(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 891 727 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
20.01.1999 Bulletin 1999/03

(51) Int. Cl.[6]: **A47C 3/30**

(21) Application number: **98112532.1**

(22) Date of filing: **07.07.1998**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **17.07.1997 IT BO970435**

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(54) Compressed-air column, cushioned and turning, particularly suitable for office chairs

(57) The column is comprised of an assembly with cylinder (1) and piston (3), the piston being integral with one end of the stem (5), the free ends of the cylinder and of the stem prearranged with a suitable conical shape for the coupling with correspondent seats of the chair base and seat. The stem is crossed by a control rod (18) cooperating with a drawer valve (29), which intercepts the communication between the pressure chambers (A-B) of the cylinder-piston assembly, the chambers containing compressed air under low pressure. The column is equipped with means (32, 37) which stop the extension travel of its stem (5) within such limits that the volume and the length of the pressure chamber with the smaller section (B) do not decrease below predetermined minimum values, which ensure for the assembly the maintenance of the necessary features of bending strength and which prevent cavitation phenomena when the column is suddenly loaded by the weight of the person sitting down. According to a preferred form of embodiment, the cylinder (1) has a constant diameter the whole of its length and it is coated with a tubular jacket (1=) whose lower end (101=) is shaped into a cone for the coupling with the seat of the chair base.

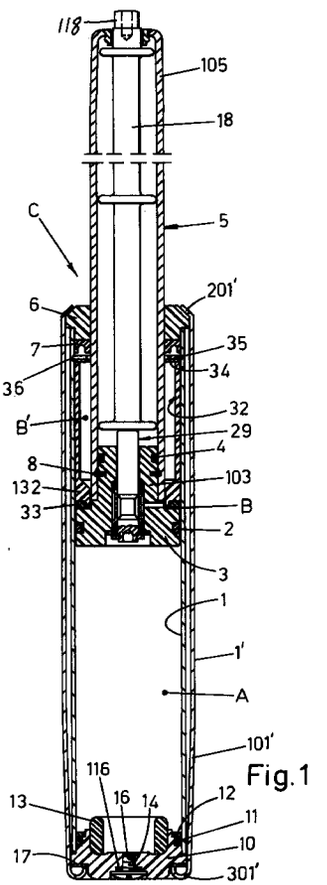

Fig.1

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Description

The present invention relates to a compressed-air column, cushioned and turning, particularly suitable for office chairs. In particular, this column includes a closed cylinder at one end, and a piston integral with the stem running with lateral seal and coming out with lateral seal and co-axially from the other end of the aforesaid cylinder, the opposed ends of the same cylinder and of the stem being prearranged to be linked to the base and/or to the chair seat. A control that can be operated by the user comes out from one end of the stem: this control is linked to a drawer valve placed in the aforesaid piston, which controls the passage of a fluid between two pressure chambers, an upper and a lower one, in the column, corresponding to the opposite faces of the same piston, in order to allow the desired adjustment of the column height by the person sitting down. Column of this kind are described, for example, in the European patents EP-0357595 and EP-0462997. Columns of the kind described above are also known: they operate only with air or gas and with a limited pressure, about 6-7 Bar. These columns have their stems pointing upwards and they are characterized by the presence of an extension of the stem itself within the cylinder, beyond the piston, this extension cooperating with some guiding means placed co-axially in the lower inside part of the piston itself and such that the air pressure in the lower chamber also affects the lower end of such stem extension, so that the whole of the lower piston surface is affected by the air pressure which can thus remain at the aforesaid minimum values. A column of this kind is described in the Italian patent No. 1.262.248. This column, though, presents the following disadvantage. When the column stem is in its position of maximum extension, the upper pressure chamber of the column itself has practically no volume. When the user sits down onto the chair and suddenly unloads his/her weight on the column stem, the stem itself, cushioned by the air compression, goes down to the lower chamber and produces in the aforesaid upper chamber so high a value depression that in the long run it may deform the upper seal/s and may compromise the working of the whole column. A first aim of the presentinvention is the creation of a compressed-air column, with low pressure, occupying a relatively small space and without the aforesaid disadvantages. A further aim of the present invention is the creation of a column with the aforesaid features, which is relatively easy to build, with a low cost and with a high technological reliability. The column according to the present invention is substantially characterized by the fact that it includes a cylinder-piston group of the known kind, with the piston integral with the stem end within the cylinder, this end usually pointing with the stem itself upwards and equipped inside with stroke end means which stop the stem extension within such limits that the volume and length of the upper chamber do not fall below the predetermined minimum values, so that these two goals can be achieved: - even when the stem has reached the maximum extension stroke, the upper chamber of the column has such a volume and contains such a quantity of compressed air that the aforesaid cavitation phenomena are avoided; even when the stem has reached the maximum extension stroke, the stem itself is still guided within the cylinder, on one side through the piston and on the other through the upper closing bushing of the cylinder itself, with such a length stretch as to make sure that the whole column maintains the necessary qualities of bending strength. The lower end of the cylinder column can be tapered for a length useful for the link with the chair base, or the cylinder may have a constant diameter the whole of its length and can be coated with a skirt of any suitable material, which is tapered in the lower end to be linked to the chair base. Other characteristics of the present invention, and the advantages deriving from them, will be more evident through the following description of a preferred form of embodiment of the invention, shown as an example, non-limiting, in the figures of the two enclosed drawings, where:

