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(54) Pneumatic cylinder with non rotating shaft

(57) A pneumatic cylinder (10) having a non rotating shaft (48), thus having only a translation motion, is disclosed. The pneumatic cylinder (10) in its preferred embodiment has a splined member (28, 48) and one or more sets of freely rotating or rolling elements (44), the rotating or rolling elements (44) of each set (42) engag-

ing one groove (40) of said member (28, 48). In this way the sliding friction of the devices of the state of the art is replaced by a rolling friction of said rotating or rolling elements (44) in the corresponding grooves (40).

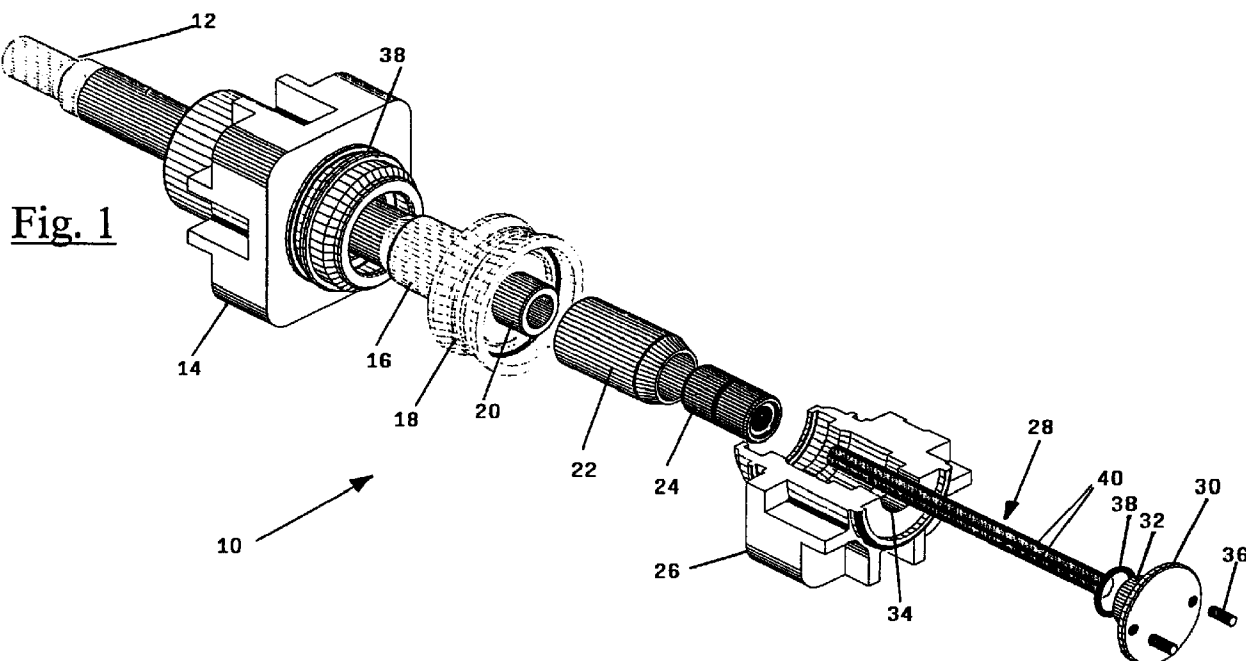


Fig. 1

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Description

[0001] The present invention relates to the field of pneumatic equipment and more particularly a pneumatic cylinder of the kind having a non rotating shaft.

[0002] Several kinds of pneumatic cylinders are known in the art. Many have a shaft which can freely rotate around its axis besides the motion of axial translation. On the contrary, others have means to hinder the rotation of the shaft around its axis. The latter kind is normally used for particular applications where precision is needed, such as robotics (manipulation of articles) and printing.

[0003] Pneumatic cylinders with non rotating shaft of state of the art are generally provided with shaped bushings, for instance of triangular or quadrangular cross-section or with lobes and a shaft that has a cross-sectional shape corresponding to that of the bushing.

[0004] In another kind of pneumatic cylinder shaft rotation is hindered by the particular shape of the lining and the piston.

[0005] In any case sliding occurs in both the above mentioned kinds of pneumatic cylinders and this sliding causes a sliding friction that affects strongly and negatively the operation of the pneumatic cylinder: its performances, initially considered to be satisfactory, decrease when lubrication diminishes. Moreover precision obtained by such pneumatic cylinders of the known art is often poor.

[0006] Object of the present invention is to remove the above mentioned drawbacks and to provide a pneumatic cylinder with non rotating shaft, having great precision and performances that are considerably higher than those of the known pneumatic cylinders.

[0007] These and other objects are attained by a pneumatic cylinder having the features recited in the characterizing part of independent Claim 1. Further advantageous characteristics of the invention are set forth in the dependent claims.

