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(54) **Gearshift lever**

Getriebeschalthebel

Levier de vitesse

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## Description

**[0001]** The present invention relates to a gearshift lever in accordance with the preamble of Claim 1.

**[0002]** Gearshift levers are known that have a universal joint and a spring mechanism for returning the grip to the central position. Arranged about said universal joint, generally speaking, are four pin-shaped shift elements which are pressed by a pressure spring against a limit stop and which extend to the pivot point of said universal joint. The limit stop has a shoulder on the pin-shaped shift element which presses against the housing. Mounted on the grip is a plate that extends to the pin-shaped shift elements. If the grip is shifted, the plate presses against a shift element, and a return force is exerted. In order to make additional functions in the controlled device perceptible to the user in a gearshift lever of this type, additional functional devices are realized for sudden changes in the return force (overcoming the pressure point) and/or retaining (locking) the shift element in a predetermined position. In the case of familiar, purely mechanical gearshift levers, functional devices of this type are realized by additional spring-activated pins or by ball thrust bearings.

**[0003]** The disadvantage herein is that realizing a pressure point or a locking function purely mechanically is often not possible in unlimited numbers because each additional mechanical element requires installation space and generates higher costs. Furthermore, the service life is limited by the wear and tear on these mechanical elements. Variable engagement of components is hardly possible.

**[0004]** WO 99/00615 A, which shows the features of the preamble of claim 1, discloses a manoeuvering arrangement having a gear shift lever acting on a number of hydraulic cylinders via flow limiters and having a number of sensor members for detecting manoeuvering forces.

**[0005]** US-A-5 452 745 discloses a magnetorheological fluid valve used in a suspension system of a drivers' seat in a vehicle in order to damp vibrations of such a seat.

**[0006]** DE 199 61 052 A1 discloses a manoeuvering device for manually or pedally controlling machines comprising parallel hydraulic cylinders being connected with an arrangement for affecting the flow rate of the hydraulic fluid from the hydraulic cylinders.

**[0007]** The objective of the present invention is therefore to indicate a gearshift lever of the type cited above in which functional devices can be provided in greater numbers without requiring substantially more installation space or substantially higher costs.

**[0008]** To achieve this objective in a gearshift lever of the aforementioned type, the features indicated in Claim 1 are provided.

**[0009]** As a result of the measures proposed according to the present invention, a gearshift lever can be realized in which functional devices for overcoming a pressure point during activation and/or for retaining a selected shift position can be achieved in a way that reduces wear and tear.

**[0010]** In the present invention a magnetorheological fluid is used that is subject to a magnetic field in a simple manner for choking or blocking the flow from one shift element to another.

**[0011]** Advantageous designs of both exemplary embodiments may be derived from the features of one or more of Claims 2 to 4.

**[0012]** Further details of the invention can be seen from the following description, in which the invention is described and explained in greater detail on the basis of the exemplary embodiment that is depicted in the drawing. In the drawing:

Figure 1 in a longitudinal section depicts a gearshift lever in accordance with a preferred exemplary embodiment of the present invention in a resting or initial position, and

Figure 2 depicts the gearshift lever according to Figure 1 in one of many shift positions.

**[0013]** Gearshift lever 10, which is depicted in the drawing in accordance with a preferred exemplary embodiment and is also known as a joystick, can serve to control construction vehicles and devices, for example.

**[0014]** Gearshift lever 10 has a housing 11 and a handgrip 12 that can move or swivel in multiple, for example, two degrees of freedom. Housing 11, which is essentially cylindrical, is centrally located and is provided with an undepicted fixed part 13 of a universal joint 14, whose movable part 15 is arranged on the lower side of a plate 16 of handgrip 12. Fixed part 13 of universal joint 14 is attached at the upper, open end of a central blind-hole opening 17 on housing 11.

