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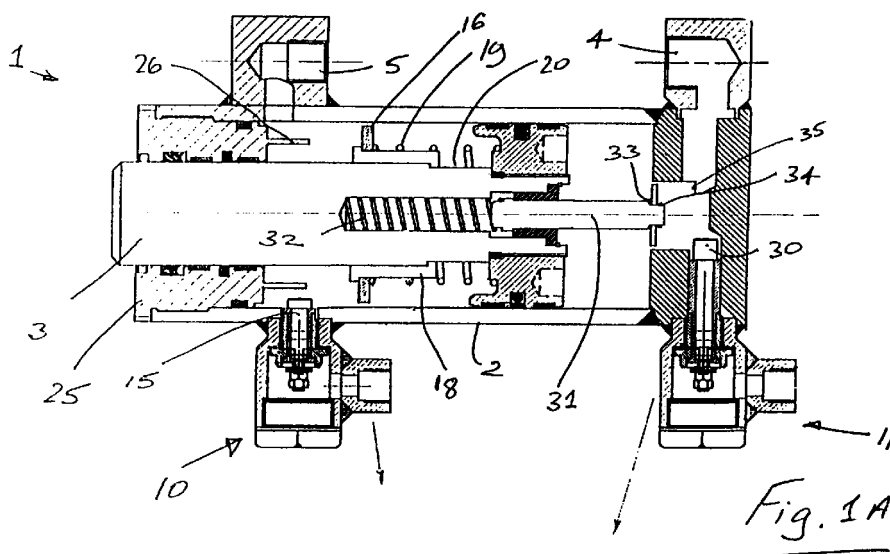
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Remarks:
Amended claims in accordance with Rule 86 (2)
EPC.

(54) **Limit switch device for fluid actuators**

(57) A cylinder 1 has an outer housing 2 defining a pressure chamber and an inner piston 3 which is slidably movable through the pressure chamber. An electrical signal is provided from within the pressure chamber depending on the axial position of the piston 3 within the chamber. The piston 3 carries a contacting device which completes a circuit and provides a control signal. The control signal is generated at a pre-determined position

before the piston 3 reaches the end of the stroke. The travel of the piston 3 is not restricted when the circuit is completed. A full bore side contact device is provided by an auxiliary plunger (31) which is slidably movable against the biasing of a spring 32 when the contact is made with a contact pin 30.



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Description

Introduction

[0001] The invention relates to a hydraulic or pneumatic cylinder and in particular to a cylinder having an outer housing and an inner piston which is movable through the housing. An electrical signal is provided from within the pressure chamber(s) of the cylinder depending on the axial position of the piston within the cylinder.

[0002] More particularly, the cylinder is of the type having a sensing device physically located within the pressure chamber to sense the position of the piston and a contacting device which operates the sensing device when the piston is at a predetermined position in the housing. A low voltage electric supply is connected to the sensing device but electrically insulated from the main cylinder body. A second electrical connection is made to the cylinder body. When the contacting device reaches a predetermined position it completes the circuit and provides a signal which can be used to control the function of the cylinder itself and, or, other ancillary equipment.

[0003] Cylinders of this type are known. However, there is a major problem with conventional cylinders as the operation of the sensing device and associated contact device shortens the stroke length of the piston. Consequently the cylinder housings are relatively long to achieve the necessary switching with a given stroke. This is a technically important disadvantage as often there are severe space limitations in the installation of such cylinders for specific applications.

[0004] There is therefore a need for an improved cylinder which will overcome this difficulty.

Statements of Invention

[0005] According to the invention there is provided a cylinder having:-

an outer housing with a pressure chamber;

an inner piston which is movable through the pressure chamber;

a sensing device located within the pressure chamber to sense the position of the piston; and

a contacting device carried by the piston which contacts the sensing device when the piston is at a predetermined position in the housing to provide a control signal, characterised in that the contacting device is movable relative to the piston to allow the travel of the piston to continue within the pressure chamber on engagement of the contacting device with the sensing device.

[0006] The invention provides a cylinder in which a reliable signal is provided from within the pressure chamber(s) of a hydraulic or pneumatic cylinder, at a desirable point before a moving piston reaches its end position but allowing the piston to complete its full travel without sacrificing stroke length or alternatively demanding additional overall assembly length in order to obtain a particular stroke length.

[0007] In a preferred embodiment of the invention the contacting device is biased between a retracted position and an extended position. Preferably, the contacting device is spring biased from the retracted to the extended position.

[0008] In a particularly preferred arrangement the contact device is a secondary plunger mounted within the piston for movement between the retracted and extended positions.

