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(54) Device for detecting the position of a control element

(57) In a device for detecting the position of a control element (2, Fig 1) which can be influenced hydraulically or pneumatically by means of a control line having a measuring piston 3 sliding in a housing 4, in the control line of the control element (2), a sensor is provided for monitoring the position of the measuring piston to monitor the position of the control element (2). The sensor may be a rotary potentiometer actuated by a toothed wheel 13 engaging teeth on a measuring rod 12 or a measuring coil (35, Fig 3) surrounding the housing 4. The device may be used with a control element in an actuating device for a friction coupling (Fig 1) of a motor vehicle having a slave cylinder (2), a directional control valve (20), a pressure medium pump (23) driven by a motor (22), a non-return valve (25) and a pressure switch (26).

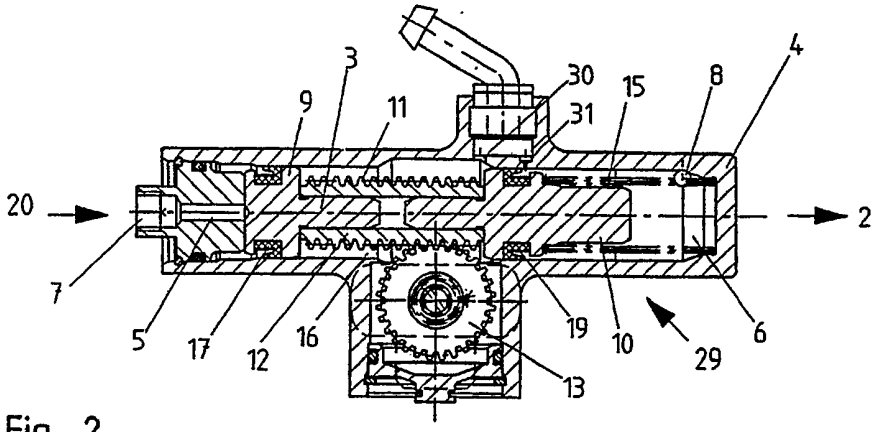

Fig. 2

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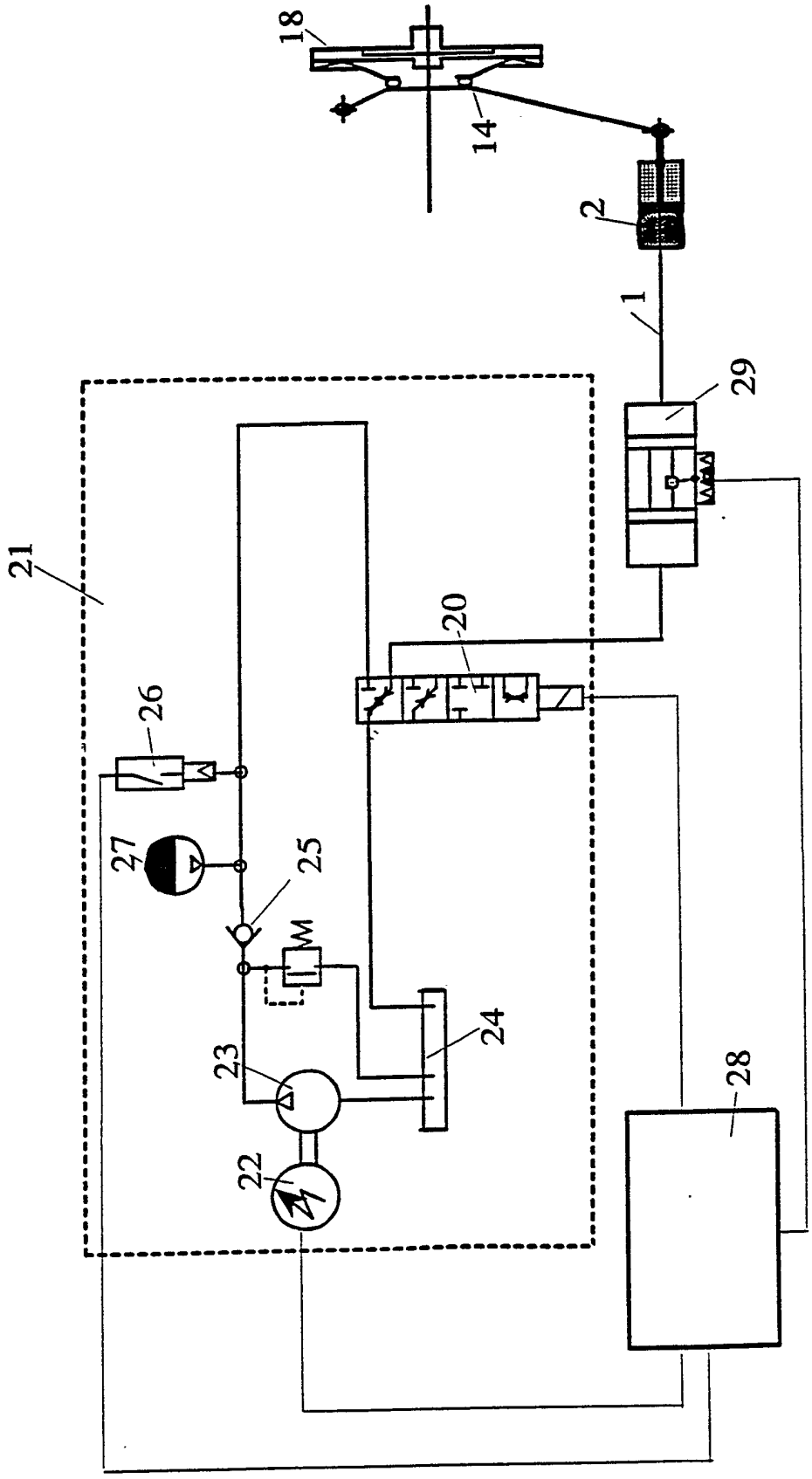

