



12

EUROPEAN PATENT SPECIFICATION

45 Date of publication of patent specification :
10.02.93 Bulletin 93/06

51 Int. Cl.⁵ : **F15B 15/28**

21 Application number : **91201793.6**

22 Date of filing : **09.07.91**

54 **A pressure-operated piston-cylinder device, comprising at least one pair of contact elements acting as a piston end position switch.**

30 Priority : **09.07.90 NL 9001563**

43 Date of publication of application :
15.01.92 Bulletin 92/03

45 Publication of the grant of the patent :
10.02.93 Bulletin 93/06

84 Designated Contracting States :
CH DE DK ES FR GB IT LI NL SE

56 References cited :
FR-A- 1 410 863

73 Proprietor : **APPLIED POWER INC.**
12801 W. Silver Spring Road
Butler, Wisconsin 53007 (US)

72 Inventor : **Oudelaar, Tone**
Brederostraat 3
NL-7576 CA Oldenzaal (NL)

74 Representative : **Boelsma, Gerben Harm, Ir. et al**
Octrooibureau Polak & Charlouis Laan Copes
van Cattenburch 80
NL-2585 GD Den Haag (NL)

EP 0 466 273 B1

Note : Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid (Art. 99(1) European patent convention).

Description

The invention relates to a pressure-operated piston-cylinder device, comprising at least one pair of contact elements, adapted to be electrically connected when the piston is in an end position within the cylinder, one of said contact elements being mounted at the corresponding cylinder end in an electric insulating manner and being connected to an electrical lead, whereas the other contact element is mounted to establish - in the said piston end position - an earthed connection with said first mentioned contact element through said piston, whereby furthermore the one of the contact elements extends laterally into a bore in the respective cylinder end wall and the other contact element is in the form of a helical spring which has its axis parallel to the axis of the device. A device of this type is disclosed in FR-A-1 410 863 (vide particular Fig. 1-3).

In this well-known device the helical spring shaped contact element is extending from the respective cylinder end wall inwardly into the cylinder space at a location which is excentric with respect to the axis of the device. The helical spring is connected at one end with the electrical lead, which is insulatingly positioned with an axial passage located radially outwardly with respect to the central bore. The free terminal winding of the helical spring is adapted to engage the respective end face of the piston, when the latter is entering into its respective end position.

The other contact element is conductively mounted within the wall of the central bore as a sliding contact.

Although it is said in the specification of FR-A-1 410 863, that the electrical lead/helical spring assembly is particularly suitable for use with cylinders of small diameters, the rather excentric location of the helical spring/electric lead assembly requires additional mounting space which prevents the cylinder diameter from being reduced to a still larger extent.

Accordingly it is an object of the present invention to change the well-known contact elements assembly such that the cylinder diameter may be reduced still further. As an example, cylinders of reduced diameter are particularly important for hydraulic piston cylinder devices which are used for opening and closing of the folding roofs in vehicles of the cabriolet type.

In accordance with the present invention the said aim is achieved in that the helical spring shaped contact element coaxially extends from the respective piston end face and is adapted - when the piston is entering into its respective end position - to slidingly engage the wall of a central bore in the respective cylinder end wall, whereas it is the electrical lead connected contact element that extends laterally into said central bore at a location such that it is directly contacted - in said piston end position - by the free terminal winding of said helical spring. Due to the solution

offered the present invention, the helical spring is now moving along with the piston and takes a central position within the cylinder in which position it does not prevent the piston and cylinder diameter from being reduced rather drastically.

It will be understood that in the event the contact elements are to function as an end switch for the piston in its extended position, the helical spring will surround the inner portion of the piston rod and said piston rod will extend through said central bore outwardly. In this case the central bore is constituted a widened portion of the usual guiding bore for the piston rod. It will also be understood that in this case the contact element extending laterally into said widened bore portion shall be kept out of direct contact with the passing piston rod.

The invention will be hereinafter further explained by way of example with reference to the drawing.

Fig. 1 is a side elevation, substantially in longitudinal section, of a hydraulic piston cylinder device having two end position switches in accordance with the invention and

fig. 2 shows a diagram of three cooperating piston cylinder devices making part in an hydraulic circuit on one hand and in an electrical circuit on the other hand.

