding sealing elements can be fixed jointly and hence at low cost by means of the cap.

(11) In addition or alternatively, in one embodiment, the inner receiver is designed to be complementary to the inner sealing element in the unloaded state, and/or the outer receiver is designed to be complementary to the outer sealing element in unloaded state. The term “unloaded” here in particular means the state of the sealing element in which the sealing element is in the unstretched state before mounting of the sealing element. Because of this design, the inner sealing element or the outer sealing element is received in the assigned receiver such that the

corresponding sealing element is not stretched. This ensures that, in mounted state, the corresponding sealing element has a defined form and hence provides a defined sealing effect.
(12) Here, the inner receiver and/or the outer receiver may each have no undercut in which the inner or outer sealing element engages in the radial direction. This design has the advantage that the sealing body is simpler in design and can be produced at low cost.
(13) In a further embodiment, the piston body is designed such that, viewed in the axial direction, the inner and/or outer sealing element is not concealed by the piston body. In particular, this means that the inner and/or outer sealing element is not concealed even in portions by the piston body. In other words, in the axial direction, the sealing elements are completely visible and may thus be pushed onto the piston body in the axial direction without being stretched, as would be necessary for example if the sealing elements had to be pushed over an extension or shoulder of the piston body. Thus the piston can be produced at low cost.
(14) According to the invention, to achieve the above-mentioned object, a gear-change selector module for a motor vehicle is also provided which has at least one, preferably several pistons according to the invention, with the above-mentioned advantages.
(15) Furthermore, according to the invention, to achieve the above-mentioned object, a method is provided for mounting a piston of a gear-change selector module. The piston here has a piston body, a cap and an inner sealing element and/or an outer sealing element. The method comprises the following steps: a) insertion of the inner sealing element into an inner receiver of the piston body in the axial direction and/or of the outer sealing element into an outer receiver of the piston body in the axial direction, and b) fixing of the cap to the piston body by means of a clip connection.
(16) In this way, the piston can be mounted at low cost.
(17) In one embodiment, it may be provided that on insertion of the inner and/or outer sealing element in step a), the inner and/or outer sealing element is not stretched. Thus the corresponding sealing elements retain their defined form in unloaded state and may thus reliably guarantee a high tightness. Furthermore, this embodiment has the advantage that no forces are required for stretching the corresponding sealing elements, whereby the method is particularly cost efficient.

Description

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS
(1) Further advantages and features will become apparent from the following description and from the appended drawings, in which:
(2) FIG. **1** shows a perspective illustration of a gear-change selector module according to the invention with several hydraulic cylinders and shift forks,
(3) FIG. **2** shows a piston according to the invention in an exploded view,
(4) FIG. **3** shows a side view of the piston from FIG. **2**, and
(5) FIG. **4** shows a sectional view of the piston along plane V-V from FIG. **3**.
DETAILED DESCRIPTION OF THE INVENTION
(6) FIG. **1** shows a gear-change selector module **10** for a gearshift of a motor vehicle, which has a housing **12** with hydraulic cylinders **14** and several shift forks **16** which can be moved by means of the hydraulic cylinders **14** in the axial direction A on a shaft **18** of the gear-change selector module **10**.
(7) The hydraulic cylinders **14** each comprise a piston **20** (see FIG. **2**) which is mounted in a piston receiver of the hydraulic cylinder **14** so as to be movable in or against the axial direction A.
(8) The hydraulic cylinders **14** are here each coupled to one of the shift forks **16** via a carrier arm **22** of the shift fork **16**, which engages radially in a recess **24** in the piston **20**.
(9) In an alternative embodiment, the gear-change selector module **10** has at least one hydraulic