Fig. 1

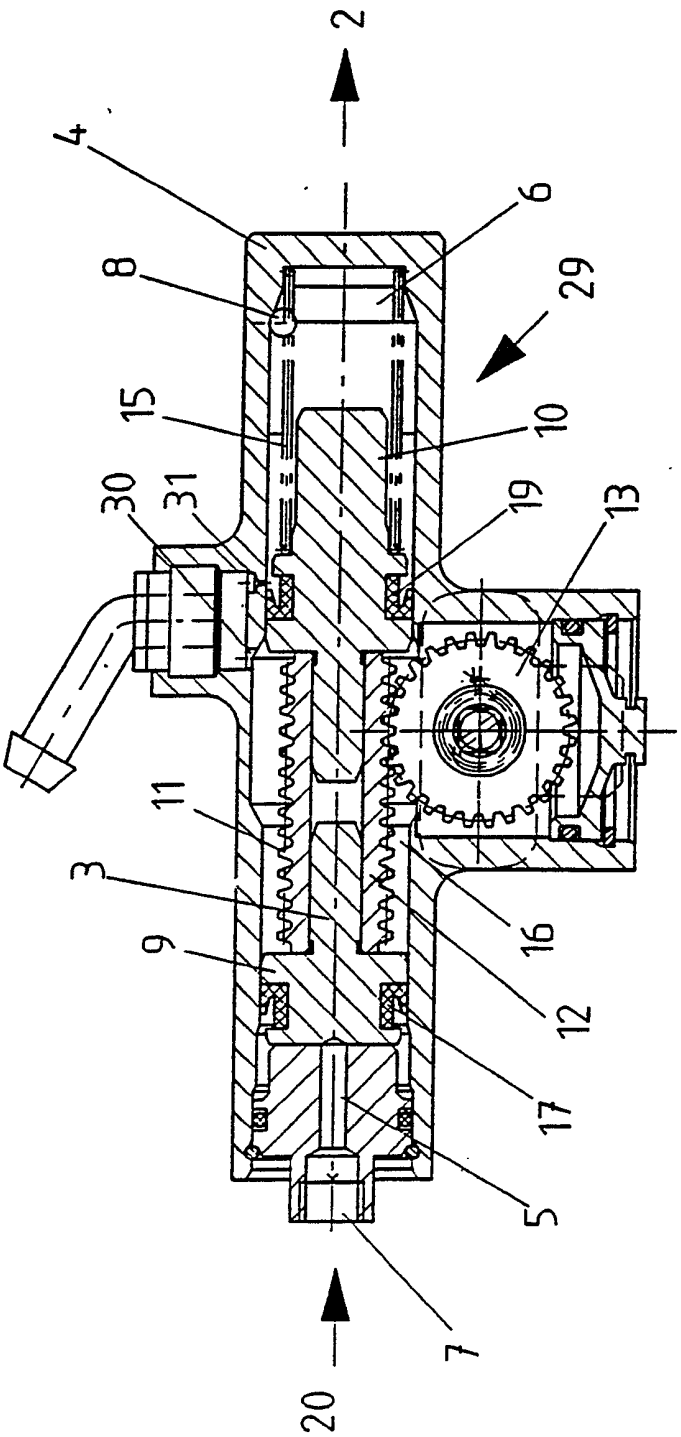

Fig. 2

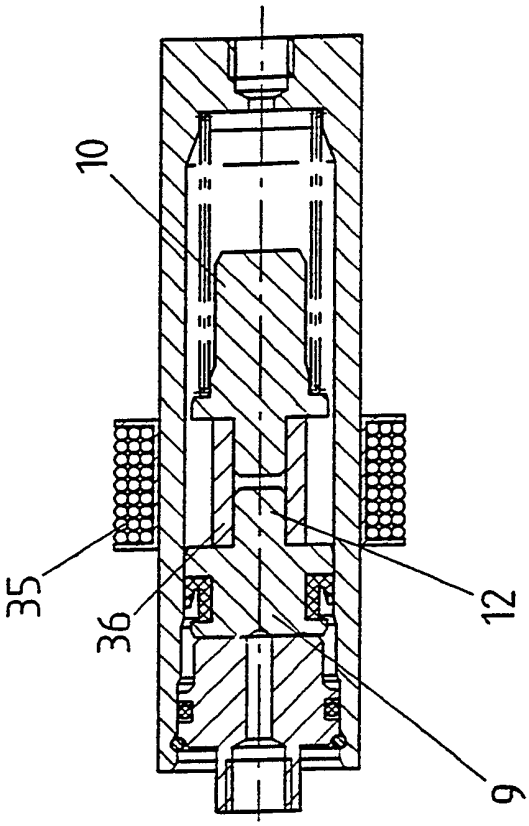

Fig. 3

DESCRIPTION

DEVICE FOR DETECTING THE POSITION OF A CONTROL ELEMENT

The present invention relates to a device for detecting the position of a control element which can be influenced hydraulically or pneumatically by means of a control line, having at least one position transmitter.

Control elements which can be influenced hydraulically are used, for example, in actuating devices for friction couplings in motor vehicles, effective between the engine and the gears. From German laid-open document DE 40 11 850 A1, for example, an automatically effective friction coupling is known. This coupling can be engaged and disengaged by means of an actuating mechanism which comprises a disengaging bearing and a fork engaging therewith. The actuating mechanism is in turn actuated by a control member in the form of a hydraulic cylinder which is connected by controllable hydraulic directional control valves to a pressure medium circuit. Furthermore, an electronic control unit is provided which, in dependence upon different parameters, controls the directional control valves of the pressure medium circuit in order, by means of the hydraulic control member, to adjust a corresponding

coupling engagement. Such parameters are, for example, the engine speed, the position of the throttle valve or the coupling actuation path or the coupling engagement state. In the known actuating mechanism the coupling actuation path or the engagement state is detected by means of a potentiometer disposed directly on the control member, which determines the path and/or position of the piston of the control member and sends a corresponding electrical variable to the electric control unit. In certain applications of such hydraulic control members the direct arrangement of a position or path transmitter can be problematic for reasons of space or because of the necessary electrical supply lines.

The aim of the present invention is to create a device to detect the position of a control element which can be acted upon by pressure, which device is not disposed directly on the control element.