[0009] In one embodiment of the invention the sensing device includes a contact pin which extends into the pressure chamber for engagement with the contacting device. Preferably, the contacting device includes a flange for contacting the contact pin of the sensing device. Ideally, the flange is provided by a washer.

[0010] In a preferred embodiment of the invention the flange or washer extends outwardly of a sleeve which is slidably movable relative to the piston when the flange or washer engages a contact pin.

[0011] In a particularly preferred embodiment of the invention the cylinder has a full bore side sensing device with an associated full bore side contacting device and an annular side sensing device with an associated annular side contacting device.

[0012] In one preferred embodiment of the invention the full bore sensing device comprises a secondary plunger mounted within the piston for movement between a retracted and an extended position and a flange or washer mounted to the secondary plunger for engagement with a full bore contact pin extending into the pressure chamber.

[0013] In one preferred embodiment of the invention the annular side sensing device comprises a sleeve mounted to the piston for movement between a retracted and or extended position and a flange or washer mounted to the sleeve, for engagement by an annular contact pin extending into the pressure chamber.

Brief Description of Drawings

[0014] The invention will be more clearly understood from the following description thereof given by way of example only, in which:-

Fig. 1A is a longitudinal cross sectional view of a cylinder according to the invention with a piston in a mid position;

Fig. 1B is transverse cross sectional view of the cylinder of Fig. 1A;

Fig. 1C is a diagram illustrating the circuit formed by the cylinder of Fig. 1A;

Figs 2A to 2C are views similar to Figs 1A to 1C with the piston in an annular closing position;

Figs 3A to 3C are views similar to Figs 1A to 1C with the piston in an annular closed position;

Figs 4A to 4C are views similar to Figs 1A to 1C in a full bore closing position; and

Figs 5A to 5V are views similar to Figs 1A to 1C in a full bore closed position.

Detailed Description

[0015] Referring to the drawings there is illustrated a cylinder, in this case an hydraulic cylinder 1 according to the invention having an outer housing 2 defining a pressure chamber and an inner piston 3 which is slidably movable through the pressure chamber. The housing 2 has main oil ports 4, 5, for the pressure chamber.

[0016] An electrical signal is provided from within the pressure chamber depending on the axial position of the piston 3 within the chamber. A low voltage electrical supply is connected to a sensing device which is physically located within the pressure chamber but is electrically insulated from the cylinder housing. A second connection is electrically connected to the cylinder housing 2. The piston 3 carries a contacting device which completes the circuit and provides a control signal when the piston 3 has reached a predetermined position within its stroke. The electrical circuit is manipulated as between the normally "open" position and a selected "closed" position. In the cylinder of the invention the control signal is generated at a predetermined desired position before the piston 3 reaches the end of its stroke. The travel of the piston 3 is not restricted and the piston may continue to its full travel without sacrifice of its normal stroke. Thus an advance control signal is provided without any loss of stroke or any requirement to lengthen the cylinder.

[0017] In this case the cylinder has an annular side switch housing 10 and a full bore side switch housing 11 from which switching signals are directed to operate the cylinder 1 and/or associated equipment.

[0018] The switch housing 10 contains an annular side sensing device, which in this case is in the form of an annular contact pin 15. The contact pin 15 is engaged by an annular side contact device which in this case is a flange provided by a washer 16. The washer 16 is movable along a sleeve 18 slidably carried by the piston 3. The washer 16 is biased into the extended position illustrated in Fig. 1A by a coil spring 19 extend-

ing around the sleeve 18. The sleeve 18 is, in turn, slidably movable along a step formation 20 of the piston 3.

[0019] An end cap 25 of the cylinder 1 is sealingly engaged in the housing 2 and includes an axially protecting ring 26 to engage the washer 16 as the piston 3 moves towards the annular closed position. It will be noted that the contact pin 15 extends axially just beyond the ring 26 so that the pin 15 is first engaged by the washer 16 to make a switching contact. The washer 16 is mounted for self alignment to remain in contact with the pin 15 as the piston 3 moves to the left in Fig. 1A and the ring 26 pushes the washer 16 against the biasing of the spring 19. Thus, after switching contact is made the piston 3 may continue its travel through the housing 2 to maximise the stroke of the piston. Initially, the washer 16 moves back along the sleeve 18 until the sleeve 18 contacts the end cap 25. Then, the sleeve 18 is further slidably movable relative to the piston 3 as illustrated particularly in Figs 2A and 3A. In this way switching contact is maintained without interruption of the stroke of the piston.