cylinder **14** which is coupled to at least one shift fork **16**.
(10) With reference to FIGS. **2** to **4**, it is now explained how the pistons **20** are designed, using the example of a piston **20**.
(11) The piston **20** has a piston body **26** which extends in the axial direction A from a first axial end **28** to a second axial end **30**.
(12) In the present embodiment, the piston body **26** is formed as one piece, whereby the piston **20** consists of particularly few parts.
(13) Alternatively, the piston body **26** may consist of more than one component.
(14) Furthermore, the recess **24** is arranged in or formed in the piston body **26**.
(15) In the present embodiment, the piston **20** is a double-action piston and accordingly at the first axial end **28** has a first sealing portion **31**, and at the second axial end **30** a second sealing portion **32**, each of which has a piston end face **34** of the piston **20** which can be pressurised with a working fluid.
(16) In an alternative embodiment, the piston **20** may be a single-action piston which has a piston end face **34** that can be pressurised by a working fluid at only one axial end **28**, **30**.
(17) In the present exemplary embodiment, the first sealing portion **31** and the second sealing portion **32** are formed substantially identically.
(18) Evidently, in an alternative embodiment, the piston **20** may have only a single sealing portion **31**, **32**, or a first sealing portion **31** and a second sealing portion **32** which differ substantially from one another.
(19) The structure of the sealing portions **31**, **32** will now be explained using the example of the first sealing portion **31**. The explanations apply accordingly to the second sealing portion **32**, wherein the directional indication “in the axial direction A” must be replaced accordingly by “against the axial direction A” or vice versa.
(20) The first sealing portion **31** has a cap **36** which is attached to the piston body **26** via a clip connection **38** (see FIG. **4**).
(21) The clip connection **38** is formed by latching elements **40** on the cap side and complementarily designed latching elements **42** on the piston body side, which engage with one another in the radial direction. Thus the cap **36** is fixed to the piston body **26**, in particular play-free, both in and against the axial direction A.
(22) The side **44** of the cap **36** opposite the piston body **26** in the axial direction A here forms a part of the corresponding piston end face **34** of the piston **20**.
(23) The cap **36** is made for example from a plastic and is thus particularly light, in the sense of low mass, and flexible.
(24) Furthermore, the first sealing portion **31** has an inner sealing element **46** which is arranged in an inner receiver **48**, and an outer sealing element **50** which is arranged in an outer receiver **52**.
(25) The inner sealing element **46** is here arranged radially closer to the centre longitudinal axis M of the piston **20** than the outer sealing element **50**.
(26) Furthermore, the inner sealing element **46** is arranged radially inside the outer sealing element **50**, i.e. the inner sealing element **46** and the outer sealing element **50** are arranged at least in portions at the same height in the axial direction A and thus overlap when viewed in the radial direction.
(27) The inner sealing element **46** and the outer sealing element **50** are here annular, i.e. closed in the circumferential direction around the centre longitudinal axis M.
(28) In principle, the inner sealing element **46** and the outer sealing element **50** may be arbitrarily designed and/or arranged relative to one another.
(29) The inner sealing element **46** is for example a sealing element which seals a breather channel in the piston body **26**.
(30) The outer sealing element **50** forms a piston seal which is configured to seal the radial gap between the piston body **26** and the piston receiver of the hydraulic cylinder **14**. Thus the outer