The double acting piston cylinder device shown in fig. 1 comprises a cylinder 1, the ends of which are closed by end pieces 2 and 3 in a well-known manner. The end piece 2 has a guiding bore 4 for the rod 5 of the piston 6 which may reciprocate within the cylinder 1. The bore 4 has a widened portion 4a, in which the connector 7 for the liquid supply and discharge passage 8 merges.

The end piece 32 has an axially outwardly closed bore 9, in which the connector 10 for the liquid supply and discharge merges at the respective cylinder end. The end piece 3 ends at its axial end into a mounting eye 11.

So far the piston cylinder device herein is of a well-known construction.

According to the invention a contact element 12 and 13 respectively are provided in the cylinder end piece 2 and in the cylinder end piece 3 respectively, with the intermediary of a mounting sleeve 14 and 15 respectively formed of electrically insulating material.

The proper contact portion 12a and 13a respectively extends as far as within the widened bore portion 14a and as far as within the bore 9 respectively, whereas a pin-shaped portion 12b and 13b respectively of the contact element is connected, e.g. by soldering, to an electrical lead 16 and 17 respectively.

The contact elements 12 and 13 cooperate with contact elements on the piston 6, the latter contact elements, in the example shown, being formed by a coil spring 18 and 19 respectively. The coil spring 18 is fastened to the annular end face 6b of the piston 6,

whereas the coil spring 19 is coaxially fastened to the free end face 6a (facing to the right in the drawing) of the piston 6. The coil spring 18 is designed to engage, in the extended piston position, with a close fit within the widened bore portion 4a, whereas the coil spring 19 is designed to engage, in the retracted piston position, with a close fit within the bore 9, so that in the respective piston end positions a metallic contact is established between the piston 6 and the cylinder 1 through the respective end pieces 2 and 3. The openings 4'a and 9' respectively are countersunk so as to cause the springs 18 and 19 respectively to enter into the widened bore portion 4a and into the bore 9 respectively in a smooth manner. In the respective piston end positions the terminal windings of the springs 18 and 19 respectively, are contacting the contact portions 12a and 13a respectively of the contact elements 12 and 13 respectively.

It will be understood the cylinder 1, the end pieces 2 and 3, as well as the piston 6 and the springs 18 and 19 are formed of electrically conducting material, just like the contact elements 12 and 13.

In the example shown in the drawing the contact elements 12 and 13 are located diametrically opposite the connectors 7 and 10 respectively. It will, however, be clear that the contact elements, as seen in the circumferential direction, may be positioned much closer to the respective connectors. The drawing also shows how the lead 16 may be integrated, through a part of its length, into (the sheath of) the pressurized liquid conduit 8, which may be formed e.g. by a hose.

Fig. 2 shows in a diagrammatic manner, how three of such double acting hydraulic piston cylinder devices may be connected within an electric/hydraulic circuit.

The three piston cylinder devices A, B and C together form e.g. the hydraulic actuating device for the opening and closing of a folding roof of a vehicle of the cabriolet type. In this case the devices A, B and C are to be put into operation one after the other. The cylinders of the devices A, B, C are each connected - through two respective control valves a1, a2; b1, b2; c1, c2 - to a pressure conduit supplied by a hydraulic pump 21, and to a return conduit 24 which leads to a hydraulic fluid reservoir 23.

Each of the devices A, B and C has an upper and a lower piston end switch, the contacts of which correspond with the contact elements 12, 18 and 13, 19 respectively of fig. 1. In the circuit of fig. 2, for simplicity's sake, only the contacts associated with the device A are shown.

The leads 16 and 17 of all of the piston cylinder devices A, B and C are connected to an electrical control unit 25. In the drawing the pistons of all of the three devices A, B, C have been represented in their retracted position. This position corresponds e.g. with the fully opened position of the folding roof.