[0020] The switch housing 11 contains a full bore side sensing device, which in this case is in the form of a full bore contact pin 30. A fixed land 35 is also provided opposite to the contact pin 31. The contact pin 30 is engaged by a full bore contact device which in this case is provided by an auxiliary plunger 31 co-axial with the piston 3 and extending axially therefrom. The plunger 31 is spring biased by a coil spring 32 into a normally extended position illustrated in Fig. 1A. The plunger 31 has a step formation at a free end to receive a washer 33 which is held in place by a circlip 34.

[0021] The auxiliary plunger 31 is slidably movable against the biasing of the spring 32 when the washer 33 contacts the contact pin 30. The land 35 assists in aligning the washer 33 to maintain contact with the pin 30. As the piston 3 moves to the right the washer 33 first contacts the pin 30 and the land 35, making switching contact. The piston 3 is free to continue its stroke as the plunger 31 moves into the piston 3 as illustrated in Fig. 5C. In this way the stroke of the piston 3 is maximised as there is no interruption or shortening of the stroke by engaging and maintaining the full bore contact.

[0022] In each case the contacting device telescopes in relation to the piston. Therefore, an "advance" signal can be provided without any undesirable loss of stroke or alternative overall lengthening of the cylinder.

[0023] The invention provides a hydraulic cylinder with exceptionally efficient switching, especially on the full bore side which does not adversely effect the stroke of the piston. Thus, to achieve a given stroke length the cylinder is relatively short and may therefore be used in a very wide range of applications, especially where there are space limitations.

[0024] The cylinder may be used in a wide variety of application in which the cylinder requires to be controlled from an external source to be brought to a halt or reversed in motion, for example to achieve a reciprocating

ing motion. The cylinder may be used, for example, in a compacting machine or a digging device. The cylinder may also be used with a personnel lift, in which case a signal is required to actuate a security device.

[0025] The invention is not limited to the embodiments hereinbefore described which may be varied in detail.

Claims

1. A cylinder (1) having:-

an outer housing (2) with a pressure chamber;

an inner piston (3) which is movable through the pressure chamber;

a sensing device (15, 30) located within the pressure chamber to sense the position of the piston (3); and

a contacting device (16, 18, 31, 33) carried by the piston (3) which contacts the sensing device (15, 30) when the piston (3) is at a pre-determined position in the housing (2) to provide a control signal, characterised in that the contacting device (16, 18, 31, 33) is movable relative to the piston (3) to allow the travel of the piston (3) to continue within the pressure chamber on engagement of the contacting device (16, 18, 31, 33) with the sensing device (15, 30).

2. A cylinder as claimed in claim 1 wherein the contacting device (16, 18, 31, 33) is biased (19, 32) between a retracted position and an extended position.

3. A cylinder as claimed in claim 2 wherein the contacting device (16, 18, 31, 33) is spring biased from the retracted to the extended position.

4. A cylinder as claimed in claim 3 wherein the contacting device (16, 18, 31, 33) is a secondary plunger (31) mounted within the piston (3) for movement between the retracted and extended positions.

5. A hydraulic cylinder as claimed in any preceding claim wherein the sensing device (15, 30) includes a contact pin (15, 30) which extends into the pressure chamber for engagement with the contacting device (16, 18, 31, 33).

6. A cylinder as claimed in claim 5 wherein the contacting device (16, 18, 31, 33) includes a flange or washer (16, 33) for contacting the contact pin (15, 30) of the sensing device.

7. A cylinder as claimed in claim 6 or 7 wherein the flange or washer (18) extends outwardly of a sleeve (18) which is slidably movable relative to the piston (3) when the flange or washer (16) engages a contact pin (15).

8. A cylinder as claimed in any preceding claim wherein the cylinder has a full bore side sensing device (30) with an associated full bore side contacting device (31, 33) and an annular side sensing device (15) with an associated annular contacting device (16, 18).

9. A cylinder as claimed in claim 8 wherein the full bore contacting device comprises a secondary plunger (31) mounted within the piston (3) for movement between a retracted and an extended position and a flange or washer (33) mounted to the secondary plunger (31) for engagement with a full bore contact pin (30) extending into the pressure chamber.

10. A cylinder as claimed in claim 8 or 9 wherein the annular side contacting device comprises a sleeve (18) mounted to the piston (3) for movement between a retracted and an extended position and a flange or washer (16) mounted to the sleeve (18) for engagement by an annular contact pin (15) extending into the pressure chamber.

Amended claims in accordance with Rule 86(2) EPC.

1. A cylinder (1) having:

an outer housing (2) with a pressure chamber;

an inner piston (3) which is movable through the pressure chamber;

a sensing device (15, 30) located within the pressure chamber to sense the position of the piston (3); and

a contacting device (16, 18, 31, 33) carried by the piston (3) which contacts the sensing device (15, 30) when the piston (3) is at a pre-determined position in the housing (2) to provide a control signal,

the contacting device (16, 18, 31, 33) being movable relative to the piston (3) to allow the travel of the piston (3) to continue within the pressure chamber on engagement of the contacting device (16, 18, 31, 33) with the sensing device (15, 30); characterised in that:-

the contacting device (16, 18, 31, 33) is a secondary plunger (31) mounted within the piston (3) for movement between a retracted position and an extended position.