According to the present invention there is provided a device for detecting the position of a control element which can be influenced hydraulically or pneumatically by means of a control line, having at least one position transmitter, comprising a measuring piston slidably located in a housing which is provided, in the control line of the control element, a sensor being provided for monitoring the position of

the measuring piston in the housing to thus monitor the position of the control element.

In an advantageous development of the present invention the measuring piston divides the housing into a primary and a secondary chamber, each with at least one flow connection to the control line upon which the pressure medium acts, the piston being prestressed towards its rest position against the pressure of the control medium, which can be influenced. If the control element is then moved from its rest position, the measuring piston is primarily acted upon on the primary chamber side by pressure medium by way of the control line and, operating as a transfer piston, transfers a corresponding displacement by virtue of an adjustable transfer relationship to the control element.

In a preferred embodiment of the device in accordance with the present invention the measuring piston consists of a first and a second partial piston sliding in a sealing manner on the inner wall of the housing, wherein an unpressurised chamber is formed between the partial pistons. In order to relieve pressure the unpressurised chamber advantageously has a flow connection to an equalising reservoir or tank.

In one embodiment, in order to detect the position of the control element, the partial pistons

are connected to each other by a measuring rod comprising a measuring scale. In accordance with a development of the embodiment the length of the measuring scale corresponds, according to a transfer relationship, to the displacement path of the control element. The pressure medium transfer can be adjusted by forming the primary and secondary chambers with different diameters.