**[0015]** Gearshift lever 10 in the depicted exemplary embodiment is provided with shift elements that are arranged uniformly distributed over the periphery, whereby in the sectional representation only two shift elements 18 and 19 are represented, which are diametrically opposite each other. The two other shift elements are arranged diametrically opposite each other and are rotated 90° with respect to gearshift levers 18 and 19. Shift elements 18 and 19, like the other, undepicted shift elements, are configured in a pin-shaped manner and protrude in the axial direction into part 25 of housing 11 that surrounds blind-hole opening 17, whereby with their upper free ends 22, 23 they are situated opposite an annular surface 21 of the lower side of plate 16 of grip 12, or they contact said annular surface in the initial position (Figure 1) in an axially biased manner.

**[0016]** Starting from its annular surface 24 that is opposite handgrip 12, housing part 25 is provided with boreholes that extend axially and that, like the shift elements, are arranged uniformly distributed over the periphery, of which only boreholes 26, 27 are depicted, which are diametrically opposite each other. In the upper part of boreholes 26, 27 bearing sleeves 28, 29 are introduced that

are axially fixed, protrude beyond annular surface 24, and are sealingly held against a shoulder of the borehole at their inner ends by a sealing ring 31. Bearing sleeves 28, 29 accommodate shift elements 18, 19 so that the latter are axially movable. Shift element 18, 19 is directly guided within segment 32 of boreholes 26, 27, which are connected to said bearing sleeves and are smaller in diameter. Attached thereto and larger in diameter is a hydraulic chamber 33, 34 of a hydraulic arrangement 35. Hydraulic chamber 33, 34 is open to borehole 26, 27 at the lower end of housing 11 and is provided with an interior threaded borehole.

**[0017]** Screwed into hydraulic chamber 33, 34 is an elongated sleeve 36, 37, whose interior end 38 in hydraulic chamber 33, 34 is smaller in diameter and is surrounded there by a pressure spring 41, 42, which at one end is supported at a shoulder 43 of elongated sleeve 36, 37, adjacent to the exterior thread, and at the other end is supported on a disk 45, which is supported on an annular shoulder between hydraulic chamber 33, 34 and borehole part 32. Engaging in this disk 45 is an end 44 of shift element 18, 19 that is smaller in diameter. Therefore, each shift element 18, 19 is acted upon by pressure spring 41, 42 such that, in the idle or initial position, shift elements 18, 19 are pressed against handgrip 12.

**[0018]** Lower ends 39 of elongated sleeves 36, 37 protrude from housing 11, which is supported on a pot-like element 47, into whose hollow space elongated sleeves 36, 37 extend, which are connected to each other by a connecting line 51. The Figures at least partially also indicate a connecting line 52 which is provided in the corresponding hydraulic chambers between the elongated sleeves that are rotated by 90°.

**[0019]** Hydraulic arrangement 35 is filled with a hydraulic fluid within hydraulic chambers 33, 34, elongated sleeves 36, 37, and their connecting line 51. This means that when handgrip 12 is turned in the direction of arrow A in accordance with Figure 2, shift element 18 is axially pressed downwards. Because end 44 of shift element 18 engages in disk 45 and moves along with it, these two elements act as hydraulic pistons in hydraulic chamber 33, so that, at the other end of hydraulic arrangement 35, the hydraulic fluid presses through disk 45 onto shift element 19 moving it upwards in the direction of arrow B.