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2. A cylinder as claimed in claim 1 wherein the contacting device (16, 18, 31, 33) is biased (19, 32) between the retracted position and the extended position.

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3. A cylinder as claimed in claim 2 wherein the contacting device (16, 18, 31, 33) is spring biased from the retracted to the extended position.

4. A hydraulic cylinder as claimed in any preceding claim wherein the sensing device (15, 30) includes a contact pin (15, 30) which extent into the pressure chamber for engagement with the contacting device (16, 18, 31, 33).

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5. A cylinder as claimed in claim 4 wherein the contacting device (16, 18, 31, 33) includes a flange or washer (16, 33) for contacting the contact pin (15, 30) of the sensing device.

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6. A cylinder as claimed in claim 5 wherein the flange or washer (16) extends outwardly of a sleeve (18) which is slidably movable relative to the piston (3) when the flange or washer (16) engages a contact pin (15).

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7. A cylinder as claimed in any preceding claim wherein the cylinder has a full bore side sensing device (30) with an associated full bore side contacting device (31, 33) and an annular side sensing device (15) with an associated annular contacting device (16, 18).

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8. A cylinder as claimed in claim 7 wherein the full bore contacting device comprises a secondary plunger (31) mounted within the piston (3) for movement between a retracted and an extended position and a flange or washer (33) mounted to the secondary plunger (31) for engagement with a full bore contact pin (30) extending into the pressure chamber.