- Fig. 1 shows the column in axial section with the stem at the end of the extension stroke;
- Fig. 2 shows an upper portion of the column in axial section and in an intermediate working position;
- Fig. 3 shows the axial section of the column piston, with the attached drawer valve in the open position of compressed air passage between the two inside chambers of the column itself;
- Fig. 4 is a plan view from below of the central part of the closing base of the column cylinder;
- Fig. 5 shows an execution variation of the fixing of the piston to the column stem;
- Fig. 6 shows the axial section of an upper stretch of the column, with an execution variation of the means limiting the extension stroke of the stem of the column itself.

Figure 1 shows that column C includes a cylindrical body or cylinder 1, made of steel, with a round section, in which a piston 3 is axially moving with lateral seal by means of gasket 2, a piston 3 made, for instance, with a suitable antifriction plastic material and being equipped with an upper axial tang 103 which is inserted with lateral seal by means of gasket 4 and which is fixed with suitable means (see below) to the lower end of a steel tubular stem 5, which runs in a guide bushing 6 made, for instance, of a suitable antifriction plastic material, closing the upper end of the said cylinder 1. At least one suitable seal 7 ensures the sealed link of the bushing 6 to the stem 5 and to the cylinder 1.

The tang 103 of the piston is axially fixed to the stem 5 by means of an elastic ring 8 placed in a round recess of the tang itself and that snap in a similar round recess provided on the inside lateral surface of the stem. According to a different execution form shown in