**[0020]** In the exemplary embodiment depicted, the hydraulic fluid is a magnetorheological fluid within hydraulic arrangement 35 as well as within the hydraulic arrangement that is rotated 90° with respect to the former. For controlling the flow rate of the hydraulic fluid within hydraulic arrangement 35, an electromagnet 55 is arranged, for example, on the right-hand side, about lower end 39 of elongated sleeve 37 of hydraulic arrangement 35, the electromagnet partly or entirely surrounding sleeve 37, 36 or another area of hydraulic arrangement 35. The viscosity of the magnetorheological fluid can be altered by the magnetic field of electromagnet 55. In other words, the functional device that results from the interaction of the magnetic field that is generated by electromagnet 55 and the magnetorheological fluid within hydraulic arrangement 35 can be controlled such that, during the activation of handgrip 12, by setting up an electromagnetic field the viscosity can be modified so that an artificial pressure point is produced. A further possibility of electromagnetically influencing the magnetorheological fluid consists in increasing the electromagnetic field so powerfully that the fluid in the area of electromagnet 55 is practically stationary or fixed, which amounts to blocking the flow through hydraulic arrangement 35. In this way, the selected shift position (for example, in accordance with Figure 2) is retained, because pressure spring 41, here shown on the left side, is not capable of pressing shift element 18 into the initial position. Shift elements 18, 19 and therefore handgrip 12 can only reach their initial position when the electromagnetic field is no longer present.

**[0021]** It is obvious that this can also be achieved in an opposite motion of handgrip 12 or a motion of handgrip 12 that is rotated by 90°, as can be seen from partially depicted electromagnet 56 situated around connecting line 52 or its elongated sleeve.

**[0022]** According to one undepicted exemplary embodiment of the present invention, a customary hydraulic fluid in the form of a hydraulic oil is used within hydraulic arrangement 35. In place of an electromagnet 55, 56 in connecting line 51, 52, a throttling valve and/or a blocking valve is provided, which can either generate a pressure point by narrowing the through flow or a retain a shift position by blocking the connecting line.

**[0023]** Obviously, the depiction in the drawing remains the same in a section that is rotated by 90° from the depicted section with respect to the arrangement of shift elements, hydraulic arrangements, and the like.

**[0024]** It is also obvious that, as is not depicted, specific machine and/or vehicle functions are accomplished using signals that are derived from sensor devices and that this also applies to the electrical driving of functional devices such as electromagnets, throttling or blocking valves, and the like.

## Claims

1. A gearshift lever (10), having a grip (12) which is supported in a housing (11) in a joint (14) that has two degrees of freedom and which can be shifted from an initial position in various directions for activating shift elements (18, 19), whereby spring elements (41, 42) are provided for returning the grip (12) to its initial position, and having a functional device for overcoming a pressure point during the activation and/or for retaining a desired shift position, whereby the functional device is constituted by an electrically controllable hydraulic arrangement (35), which connects to shift elements (18, 19) that advantageously are diametrically opposite each other and that can be activated by the grip (12) in two op-

posite directions of motion, wherein the hydraulic arrangement (35) has a hydraulic cylinder (33, 34) that is assigned to each shift element (18, 19), and the two hydraulic cylinders (33, 34) are connected to each other by a pipe line (36, 37, 51), in which throttling and/or blocking device is arranged, **characterised in that** the hydraulic arrangement (35) is filled with a magnetorheological fluid, and the throttling and/or blocking device has an electromagnet (55) that at least partially surrounds the pipe line (36, 37, 51) at one location and wherein the hydraulic piston has a disk (45) that is arranged within the hydraulic cylinder (33, 34), that, axially stressed by a pressure spring (41, 42) within the hydraulic cylinder (33, 34), is supported on an interior shoulder of the hydraulic cylinder, and that is acted upon by the axially movable shift element (18, 19).

**2.** The gearshift lever as recited in Claim 1, wherein the end (44) of the shift element (18, 19) that is facing away from the grip (12) directly or indirectly forms a hydraulic piston.

**3.** The gearshift lever as recited in any of Claims 1 or 2, wherein a sleeve (36, 37) is inserted in a fluid-tight manner into the end of the hydraulic cylinder (33, 34) that is facing away from the shift element (18, 19), the hydraulic piston (45) of the activated shift element (18, 19) contacting the interior end of the sleeve.