The electrical circuiting within the control unit 25

is such that, when in this situation (opened roof) the closing button is depressed, while the hydraulic pump 21 is in operation, the control valve a1 will be energized so that the cylinder space under the piston in the respective device will be connected to the pressure conduit 22, so that the piston is caused to move upwardly while hydraulic fluid is allowed to flow off from the cylinder space over the piston through the control valve a2. When reaching the upper piston end position the contact between the contact elements 12 and 18 is closed and produces a signal which is converted within the control unit 25 into an energizing signal that causes the hydraulic control valve b1 of the piston cylinder device B to shift into a position, in which the cylinder space under the piston within the device B is connected to the pressure conduit 22. When reaching the upper piston end position in the device B energisation of the hydraulic control valve c1 of the piston cylinder device C will take place. The closing procedure will be completed, as soon as the piston within the device C has reached its upper end position. The signal produced therewith may e.g. be used to cause all of the control valves a1, b1, c1 to return into the initial position shown in the drawing and to have the pump 21 switch off (as far as the valves a1 and b1 did not return to the illustrated initial position already in an earlier stage).

It will be understood that - starting from the closed roof position, whereby the pistons are in their upper end positions - the pressing of the opening button will cause the hydraulic control valves c2, b2 and a2 to be successively energized, so that the pistons within the devices C, B and A are moved into their lower end positions one after the other.

Claims

1. A pressure-operated piston-cylinder device, comprising at least one pair of contact elements (12, 18; 13, 19) adapted to be electrically connected when the piston (6) is in an end piston within the cylinder (1), one (12; 13) of said contact elements being mounted at the corresponding cylinder end in an electric insulating manner (14; 15) and being connected to an electrical lead (16; 17), whereas the other contact element (18; 19) is mounted to establish - in the said piston end position - an earthed connection with said first mentioned contact element (12; 13) through said piston (6), whereby furthermore the one of the contact elements (12; 13) extends laterally into a bore (4a; 9) in the respective cylinder end wall (2, 3) and the other contact element is in the form of a helical spring (18; 19) which has its axis parallel to the axis of the device **characterized** in that the helical spring shaped contact element (18; 19) coaxially extends from the respective piston end

face (6a, 6b) and is adapted - when the piston is entering into its respective end position - to slid-
ingly engage the wall of a central bore (4a; 9) in
the respective cylinder end wall (2, 3), whereas it
is the electrical lead (16; 17) connected contact
element (12; 13) that extends laterally into said
central bore (4a; 9) at a location such that it is di-
rectly contacted - in said piston end position - by
the free terminal winding of said helical spring
(18; 19).