figure 5, the tang 103 can be provided with a ring-shaped recess 9 where a portion of the stem 5 is rimmed by means of a rolling operation, as shown with 205. It is understood that the piston can be fixed to the stem 5 in any other way, also differently from the ones which are here indicated. The cylinder 1 is closed at the bottom by means of a base 10, made for instance of a suitable plastic material, provided outwardly with a ring-shaped seal, kept in its place, for instance, by means of a metal washer 12, which is introduced by pressing onto a tapered portion of the base itself, where it remains thanks to a suitable profile against unthreading of its own inner rim. Thanks to its tapered shape, the base 10 is deprived of any undercut, can be made with a relatively cheap mould and doesn=t show any imperfection. The base 10 is equipped, on its inner side, with a seat where a ring 13, partly projecting, is placed: the ring is made of elastomeric material and it is suitable as a cushion of the lower end stroke of the piston 3. The base itself 10 is equipped, in its center, with a threaded through hole 14, with a small groove 15 along the generatrix (see also fig. 4): in the aforesaid threaded hole there is a screw 16 with a seal 116 which seals the said hole and the said groove 15. By loosening the screw 16 and by introducing the base into an inflation unit (not shown), it is possible to introduce compressed air into the inner chambers of the column (see below), until the predetermined pressure is reached; afterwards the aforesaid screw 16 is screwed hard by means of an automatic screwer, which has been appropriately placed in the aforesaid inflation unit. In order to be fitted onto the chair, the column is provided with opposite conical ends which are introduced into correspondent conical seats in the base and in the seat of the chair itself. The stem 5 is provided with a conical end 105 and the cylinder 1 may show as well a lower conical end, which would, however, limit the stroke of the piston 3. In order to avoid this limitation, it can be provided in such a way that the cylinder 1 has a constant diameter the whole of its length and that it is surrounded by a tubular skirt 1= which has a conical shape in its lower portion as indicated by 101= and which is fixed, by its ends and with the rims 201= and 301=, respectively to the bushing 6 and to the base 10, in the first case directly and in the second case by means of a metal washer 17. Figures 1 and 3 show that in the stem 5 there is a control rod which can move axially and which is preferably made of a suitable plastic material. The aforesaid rod projects from the upper open end of the stem itself with the section 118, which can be linked to the operating lever or to any other known means connected with the chair seat, and that, with its lower end, operates on a drawer valve placed axially in the piston 3 and in its respective tang 103, said valve being normally closed by means of the air pressure in the lower chamber A of the column and, when pushed down and opened by means of the aforesaid rod 18, connecting said chamber A with the upper chamber B, in order to allow the axial travel of the complex 3-5 and the necessary adjustment in height of the column. In the example shown in the drawing tables, the drawer valve demands that the complex 3, 103 is axially equipped with a hole divided into three portions with downward increasing diameter, as indicated with 19, 20 and 21. In the central hole portion 20 the following elements are introduced: an O-ring 22, a bushing 23 made of plastic material, whose inside diameter is substantially the same as that of the hole 19, and then a second O-ring 24, and the whole is blocked on the place by means of a metal washer 25 which, through its outward rim profiled against unthreading, is forced by pressure into the hole portion 21, until it reaches the bottom of the hole. The inside diameter of the washer 25 is substantially the same as - or only slightly bigger than - the diameter of the aforesaid hole portion. The inside diameter of the O-rings 22 and 24 is appropriately smaller than diameter of the same hole portion 19. The bushing 23 is outwardly equipped with a central ring-shaped recess which forms, with the hole portion 20, a ring-shaped chamber 26, which is constantly connected with the upper chamber B of the column by means of at least one suitable hole 27, radially positioned on a base bulge of the tang 103 of the piston 3. In the ends of the same chamber 26, some holes 28 are also open: they are provided on the bushing 23, which can be introduced into its seat in any direction. The hole portion 19 and the assembly 22-25 are crossed by a cylindrical drawer 29, preferably made of steel, which can move axially and cooperates with lateral seal with the O-rings 22, 24, a portion of it projecting into the axial cavity of the stem 5, at atmospheric pressure, while the other end is in the pressure chamber A of the column, and which is, provided with a head 30, for instance adjoined, which usually leans against the washer 25. The pressure in the chamber A, in fact, normally keeps the drawer 29 pushed upwards. In such a condition, as shown in figure 1, the portion of the drawer 29 which projects from the top of the tang 103 of the piston 3, keeps the control rod lifted and appropriately projecting from the stem 5. The drawer 29 is provided with a central ring-shaped recess 31 which, when the drawer itself is at rest, is positioned between the O-rings 22 and 24, preventing the communication between the chambers A and B, since the O-ring 24 is in sealing contact with the drawer itself. On the contrary, by pushing down the control rod 18, the rod pushes down the drawer 29 and brings the ring-shaped recess 31 across the O-ring 24, which does not play its sealing role anymore. The chambers A and B of the column communicate in this case by means of the hole 28, the chamber 26 and the hole 27, as well shown in figure 3. The main feature of the column according to the present invention is the fact that in the column itself means are provided which stop the piston 3 stroke in the phase of extension of stem 5 to such an extent that the stem itself is still guided within the cylinder 1, with so long a portion, for example, as 1/3 of the length of the stem itself or, anyway, with such a length that the whole