sealing element **50** protrudes beyond the piston body **26** in the radial direction, for example in the form of the sealing lip.
(31) The outer receiver **52** is a combination of a ring groove on the end face, extending in the axial direction A, and a circumferential groove in the piston body **26**. In other words, the outer receiver **52** is formed by a step in the piston body **26** which has an axial end face **54** extending in the radial direction, and a radial circumferential face **56** extending in the axial direction A.
(32) The inner receiver **48** is a ring groove in the end face of the piston body **26** extending in the axial direction A, which has a base **58** extending in the radial direction and a radially inner side face **60** and a radially outer side face **62**, which lie opposite one another and each extend in the axial direction A.
(33) The end face ring groove, forming the receiver **48**, is formed stepped in the present exemplary embodiment, whereby adjoining the base **58** in the radial direction is a portion which, at least in portions in the circumferential direction, is arranged offset to the base **58** in the axial direction A.
(34) Here, the inner receiver **48** and the outer receiver **52** are each designed to be complementary to the inner sealing element **46** or outer sealing element **50** respectively, in particular in the unloaded state.
(35) In the present exemplary embodiment, the inner diameter D.sub.1 of the inner receiver **48** corresponds to the inner diameter d.sub.1 of the inner sealing element **46** in unloaded state, while the outer diameter D.sub.2 of the inner receiver **48** corresponds to the outer diameter d.sub.2 of the inner sealing element **46** in unloaded state.
(36) Furthermore, the inner diameter D.sub.3 of the outer receiver **52** corresponds to the inner diameter d.sub.3 of the outer sealing element **50** in unloaded state.
(37) The radial circumferential face **56**, the inner side face **60** and the outer side face **62** here extend directly in the axial direction A or parallel to the centre longitudinal axis M. Thus the inner receiver **48** and outer receiver **52** have no radial notches or undercuts in which the inner sealing element **46** or outer sealing element **50** could engage in the radial direction.
(38) Furthermore, the piston body **26** is designed such that, viewed in the axial direction A, the inner receiver **48**, in particular the base **58**, and the outer receiver **52**, in particular the axial end faces **54**, are each completely visible when no sealing elements **46**, **50** are arranged in the receivers **48**, **52** and no cap **36** is attached to the piston body **26**.
(39) Thus the sealing elements **46**, **50** are completely visible in the receivers **48**, **52**, viewed in the axial direction A, and can be inserted in the corresponding receivers **48**, **52** in the axial direction A without being stretched.
(40) In principle, in an alternative embodiment, the inner receiver **48** and the outer receiver **52** each can be of an arbitrary design.
(41) In this context, the cap **36** has an inner holding portion **64** and an outer holding portion **66**.
(42) In mounted state, i.e. when the cap **36** is attached to the piston body **26**, the inner holding portion **64** delimits the inner sealing element **46** in the axial direction A, and the outer holding portion **66** delimits the outer sealing element **50** in the axial direction A.
(43) Here, the cap **36** and the piston body **26** are designed such that the inner sealing element **46** is arranged between the base **58** and the inner holding portion **64**, play-free in the axial direction A and is thus fixed.
(44) Furthermore, the cap **36** and the piston body **26** are designed such that the outer sealing element **50** is arranged between the axial end face **54** and the outer holding portion **66** play-free in the axial direction A and is thus fixed.
(45) The sealing elements **46**, **50**, the receivers **48**, **52** and the holding portions **64**, **66** are here designed coaxially to the centre longitudinal axis M or to one another.
(46) In order to align the cap **36** in the radial direction in defined fashion relative to the piston body **26**, the cap **36** has a central guide portion **68** and the piston body **26** a complementarily formed guide peg **70**, which in mounted state together form a guide in the axial direction A.

(47) In the present embodiment, the guide peg **70** transforms steplessly into the inner side face **60** of the inner receiver **48** in the axial direction A. Thus the guide peg **70** has an outer diameter D.sub.4 and the guide portion **68** has an inner diameter D.sub.5 which each correspond to the outer diameter D.sub.1 of the inner receiver **48**.
(48) The latching elements **40** on the cap side are here arranged on the outer holding portion **66**.
(49) In principle, the guide portion **68** and/or the latching elements **40** on the cap side may be arranged at any location on the cap **36**, wherein the piston body **26** is complementarily designed accordingly.
(50) For mounting the piston **20**, first the inner sealing element **46** and the outer sealing element **50** are pushed in the axial direction A into the inner receiver **48** and outer receiver **52** of the piston body **26**, and thus inserted therein.
(51) Here, the inner sealing element **46** and the outer sealing element **50** are not stretched, in particular not in such a fashion that the inner diameter d.sub.1, d.sub.3 of the sealing elements **46**, **50** changes.
(52) The cap **36** is then fixed to the piston body **26** in the axial direction A by means of the clip connection **38**.
(53) In this way, the inner sealing element **46** and outer sealing element **50** are attached to the piston body **26** by means of the cap **36**, so that no additional fixing means are required for fixing the sealing elements **46**, **50**.
(54) In an alternative embodiment, at least one of the sealing elements is fixed to the piston body by means of the cap.
(55) In this way, a piston **20** and a gear-change selector module **10** with the piston **20** provided which can be produced at low cost.