The measuring scale may be formed by a toothed rod disposed between the partial pistons, which transmits the translatory movement of the measuring piston, for example, to a toothed wheel with which it is engaged, and which converts this movement into a rotary movement which is transferred to a potentiometer.

Another possibility for the detection of the position or displacement path, consists of forming the measuring scale magnetically and carrying out the detection of measuring values inductively.

In addition to the arrangement of the measuring rod between the two partial pistons there is also the possibility of driving this laterally against one of the two partial pistons either by means of the primary or the secondary chamber to the outside, where it is in operational connection with a measuring value sensor.

The device of the present invention can be used in a particularly advantageous manner to detect a coupling actuation path. The measuring piston sliding in a housing is, for example, disposed in the pressure medium control line of the control cylinder which can be acted upon by the pressure medium.

In the device for actuating a coupling, the measuring piston preferably divides the housing into a primary and a secondary chamber with at least one flow connection, and is prestressed towards its rest state against the pressure of the control medium, which can be influenced, wherein the secondary chamber is connected, when the measuring piston is in the rest position, to a venting passage in the housing.

According to an advantageous embodiment at least one of the valves controlling the flow of pressure medium in the control line forms a construction unit with the housing in which the measuring piston slides, wherein it is possible freely to choose the spatial position of the pressure medium supply unit, with respect to devices, in which the valves are integrated in the pressure medium supply unit and thus the connection line must be disposed upwardly inclined between the measuring piston and valves for the purpose of venting.

However, in addition to the use in a device to

actuate a coupling there are other uses for the device in accordance with the invention, for example, for valves acted upon by pressure.

The present invention will now be described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is a device constructed according to the present invention for actuating a friction coupling,

Figure 2 is cross sectional view of one embodiment of a device according to the present invention for detecting the position of a control element with a mechanical position transmitter; and

Figure 3 is a cross sectional view of a device according to the present invention for position detection utilising an inductive position transmitter.

The device illustrated in Figure 1 comprises a friction coupling 18, which connects an internal combustion engine of a motor vehicle to gearing in dependence upon certain operating states or transitions between individual operating states. The friction coupling can be engaged and disengaged by means of an actuating mechanism 14. The actuating mechanism is actuated in turn by a control element 2 in the form of a slave cylinder. The slave cylinder 2 is connected by means of a control line 1 and a directional control valve 20 to a pressure medium

circuit 21. The pressure medium circuit comprises a pressure medium pump 23 which can be driven by a motor 22 and which is connected to a fluid storage container 24, the pump 23 acting on the slave cylinder 2 by means of the directional control valve 20. Between the pressure medium pump 23 and the directional control valve 20 a non-return valve 25, is located together with a pressure switch 26 which switches the motor 22 on and off according to requirements, and an accumulator 27. The accumulator 27 can be dimensioned in such a way that when the motor vehicle is put into operation at least a first disengagement or supply of energy is possible. Thus no special motor is required for the pressure medium pump 23, the accumulator 27 being supplied during the driving operation, by the pressure medium pump 23 driven by the internal combustion engine 22.

In order to adjust the frictional engagement of the friction coupling 18 an electronic control unit 28 is provided which in dependence upon sensed or preset variables transmits an adjustment variable to the directional control valve 20 to actuate the coupling. The sensed variables are among other things, the engine speed, the throttle valve position and the coupling actuation path or the coupling engagement state. In order to detect the coupling actuation path

a sensor cylinder 29 is disposed in the pressure medium control line 1 of the slave cylinder 2. The control line 1 thus represents a hydraulic rod which displaces the fluid volume between the slave cylinder 2 and the sensor cylinder 29.

The sensor cylinder 29 shown in more detail in Figure 2, consists of a cylindrical housing 4 which a measuring piston 3 divides into a primary chamber 5 and a secondary chamber 6. Both the primary and secondary chambers 5, 6 are connected to flow connections 7, 8, wherein the primary chamber is connected by the directional control valve 20 to the pressure medium circuit, and the secondary chamber 6 is connected to the slave cylinder 2. The measuring piston 3 is prestressed in its rest position by a compression spring 15 against the action of the pressure medium through the pressure medium circuit. The measuring piston 3 consists of two partial pistons 9 and 10 which slide over sealing rings 17 and 19 provided on the inner wall of the housing 4. A measuring rod 12 comprising a measuring scale 11 formed as teeth, is located between the partial pistons 9, 10 and is fixedly connected to the partial pistons. An unpressurised measuring chamber 16 between the partial pistons 9, 10, in which the measuring rod 12 is located, is connected by a

connection bore 30 to a tank (not illustrated).