telescopic system keeps its features of bending strength which are necessary for the use to which it is bound. In the same condition of maximum extension of the stem, the chamber B of the column, with a smaller section, should keep such a predetermined minimum volume as to avoid those cavitation phenomena which can be observed in the columns of the known type. In order to achieve this, in the upper part of the cylinder 1 a spacing bushing 32 is introduced, made for instance of a suitable plastic material, equipped on its lower end with a rim 132, thickened and shaped to house a ring 33 made of a suitable elastomeric material, which can be useful as a damper for the upper end stroke of the piston 3. The upper end of the bushing 32 leans onto a metal washer 34, which is kept at a distance from the gasket 7 by means of an elastic ring 35, fitted into an appropriate ring-shaped recess 36, which has been obtained from the inside lateral surface of the cylinder. The bushing 32 has such an outside diameter that it must be fitted into the cylinder 1 by means of a light forcing, so as to remain in its high position. The thickened end 132 of the bushing 32 has an inside lateral surface with a higher diameter than the outside diameter of the stem 5, and/or equipped with equidistant recesses, so that the ring-shaped chamber B=, defined by the bushing itself and by the stem, can freely communicate with the chamber B and is under the same pressure. From figures 1 and 2 it is evident how, by compressing the stem 5 with a person=s weight, the chamber A reduces its volume and cushions the sitting, while the chamber B, at the beginning with zero volume, raises its volume proportionately without creating cavitation problems, since it is connected with the compensation or residual chamber B= which is, at the beginning, under the same pressure as the chambers A and B. It is understood that, according to an operative variation, not shown in the drawings, the chamber B= can be differently positioned between the bushing 32 and the cylinder 1. In this case the bushing 32 will be equipped, at least on its lower end, with appropriate radial holes, similarly to bushing 23 of the drawer valve placed on the piston 3. Instead of the elastic ring 35 other means can be used, such as a ring-shaped ledge towards the inside of the cylinder 1, which should be carried out with an outward rolling of the cylinder itself. Figure 6 shows that, according to an operative variation of the present invention, a ring-shaped ledge 37 towards the inside of the cylinder 1, made for instance by rolling, can be used in order to eliminate the bushing 32, since such an inside ledge 37, preferably in combination with a metal ring 38 leant or driven against or into the ledge 37 itself and in combination with an elastomeric ring 39, would provide the shoulder necessary to stop the extension travel of the stem 5 of the value necessary to keep the residual or compensation chamber B=. In this case, as the bushing 32 is not present, the chamber B= would have a bigger volume than the volume of the same chamber B= in the embodiment shown in figures 1 and 2, so that the chamber B= of figure 6 could be shorter than the chamber B= in figure 1. The column which has been described can also be used if turned upside down and the control rod 18 can be operated by means of a pedal lever placed in the base of the chair. It is understood that the description relates to a preferred embodiment of the present invention, which can be subject to several variations and changes, above all of production nature, without, however, leaving outside the principle informing the present invention, as described above, as shown in the drawings and as afterwards claimed. In the patent claims, the references in brackets are merely indicative and non-limiting of the protection boundaries of the claims themselves.

Claims

1. Compressed-air column, cushioned and turning, particularly suitable for office chairs, of the kind including a cylinder (1), closed on one end, which is prearranged, for instance, for the link to the base of the chair and where a piston (3) runs with lateral seal, such piston being integral with a stem (5) which runs axially guided and with lateral seal through a bushing (6) which, by means of sealing agents (7), closes the other end of the aforesaid cylinder, and the outward end of the stem itself being prearranged for the link to the chair seat and from such end a control rod (18) projecting, said rod axially crossing the stem itself and operating a drawer valve (29) which is fitted into the aforesaid piston in order to intercept a linking canalization between the two opposed pressure chambers (A-B) of the column, occupied by a fluid, preferably by compressed air under an appropriate pressure value, said drawer usually being in such a position to close said canalization through the pressure differential which affects the two ends, while, when operated by said control rod, the same drawer connects the aforesaid pressure chambers (A-B) in order to allow the variation in height of the column, which is **characterized** by the fact that it is equipped with stem extension-stopping means so that, at the end of the maximum extension travel, the stem is still guided into the cylinder with such a length as to ensure for the column the keeping of the necessary features of bending strength and so that, beside said stopping means, there is also a residual or compensation pressure chamber (B=) which is constantly connected with the pressure chamber with a smaller section (B) of the column, which is therefore under the same pressure and which has such a volume that, when the column is suddenly stressed in compression by the weight of the user sitting down, the chamber with a bigger section (A) reduces its volume in order to cushion the sitting, while the chamber with smaller section (B) raises proportionately its volume, without creat-