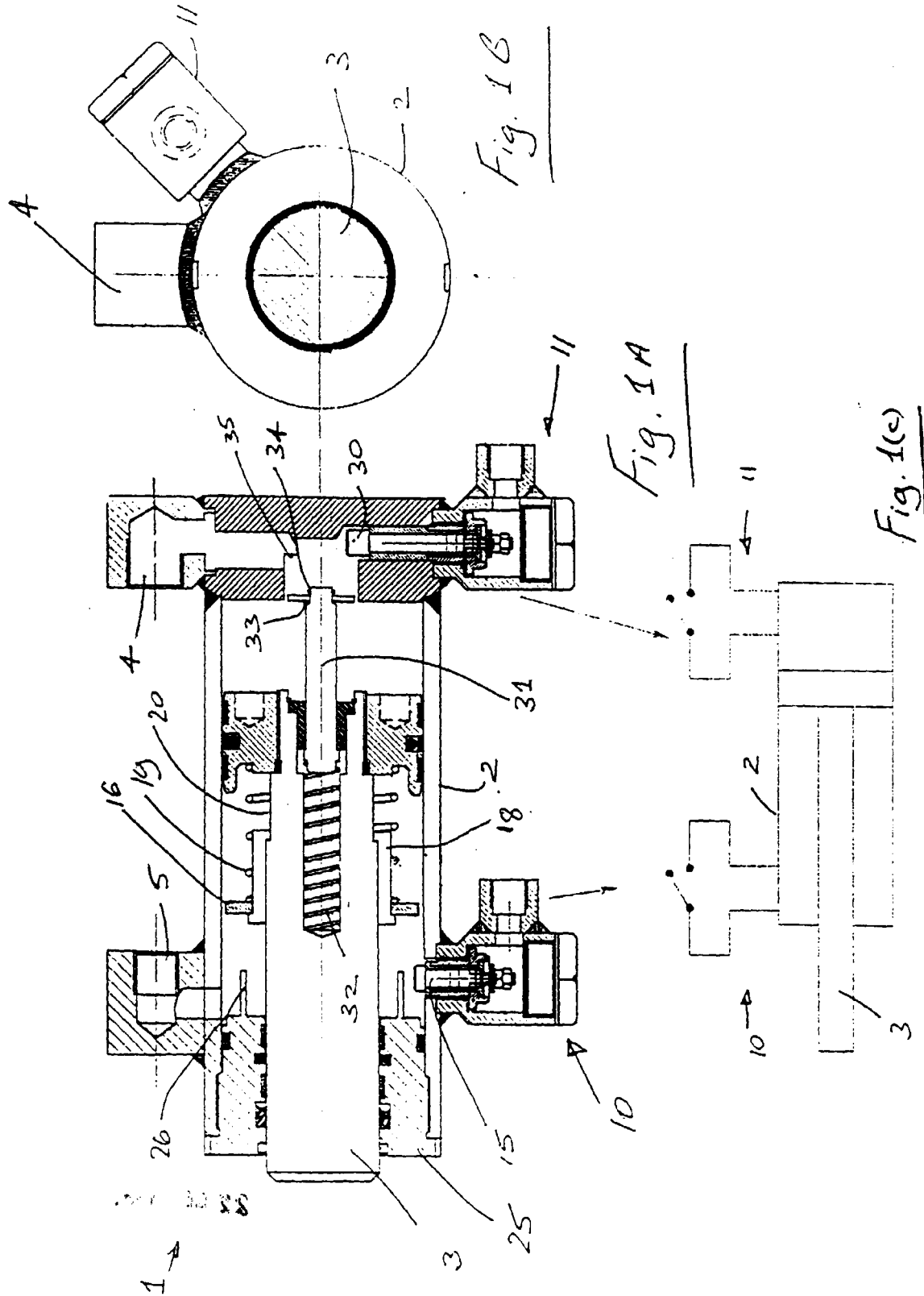
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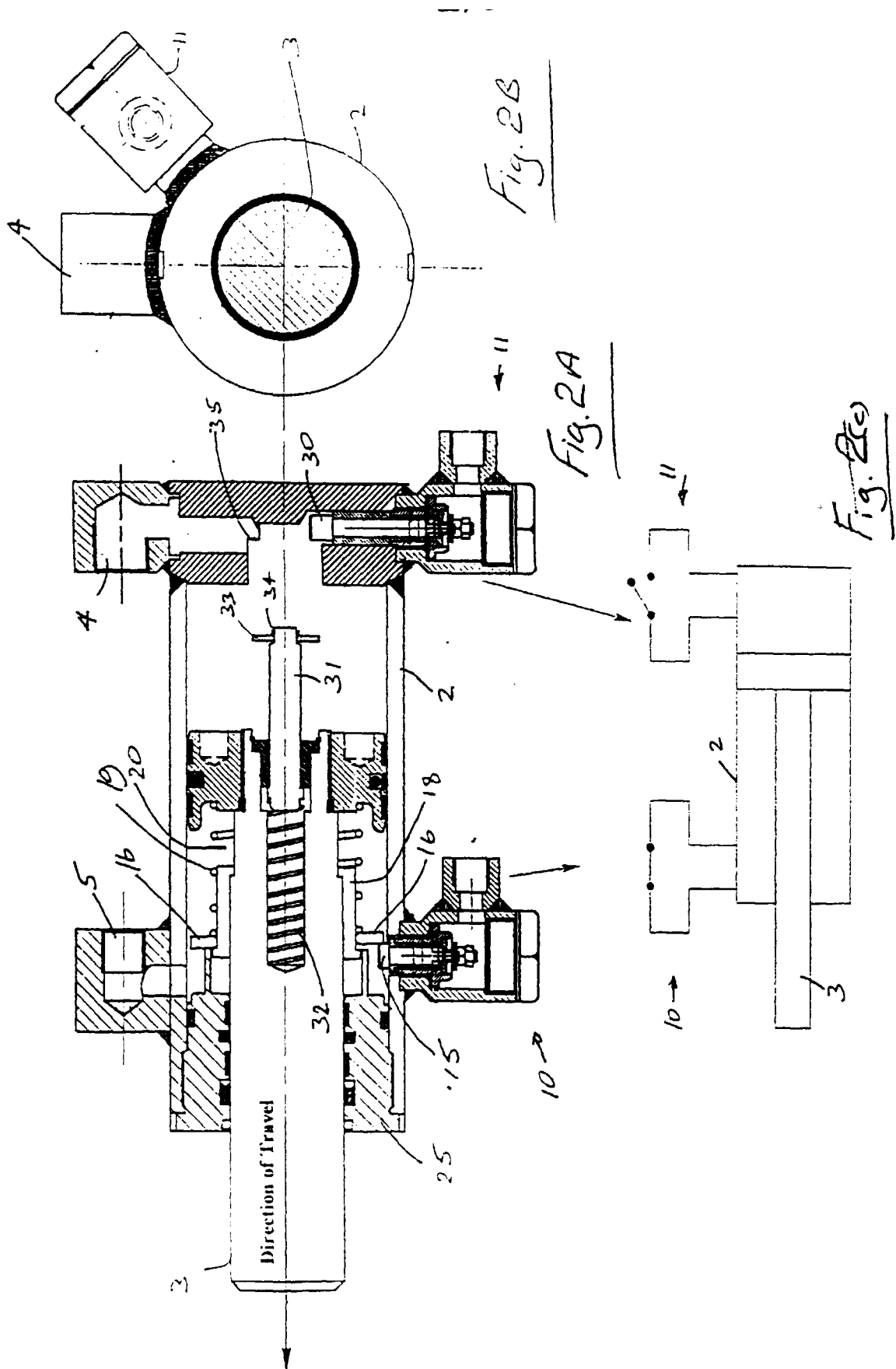
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9. A cylinder as claimed in claim 7 or 8 wherein the annular side contacting device comprises a sleeve (18) mounted to the piston (3) for movement between a retracted and an extended position and a flange or washer (16) mounted to the sleeve (18) for engagement by an annular contact pin (15) extending into the pressure chamber.