**4.** The gearshift lever as recited in Claims 1 and 3, wherein the end (39) of a sleeve (36, 37) of the hydraulic arrangement (35) that protrudes from the hydraulic cylinder (33, 34) is at least partially surrounded by the electromagnet (55).

**Patentansprüche**

**1.** Schalthebel (10) mit einem Griff (12), der innerhalb eines Gehäuses (11) in einem Gelenk (14) mit zwei Freiheitsgraden unterstützt ist und aus einer Anfangsposition in verschiedenen Richtungen verschoben werden kann, um Schaltelemente (18, 19) zu aktivieren, wobei Federelemente (41, 42) vorgesehen sind, um den Griff (12) in seine Anfangsposition zurückzustellen, und einer Funktionsvorrichtung zum Überwinden eines Druckpunkts während der Aktivierung und/oder zum Halten einer Soll-Schaltposition, wobei die Funktionsvorrichtung durch eine elektrisch steuerbare Hydraulikanordnung (35) gebildet ist, die Schaltelemente (18, 19) verbindet, die vorteilhaft diametral einander gegenüberliegen, und durch den Griff (12) in zwei entgegengesetzten Bewegungsrichtungen aktiviert werden kann, wobei die Hydraulikanordnung (35) ein Hydraulikzylinder (33, 34) ist, der jedem Schaltelement (18, 19) zugewiesen ist, und die zwei Hydraulikzylinder (33, 34) durch eine Rohrleitung (36, 37, 51) miteinander verbunden sind, in der eine Drosselungs- und/oder Blockiervorrichtung angeordnet ist, **dadurch gekennzeichnet, dass** die Hydraulikanordnung (35) mit einem magnetorheologischen Fluid gefüllt ist und die Drosselungs- und/oder Blockiervorrichtung einen Elektromagneten (55) besitzt, der die Rohrleitung (36, 37, 51) an einer Stelle wenigstens teilweise umgibt, und wobei der Hydraulikkolben eine Scheibe (45) besitzt, die in dem Hydraulikzylinder (33, 34) angeordnet ist, die aufgrund einer axialen Beanspruchung mittels einer Druckfeder (41, 42) in dem Hydraulikzylinder (33, 34) an einer Innenschulter des Hydraulikzylinders unterstützt ist und auf die durch das axial bewegliche Schaltelement (18, 19) eingewirkt wird.

**2.** Schalthebel nach Anspruch 1, wobei das Ende (44) des Schaltelements (18, 19), das von dem Griff (12) wegweist, direkt oder indirekt einen Hydraulikkolben bildet.

**3.** Schalthebel nach einem der Ansprüche 1 oder 2, wobei eine Hülse (36, 37) fluiddicht in das Ende des Hydraulikzylinders (33, 34), das von dem Schaltelement (18, 19) wegweist, eingesetzt ist, wobei der Hydraulikkolben (45) des aktivierten Schaltelements (18, 19) mit dem inneren Ende der Hülse in Kontakt ist.

**4.** Schalthebel nach den Ansprüchen 1 und 3, wobei das Ende (39) einer Hülse (36, 37) der Hydraulikanordnung (35), die von dem Hydraulikzylinder (33, 34) vorsteht, wenigstens teilweise von dem Elektromagneten (55) umgeben ist.

**Revendications**

**1.** Levier de changement de vitesse (10), comportant une poignée (12) qui est supportée dans un boîtier (11) dans un joint (14) qui possède deux degrés de liberté et qui peut être déplacée depuis une position initiale, dans des directions différentes pour activer des éléments de commande (18, 19), dans lequel des éléments de ressort (41, 42) sont prévus pour rappeler la poignée (12) dans sa position initiale, et ayant un dispositif fonctionnel pour vaincre un point de pression lors de l'actionnement et/ou pour maintenir une position de commande souhaitée, dans lequel le dispositif fonctionnel est constitué par un dispositif hydraulique à commande électrique (35), qui se connecte aux éléments de commande (18, 19) qui sont avantageusement diamétralement opposées l'un à l'autre et qui peuvent être activés par la poignée (12) dans deux directions de mouvement opposées, dans lequel le dispositif hydraulique (35) comporte un vérin hydraulique (33, 34) qui est as-