ing cavitation phenomena and without damaging the function of the aforesaid means (7) which ensure the sealing between lining and stem, since this chamber takes air under pressure from the aforesaid residual or compensation chamber (B=).

2. Column according to claim 1, **where** the aforesaid extension-travel stopping means of the stem (5) are constituted by a bushing (32), preferably made of plastic material, which is introduced, preferably by means of a light forcing, into the upper end of the cylinder (1), which has at least one thickened end (132) turned towards the piston (3) and which carries at least one ring (33), made of elastomeric material, as a stop damping for the aforesaid piston, while the other end of the said bushing leans against the axial blocking means, which prevents that it touches the seal (7) between cylinder and stem, the aforesaid bushing being characterized by the fact that it has walls of such thickness to occupy only partially the chamber portion where it is placed, in order to allow the formation of the aforesaid residual or compensation chamber (B=), which, through suitable clearances with the cylinder and/or the stem, is constantly connected with the chamber with smaller section (B) in the column.

3. Column according to claim 2, **where** the axial blocking means of the spacing bushing (32) are constituted by a metal washer (34) against which the upper end of the bushing leans, and include an elastic ring (35) against which the aforesaid washer leans and which is placed in a ring-shaped recess (36), obtained on the inside lateral surface of the cylinder (1).

4. Column according to claim 2, **where** the axial blocking means of the spacing bushing (32) include a ring-shaped ledge obtained on the inside surface of the cylinder (1) by a process of outward rolling of the cylinder itself.

5. Column according to claim 1, **where** the extension travel end means of the stem (5) include a ring-shaped ledge (37) carried on or obtained from a piece inside the cylinder (1), for instance by means of an outward rolling, with such ledge cooperating by contact the piston (3), preferably with the interposition of an elastomeric ring (39) and of a washer (37), preferably a metal washer, with an inside diameter which is smaller than the outward diameter of the column stem (5).

6. Column according to claim 1, **where** the free ends of the cylinder (1) and of the stem (5) are shaped into a cone for the coupling with corresponding conical seats of the chair seat and base.

7. Column according to claim 1, **where** the free end (105) of the stem (5) is shaped into a cone for the coupling with a conical seat of the chair seat, while the cylinder (1) has a constant inside diameter the whole of its length and it is coated with a tubular jacket (1=) whose ends are seamed to the head bushing (6) and to the base (10) closing the ends of the cylinder itself, the lower end (101=) of such jacket being appropriately shaped into a cone for the coupling with a conical seat of the chair base.

8. Column according to claim 1, **where** the base (10) closing the bottom of the cylinder (1) is made of a suitable plastic material and shows an outward layered shape, with four diameter portions increasing downwards, which, starting from the one with the higher diameter, are respectively affected by: the first one by the tubular jacket (1=) whose lower end (301=) is rimmed on the bottom of the base itself; the second one by the lower end of the cylinder (1); the third one by a gasket (11) ensuring the sealing between base and cylinder; the fourth portion by a metal washer (12) which, with its inside rim with profile against unthreading, is forced by pressure onto the fourth portion having the smaller diameter.

9. Column according to claim 8, **where** the base (10) is equipped within the lining with a central seat with a pad (13) made of elastomeric material, which works as a damper of the travel end in retraction of the column stem, the base itself being equipped with an axial hole (14, 15) in which are screwed some means of any suitable kind (16, 116) allowing to introduce the air at the necessary pressure into the inner chambers (A-B-B=) of the column.