[0008] The pneumatic cylinder according to the present invention substantially employs a splined shaft and a sleeve, friction between these two members being rolling friction, thus considerably lower than the sliding friction of the known devices.

[0009] Now follows a detailed description of an embodiment of the invention, given as a non limiting example, to be read with reference to the accompanying sheets of illustrative drawings in which:

Fig. 1 is an exploded view of a pneumatic cylinder according to the invention, with the liner or tube taken away for sake of clarity;

Fig. 2 is a view similar to Fig. 1 but with the components assembled; and

Fig. 3 is an enlarged detail of a portion of the splined shaft and a sleeve provided with a ball cir-

ulation, partially sectioned to show the inner part of the sleeve.

[0010] Clearly in the various views like reference numerals are used to indicate like or functionally equivalent elements.

[0011] With reference to the various views, the pneumatic cylinder 10 according to the invention comprises, in addition to the liner or tube (not shown for sake of clarity): a stem 12, a front head 14, a front dampening ogive 16, a piston 18, a threaded portion 20 of the shaft 48, a back ogive 22, having not only the dampening function but also that of containing a sleeve 24 (which will be described in detail hereinafter), a back head 26, a splined bar 28, an end plate 30 provided with a threaded portion 32 for matching a corresponding threaded portion 34 of the back head 26 and one or more pins 36 for locking the end plate to the back head. Clearly there are also several conventional sealing devices such as O-rings 38.

[0012] During assembly, the back ogive is screwed on the threaded portion of the shaft and the sleeve 24 is pressed inside the ogive, while the splined bar 28 may slide but not rotate inside the ogive.

[0013] The splined bar 28 is an elongated rod member provided with a plurality of longitudinal grooves 40, preferably spaced equally along the circumference.

[0014] The sleeve 24 is a cylindrical member provided with a number of sets 42 of rotating or rolling elements 44 such as balls, rollers, needles, possibly having some taper, and the like. Preferably the number of sets of rotating or rolling elements corresponds to the number of grooves 40 of the splined bar and conversely, and the sets 42 of rotating or revolving elements 44 are also spaced equally along the circumference.

[0015] In the preferred embodiment each set 42 of rotating or rolling elements 44 comprises a number of freely rotating and circulating balls 44.

[0016] Some of these balls 44 are caged and in turn partially project radially inwardly with respect to the inner surface of the sleeve 24 and engage the grooves 40. Lubrication means are of course provided in the sleeve 24, such as little holes 46.

[0017] It will now be clear that the cooperation between the elements 44 and the longitudinal grooves 40 allows to attain the above mentioned objects, namely a perfect locking of the shaft against rotation, and a considerable friction reduction, with great advantage for the general performances of the pneumatic cylinder.

[0018] A second embodiment of the invention provides the sleeve 24 integral with the front head 14 and the shaft having longitudinal grooves like the splined bar 28.

[0019] Although this embodiment is not illustrated on the drawings, a man skilled in the art will certainly consider it as apparent after having read this description. This second embodiment has only the disadvantage that sealing means must be provided between shaft and