socié à chaque élément de commande (18, 19), et les deux vérins hydrauliques (33, 34) sont connectés l'un à l'autre par une conduite (36, 37, 51) dans laquelle est disposé un dispositif d'étranglement et/ou de blocage, **caractérisé en ce que** le dispositif hydraulique (35) est rempli d'un fluide magnétorhéologique, le dispositif d'étranglement et/ou de blocage comporte un électro-aimant (55) qui entoure au moins partiellement la conduite (36, 37, 51) en un seul endroit, et le piston hydraulique comporte un disque (45) qui est disposé à l'intérieur du vérin hydraulique (33, 34), qui est sollicité axialement par un ressort de pression (41, 42) dans le vérin hydraulique (33, 34), qui prend appui sur un épaulement intérieur du vérin hydraulique, et qui est sollicité par l'élément de commande mobile axialement (18, 19).

**2.** Levier de changement de vitesse selon la revendication 1, dans lequel l'extrémité (44) de l'élément de commande (18, 19) qui est opposée à la poignée (12) forme, directement ou indirectement, un piston hydraulique.

**3.** Levier de changement de vitesse selon l'une des revendications 1 ou 2, dans lequel un manchon (36, 37) est inséré de manière étanche dans l'extrémité du vérin hydraulique (33, 34) qui est opposée à l'élément de commande (18, 19), le piston hydraulique (45) de l'élément de commande actionné (18, 19) communiquant avec l'extrémité intérieure du manchon.

**4.** Levier de changement de vitesse selon les revendications 1 et 3, dans lequel l'extrémité (39) d'un manchon (36, 37) du dispositif hydraulique (35) qui fait saillie depuis le vérin hydraulique (33, 34) est au moins partiellement entourée par l'électroaimant (55).

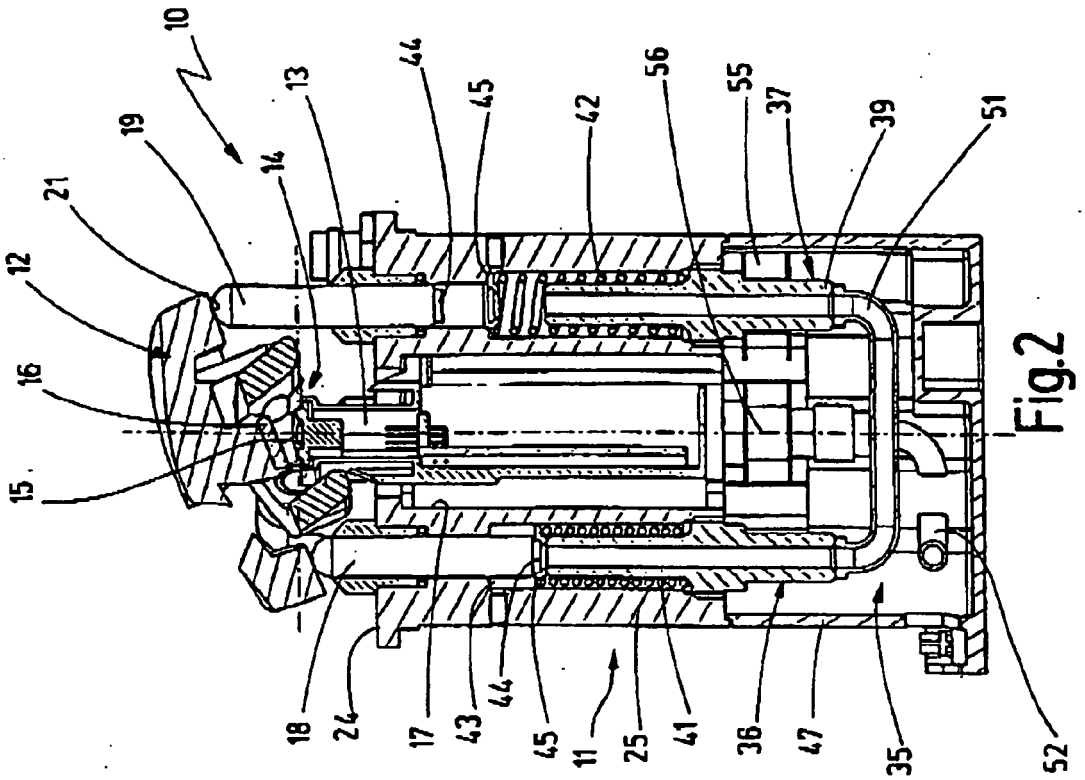
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Fig.2