10. Column according to claim 1, **where** the piston (3) is made of a suitable antifriction plastic material and is equipped with an axial tang (103) which is fixed by means of axial blocking means (8, 205) and of lateral sealing means (4) to one end of the stem (5), under which end the aforesaid tang shows a ring-shaped thickening in which there is at least one hole (27) opening radially, which hole is, with its other end, opened in the middle part of the middle portion (20) of the axial cavity in the aforesaid piston and tang, this end being formed by three portions with diameter progressively increasing towards the chamber with the bigger section (A) of the column, in said central portion being fixed a plastic bushing (23) with some O-rings (22, 24) on its ends and the whole being axially blocked by a metal washer (25) which, with its outward rim with profile against unthreading, is forced by pressure into the portion with the higher diameter (21) of the said axial cavity in the piston, the aforesaid bushing being equipped, at short distance from its ends, with some holes (28), which have been opened in a

middle and outward ring-shaped recess of the bushing itself, which defines, with the cavity housing the bushing itself, a ring-shaped chamber (26) communicating with the aforesaid radial hole (27), being provided that the axial cavity of the piston and of the tang is crossed by a cylindrical, preferably metallic, drawer (29) which cooperates in sealingly with the aforesaid O-rings (22, 24) and, with an end portion, projects inside the column stem and is connected with the control rod (18), and which, with its other end, is in the chamber with the bigger section of the column and is equipped with a head (30), usually leaning against the said washer (25), such drawer being equipped with a ring-shaped recess (31) which is usually included between the said O-rings (22, 24) so as to prevent the communication between the pressure chambers (A-B) of the column itself, while, when the drawer is pushed downwards through said control rod, its recess (31) partially comes out of the sealing area of said O-rings, thus allowing the connection between the pressure chambers of the column, which can thus vary its height.