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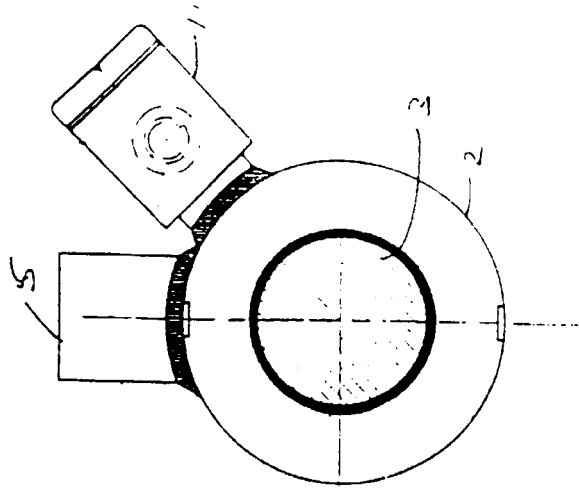


Fig. 3B

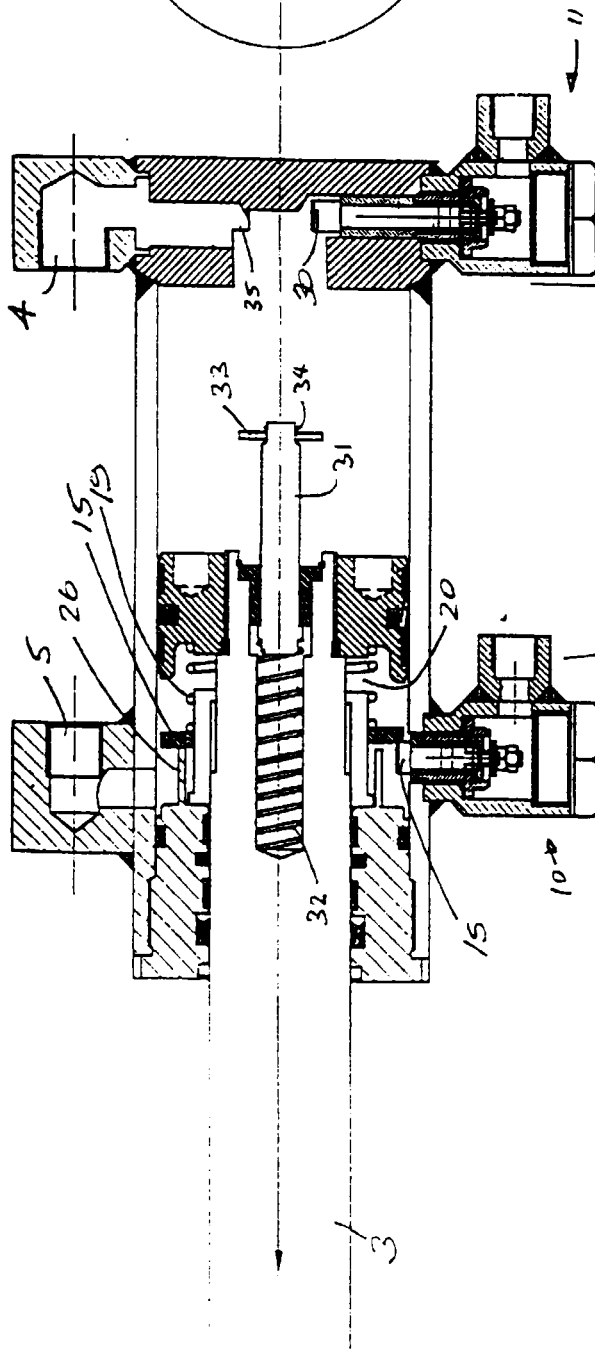


Fig. 3A

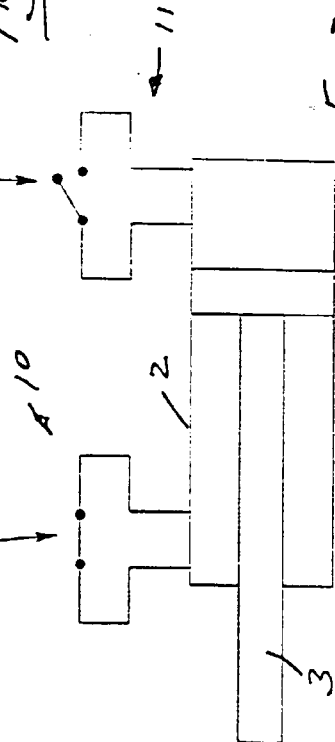
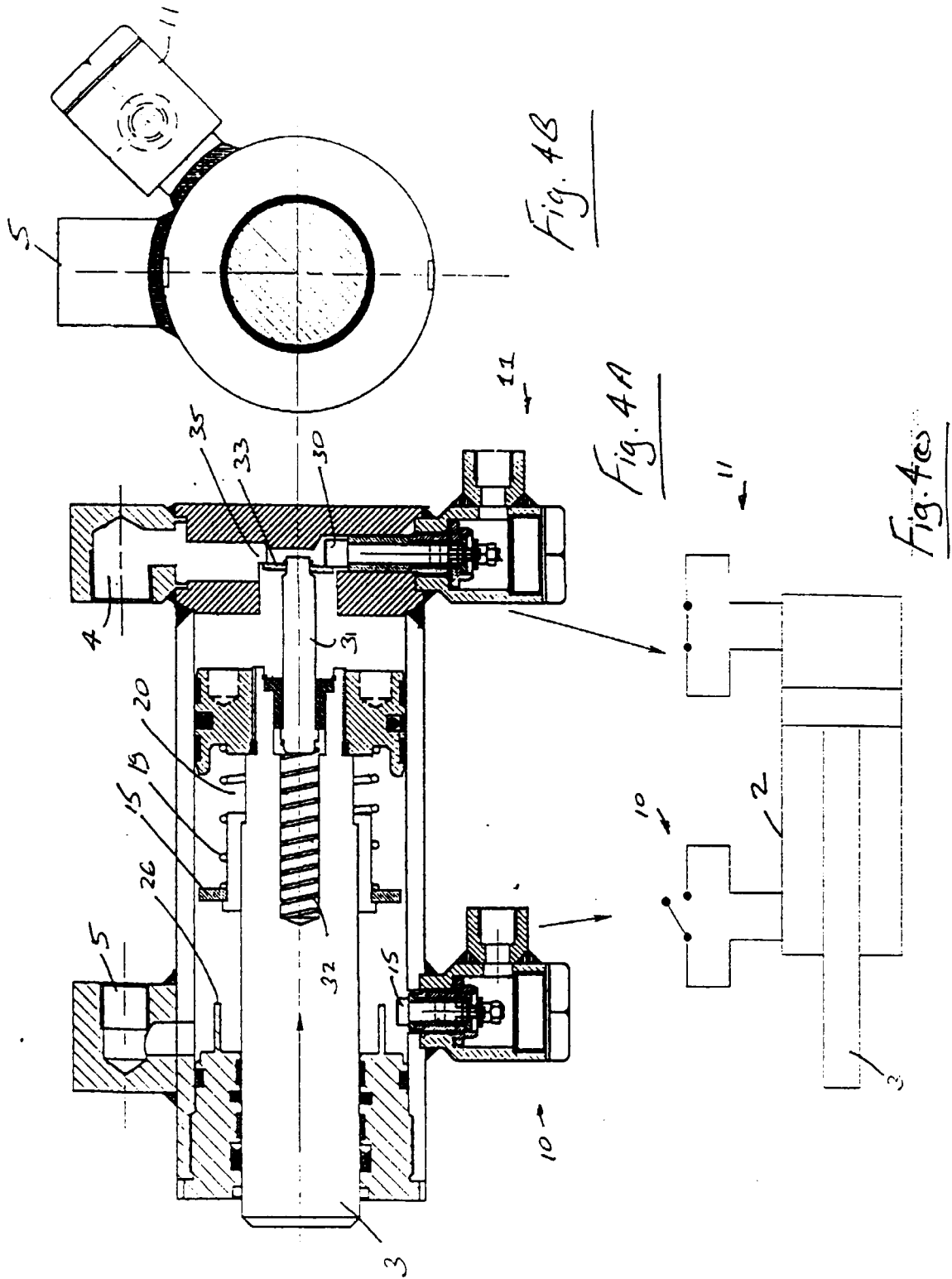