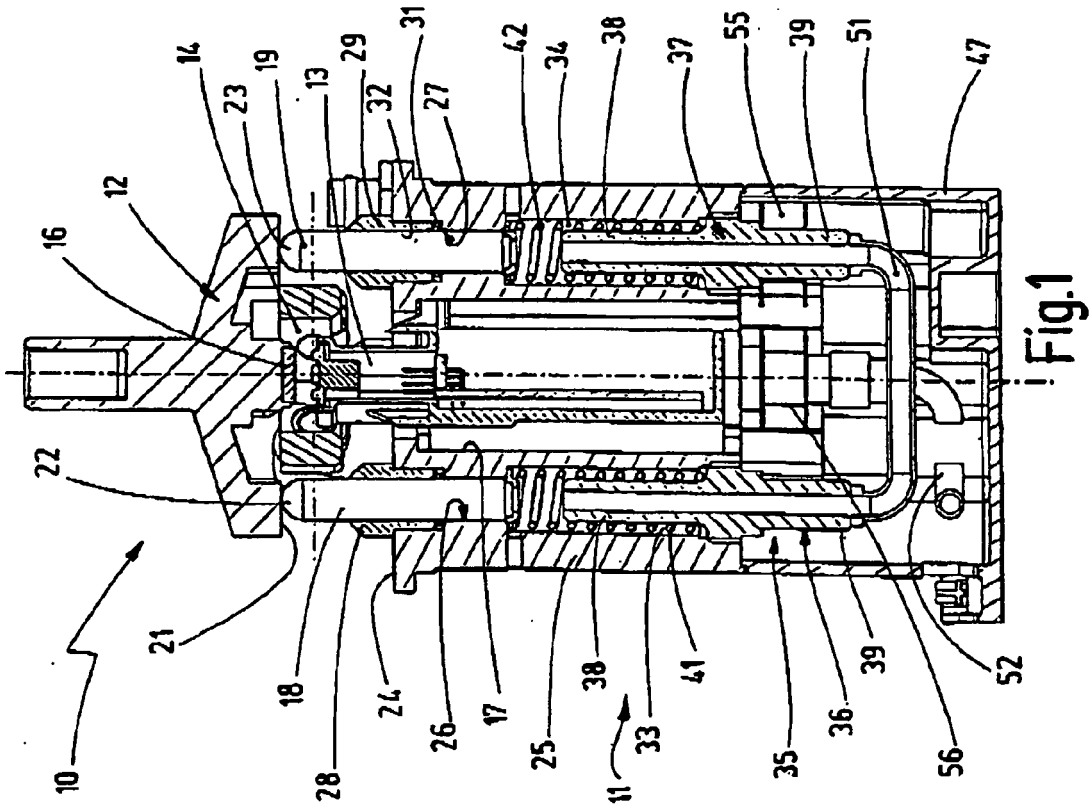
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Fig.1

## REFERENCES CITED IN THE DESCRIPTION

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- US 5452745 A **[0005]**
- DE 19961052 A1 **[0006]**