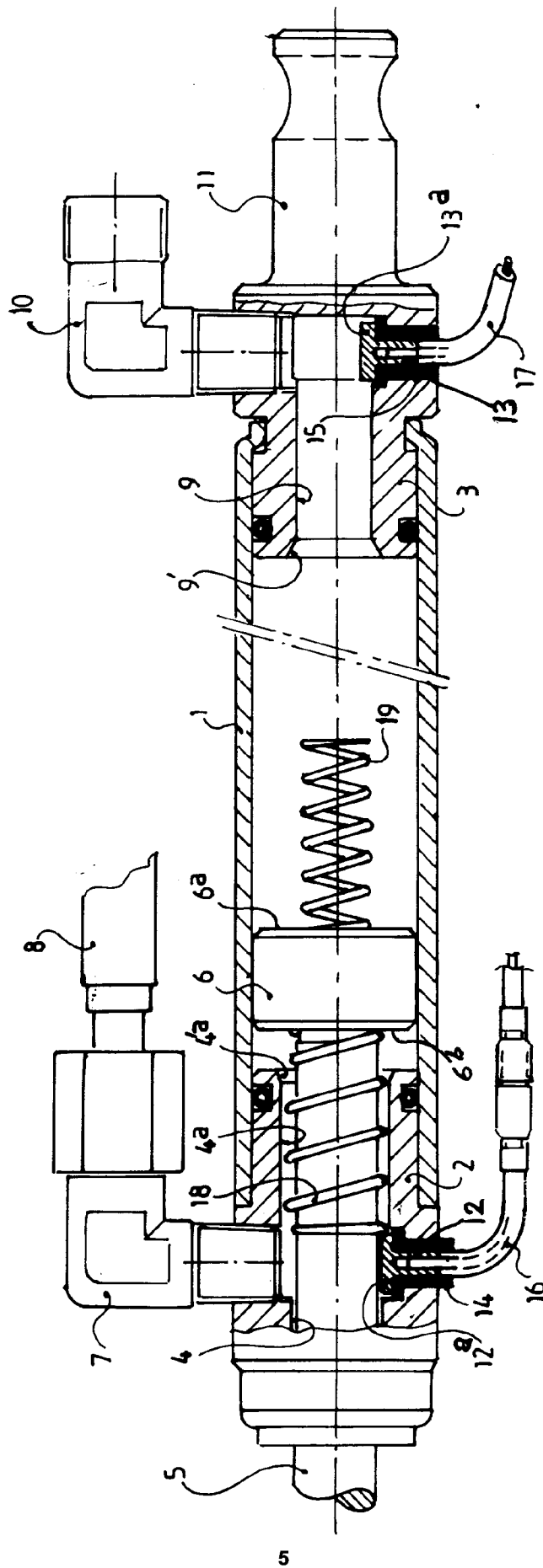
Patentansprüche

1. Druck-betätigte Kolben-Zylindervorrichtung, mit
mindestens einem Paar von Kontaktgliedern (12,
18; 13, 19), die elektrisch miteinander verbunden
werden wenn der Kolben (6) sich in einer Endlage
innerhalb des Zylinder (1) befindet, wobei eins
(12; 13) der Kontaktglieder elektrisch isoliert (14;
15), am betreffenden Zylinderende angeordnet
ist und mit einer elektrischen Leitung (16; 17) ver-
bunden ist, während das zweite Kontaktglied (18;
19) in der Weise angeordnet ist, dass - in der ge-
nannten Kolben-Endlage - über den Kolben (6)
eine geerdete Verbindung mit dem erstgenann-
ten Kontaktglied (12; 13) zustande gebracht wird,
wobei weiterhin das eine Kontaktglied (12; 13)
von der Seite her in eine Bohrung (4a; 9) in der
betreffenden Zylinder-Endwand (2, 3) ragt und
das zweite Kontaktglied in Form einer Schrau-
benfeder (18; 19) ausgebildet ist, derer Achse
sich parallel zur Achse der Vorrichtung erstreckt,
dadurch gekennzeichnet dass das schraubenfe-
derförmige Kontaktglied (18; 19) sich coaxial von
der betreffenden Stirnfläche (6a, 6b) des Kol-
bens erstreckt und bei einer Bewegung des Kol-
bens in die betreffende in Gleitkontakt auf der
Wand einer Zentralbohrung (4a; 9) in der betref-
fenden Kolben-Stirnwand (2, 3) angreift, wäh-
rend das mit dem elektrischen Leiter (16; 17) ver-
bundenen Kontaktglied (12; 13) von der Seite her
in die genannte Zentralbohrung (4a; 9) hineinragt
an einer darartigen Stelle, dass es in der betref-
fenden Kolbenendlage in direkten Kontakt mit der
freien Endwindung der Schraubenfeder (18; 19)
gelangt.

Revendications

1. Dispositif à piston et à cylindre commande par
pression, comprenant au moins une paire d'élé-
ments de contact (12, 18; 13, 19) aptes à être
connectés électriquement lorsque le piston (6) est
dans une position extrême à l'intérieur du cylindre
(1), l'un (12; 13) desdits éléments de contact
étant monté à l'extrémité correspondante du cy-

lindre d'une manière isolée électriquement (14;
15) et l'autre étant connecté à un conducteur
électrique (16; 17), tandis que l'autre élément de
contact (18; 19) est monté pour établir - dans la-
dite position extrême de piston - une connexion
de mise à la terre avec ledit premier élément de
contact mentionné (12; 13) à travers ledit piston
(6), par quoi en outre l'un des éléments de contact
(12; 13) s'étend latéralement dans un perçage (4a;
9) dans la paroi extrême respective (2, 3) du cy-
lindre et l'autre élément de contact a la forme d'un
ressort à boudin (18; 19), dont l'axe est parallèle
à l'axe du dispositif, caractérisé en ce que l'élé-
ment de contact en forme de ressort à boudin (18;
19) s'étend coaxialement depuis la face extrême
respective (6a, 6b) du piston et est apte - lorsque
le piston entre dans sa position extrême respec-
tive - à venir en prise de coulissement avec la pa-
roi d'un perçage central (4a; 9) dans la paroi ex-
trême respective (2, 3) du cylindre, tandis que
c'est l'élément de contact (12; 13) connecté au
conducteur électrique (16; 17) qui s'étend latéra-
lement dans ledit perçage central (4a; 9) à une lo-
calisation telle qu'il est en contact direct - dans la-
dite position extrême de piston - avec l'enroule-
ment terminal libre dudit ressort à boudin (18;
19).