By means of a toothed wheel 13 engaging the teeth on the measuring rod 12, any translatory movement of the measuring piston 3 is transformed into a rotary movement and in a known manner is transferred to a rotary potentiometer (not illustrated) wherein the rotary potentiometer produces an electrical output signal which is proportional and therefore linear, to the travelled path of the slave cylinder 2. In order to equalise the pressure or vent the secondary chamber 6 a breather hole bore 31 is provided in the housing 4, which, during passage of the partial piston 10 over the same into the rest position, connects the secondary chamber 6 to a tank or equalising reservoir (not illustrated).

Figure 3 shows an alternative embodiment of the present invention wherein a sensor cylinder with an inductive measuring value sensor is provided. This sensor cylinder has a measuring rod 12 disposed between partial pistons 9 and 10, and is provided with a material 36 which influences the inductivity of a measuring coil 35 disposed in the housing 4, and which in the movement direction has a position marking structure. Each position of the material attached to the measuring rod thus differently influences the inductivity of the measuring coil 35 in a

characteristic manner. The measuring coil 35 is provided with a constant voltage with a relatively high frequency and, for example, the current flowing through is measured, wherein this is a measure of the inductivity of the measuring coil 35 and therefore a measure of the momentary position of the measuring piston 3 in the cylindrical housing 4.

CLAIMS

1. A device for detecting the position of a control element which can be influenced hydraulically or pneumatically by means of a control line, having at least one position transmitter, comprising a measuring piston slidably located in a housing which is provided, in the control line of the control element, a sensor being provided for monitoring the position of the measuring piston in the housing to thus monitor the position of the control element.

2. A device as claimed in claim 1, in which the measuring piston divides the housing into a primary and a secondary chamber each with at least one flow connection to the control line, and is prestressed in its rest position against the pressure of the control medium in the control line.

3. A device as claimed in claim 1 or claim 2, in which the measuring piston is formed from a first and a second partial piston sliding in a sealing manner on the inner wall of the housing, and an unpressurised chamber is formed between the partial pistons.

4. A device as claimed in claim 3, in which a measuring rod is disposed laterally at one of the two partial pistons, and is driven out of the housing by way of the primary or secondary chamber, and which, outside the housing, is in operational connection with

a measuring value sensor in order to form the position transmitter.

5. A device as claimed in claim 3, in which the partial pistons are connected to each other by means of a measuring rod comprising a measuring scale, which is in operational connection with a measuring value sensor in order to form the position transmitter.

6. A device as claimed in claim 5, in which the length of the measuring scale corresponds, according to a transfer relationship, to the displacement path of the control element.

7. A device as claimed in claim 5 or claim 6, in which the measuring scale is formed by a toothed rod disposed between the partial pistons.

8. A device as claimed in claim 7, in which the toothed rod is in operational connection with a toothed wheel, which transfers the movement of the measuring piston to a potentiometer.

9. A device as claimed in any one of claims 1 to 6, in which the position transmitter is formed as an inductive or capacitive measuring value sensor.

10. A device for actuating a coupling of a motor vehicle, in particular by means of a slave cylinder having a pressure medium circuit which comprises at least one pressure medium pump, a driving device actuating the pressure medium pump, an accumulator and

valves controlling the flow of pressure medium, the pressure medium control line of the slave cylinder comprising a device as claimed in any one of the preceding claims.

11. A device for detecting the position of a control element which can be influenced hydraulically or pneumatically by means of a control line, having at least one position transmitter, said device being constructed and arranged substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17
(The Search report)

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Relevant Technical Fields

(i) UK Cl (Ed.N) G1N (NAEB, NAGE, NAGA10, NAGAX, NAEE)

(ii) Int Cl (Ed.6) G01D 5/12, 5/14, 5/16, 5/20; F15B 15/06, 15/28

Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii)

Search Examiner
B J EDE

Date of completion of Search
26 MAY 1995

Documents considered relevant following a search in respect of Claims :-
1-11

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 2253062 A	(MANNESMANN) see Figure 1	1 at least
X	GB 2219662 A	(DAIDO METAL) see Figure 1a	1 at least
X	GB 2202331 A	(BRITISH GAS) see Figure 1	1 at least
X	GB 2164154 A	(MARTONAIR) see 9	1 at least
X	GB 2018999 A	(UNIVERSITY COLLEGE CARDIFF) see Figure 2	1 at least
X	GB 1371869	(GIRLING)	1 at least
X	WO 84/03763 A1	(HARA) see 11 Figure 5	1 at least

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