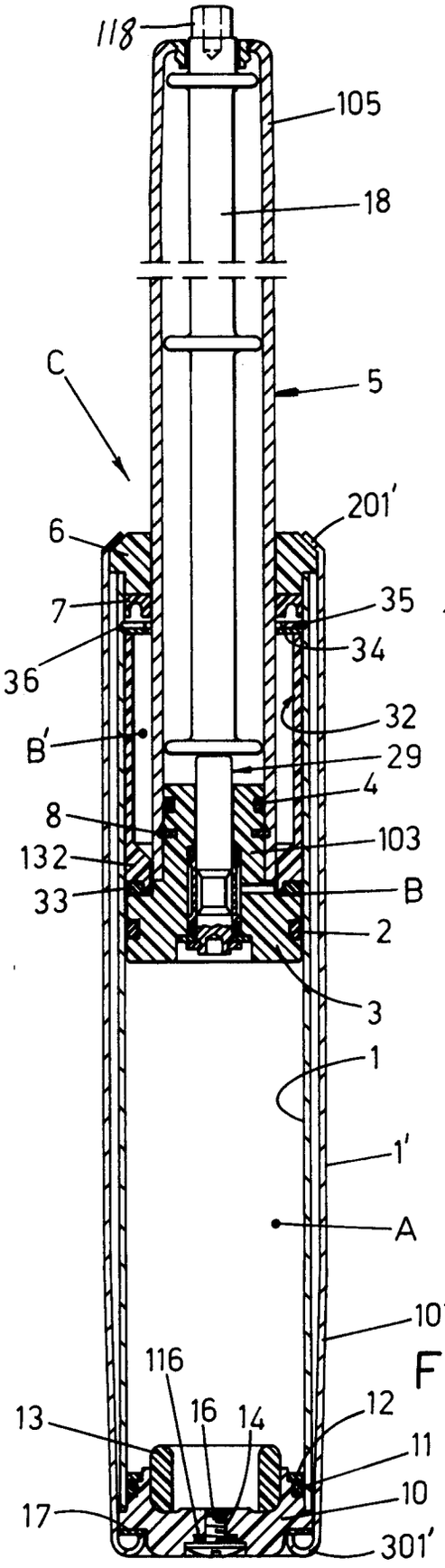

Fig.1

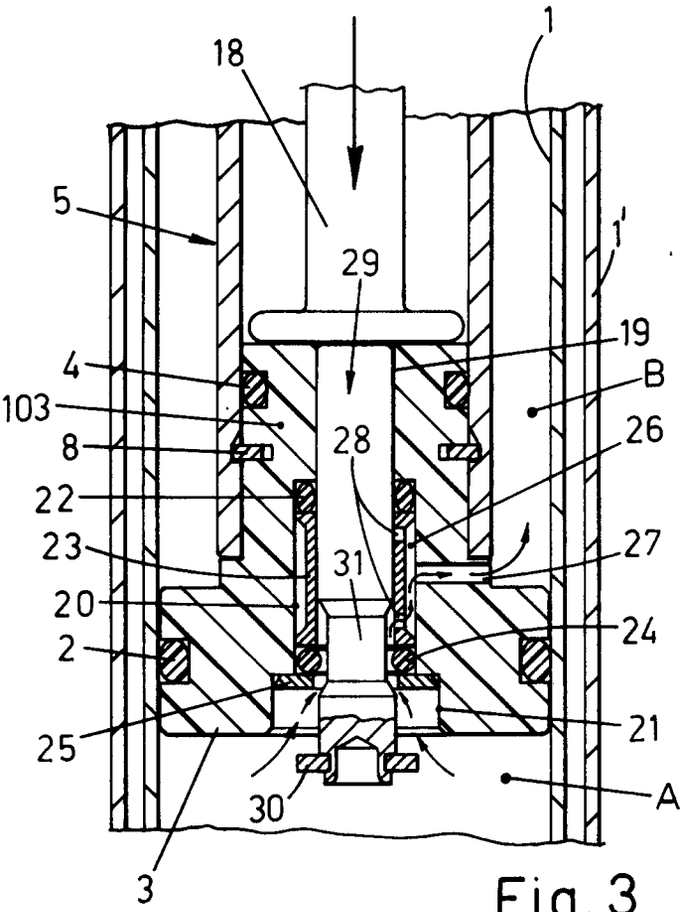

Fig.3

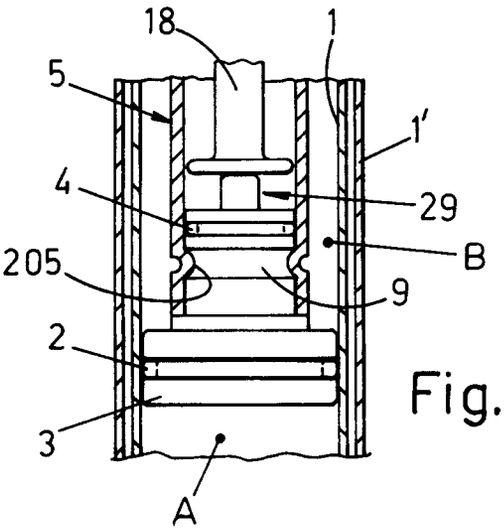

Fig.5