Claims

1. A piston for a gear-change selector module of a gearshift, comprising: a piston body; and at least one sealing element, wherein the piston has a cap which is attached to the piston body by a play-free clip connection, and wherein the at least one sealing element is attached to the piston body by the cap such that the at least one sealing element is fixed.
2. The piston according to claim 1, wherein the cap is part of a piston end face of the piston which can be pressurized with a working fluid, and the cap can be attached to the piston body in an axial direction by the play-free clip connection.
3. The piston according to claim 1, wherein the at least one sealing element includes at least one of an inner sealing element received in an inner receiver of the piston body and an outer sealing element received in an outer receiver of the piston body.
4. The piston according to claim 3, wherein at least one of the inner sealing element and the outer sealing element is attached to the piston body by the cap.
5. The piston according to claim 3, wherein at least one of the inner receiver is designed to be complementary to the inner sealing element in an unloaded state and the outer receiver is designed to be complementary to the outer sealing element in the unloaded state.
6. The piston according to claim 5, wherein at least one of the inner receiver and the outer receiver has no undercut in which the inner or outer sealing element engages in a radial direction.
7. The piston according to claim 5, wherein the piston body is designed such that, viewed in an axial direction, at least one of the inner sealing element and the outer sealing element is not concealed by the piston body.
8. A gear-change selector module for a gearshift of a motor vehicle, wherein the gear-change selector module comprises at least one, piston according to claim 1.
9. A method for mounting a piston of a gear-change selector module, wherein the piston has a piston body, a cap, and at least one of an inner sealing element and an outer sealing element, the

method comprising: a) insertion of at least one of the inner sealing element into an inner receiver of the piston body in the axial direction and the outer sealing element into an outer receiver of the piston body in the axial direction, and b) fixing of the cap to the piston body by a play-free clip connection.

10. The method according to claim 9, wherein on insertion of the at least one of the inner sealing element and the outer sealing element in step a), the at least one of the inner sealing element and the outer sealing element is not stretched.

11. The piston according to claim 2, wherein the at least one sealing element is includes at least one of an inner sealing element received in an inner receiver of the piston body and an outer sealing element which is received in an outer receiver of the piston body.

12. The method according to claim 4, wherein at least one of the inner receiver is designed to be complementary to the inner sealing element in an unloaded state and the outer receiver is designed to be complementary to the outer sealing element in the unloaded state.

13. The method according to claim 6, wherein the piston body is designed such that, viewed in an axial direction, at least one of the inner sealing element and the outer sealing element is not concealed by the piston body.

14. A gear-change selector module for a gearshift of a motor vehicle, wherein the gear-change selector module comprises at least one, piston according to claim 2.

15. A gear-change selector module for a gearshift of a motor vehicle, wherein the gear-change selector module comprises at least one, piston according to claim 3.

16. A gear-change selector module for a gearshift of a motor vehicle, wherein the gear-change selector module comprises at least one, piston according to claim 4.

17. A gear-change selector module for a gearshift of a motor vehicle, wherein the gear-change selector module comprises at least one, piston according to claim 5.

18. A gear-change selector module for a gearshift of a motor vehicle, wherein the gear-change selector module comprises at least one, piston according to claim 6.

19. A gear-change selector module for a gearshift of a motor vehicle, wherein the gear-change selector module comprises at least one, piston according to claim 7.

20. The piston according to claim 4, wherein the cap includes an inner holding portion and an outer holding portion, and in a mounted state, the inner holding portion delimits the inner sealing element in an axial direction and the outer holding portion delimits the outer sealing element in the axial direction.