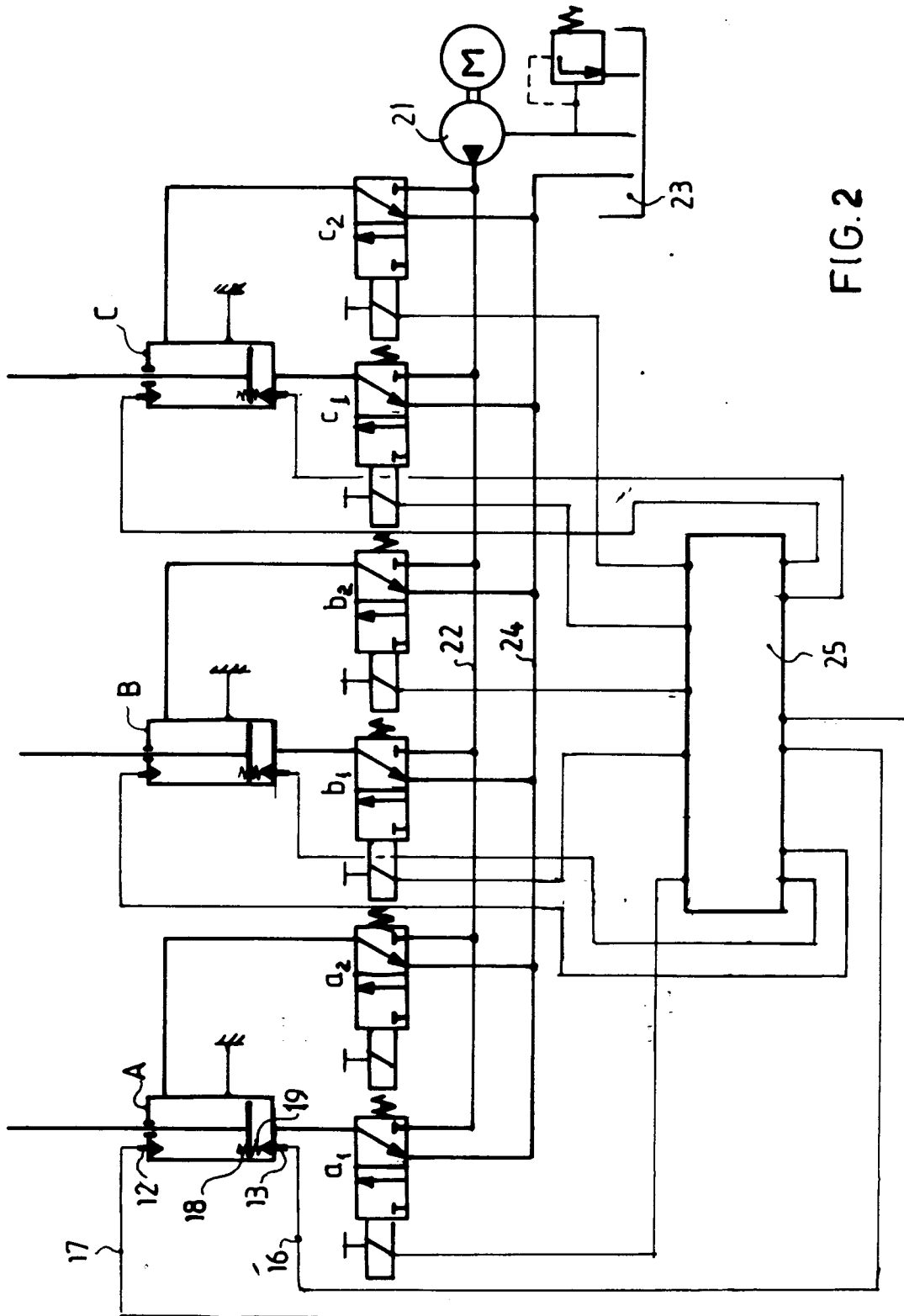


FIG. 2