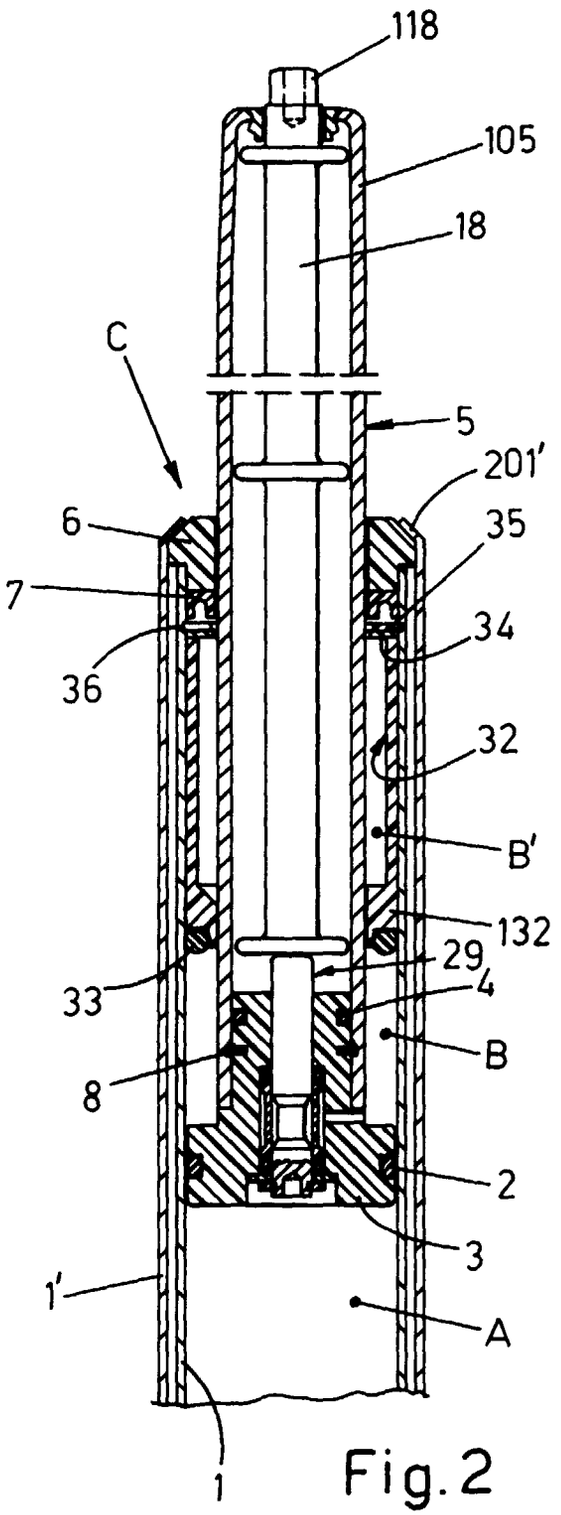

Fig. 2

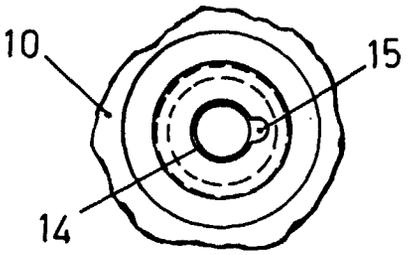

Fig. 4

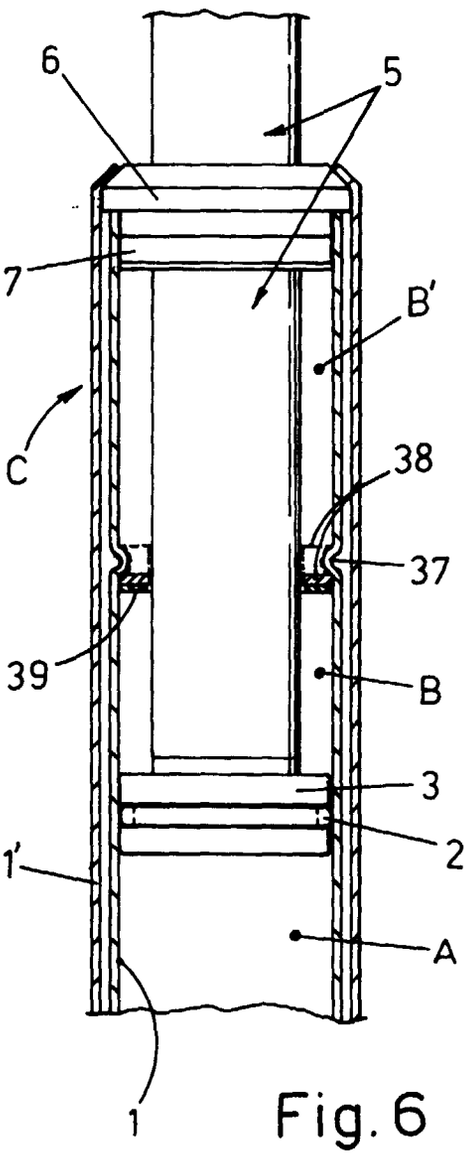

Fig. 6