Fig. 3C



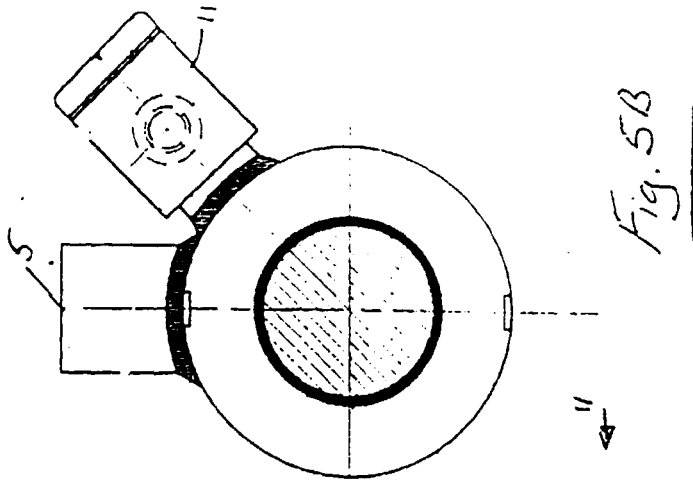


Fig. 5B

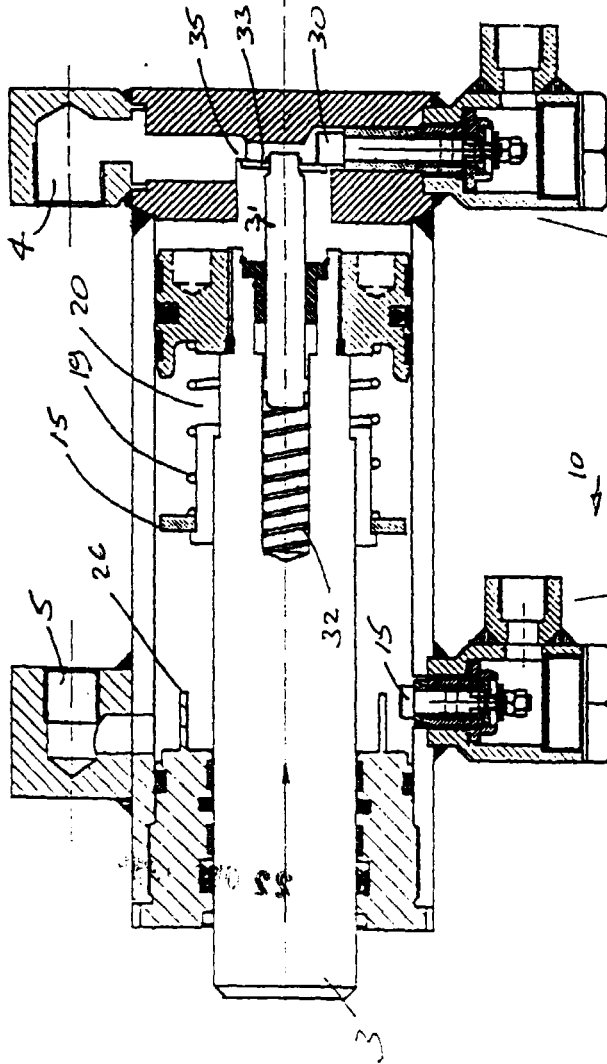


Fig. 5A

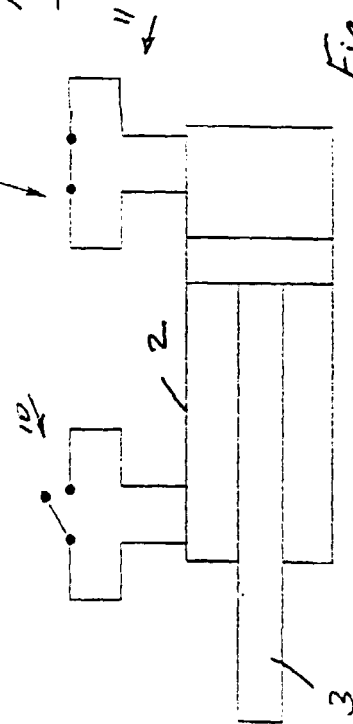


Fig. 5(c)



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 98 65 0090

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	EP 0 466 273 A (APPLIED POWER INC) 15 January 1992 * figure 1 *	1-3,5,8	F15B15/28
A	---	4,6	
A	DE 11 17 960 B (KARL HEINZ BORGGRÄFE) 23 November 1961 * figure *	4,6,9,10	
A	DE 25 38 547 A (GEOFFRAY JEAN PIERRE) 11 March 1976 * page 7, paragraph 2; figures 1,4-8 *	4,6,9,10	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			F15B
The present search report has been drawn up for all claims			
Place of search BERLIN		Date of completion of the search 22 April 1999	Examiner Pöll, A
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 98 65 0090

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The members are as contained in the European Patent Office EDP file on
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22-04-1999

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