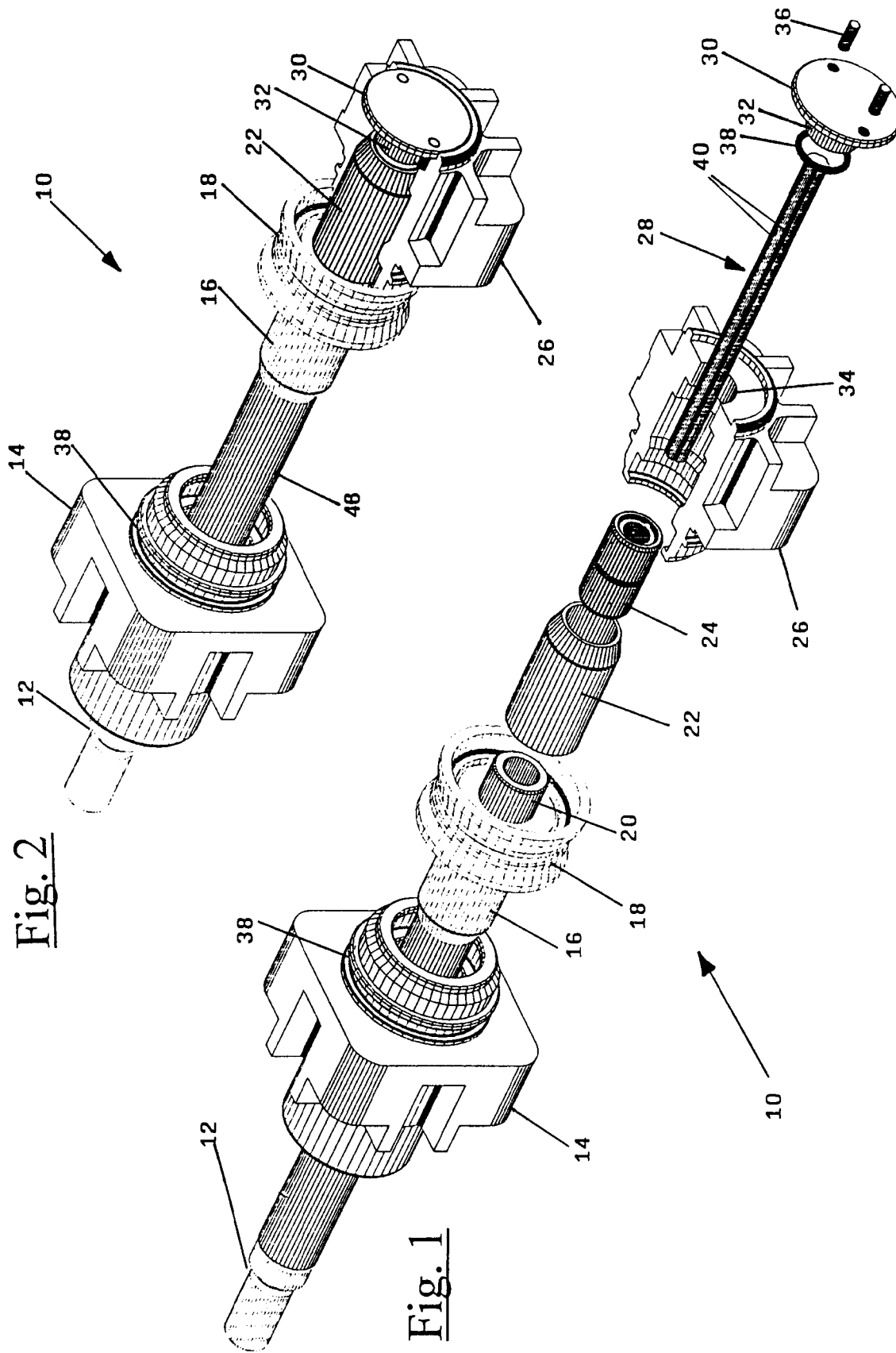
head.

[0020] Although the invention was described with reference to a pneumatic cylinder, the same operative principle might also be effectively used in cylinders operated with fluids other than air, such as hydraulic cylinders. Therefore for the purpose of this description, the term "pneumatic cylinder" should be understood as having a broader and general meaning than the mere literal one.

[0021] It is apparent that several modifications, adaptations, variations and substitutions of elements may be made to the embodiments illustrated and described in this disclosure, with other functionally equivalent elements without departing from the scope of protection as defined in the appended claims.

Claims

1. Pneumatic cylinder (10) comprising a piston (18) having a translation motion inside a liner, closed by a first and a second head (14, 26) at its ends, said piston (18) being integral with a shaft (48), characterized in that said shaft (48) is prevented from rotation by the joint action of at least one set (42) of rotating or rolling elements (44) and at least one corresponding longitudinal groove (40) in which said rotating or rolling elements (44) are operating.
2. Pneumatic cylinder (10) according to Claim 1, characterized in that said rotating or rolling elements (44) are selected from the group comprising balls, rollers, needles and the like, preferably having a tapered shape.
3. Pneumatic cylinder (10) according to Claim 1 or 2, characterized in that said at least one longitudinal groove (40) is made in a bar (28).
4. Pneumatic cylinder (10) according to Claim 1 or 2, characterized in that said at least one longitudinal groove (40) is made in said shaft (48).
5. Pneumatic cylinder (10) according to Claims 1-4, characterized in that said splined bar (28) or said splined shaft (48) are provided with a number of longitudinal grooves (40) equally spaced along the circumference of said bar (28) or shaft (48).
6. Pneumatic cylinder (10) according to any of the preceding claims, characterized in that said rotating or rolling elements (44) are inserted and caged in a sleeve member (24).
7. Pneumatic cylinder (10) according to Claim 6, characterized in that said sleeve member (24) is inserted in a back ogive (22) of the shaft and piston unit and is locked to said ogive (22).
8. Pneumatic cylinder (10) according to Claim 6, characterized in that said sleeve member (24) is integral with or fixed to the front head (14).
9. Pneumatic cylinder (10) according to any of Claims 6-8, characterized in that said sleeve member (24) comprises means for lubricating said rotating or rolling elements (44).
10. Pneumatic cylinder (10) according to any of Claims 6-9, characterized in that said sleeve member (24) is a sleeve with ball circulation.



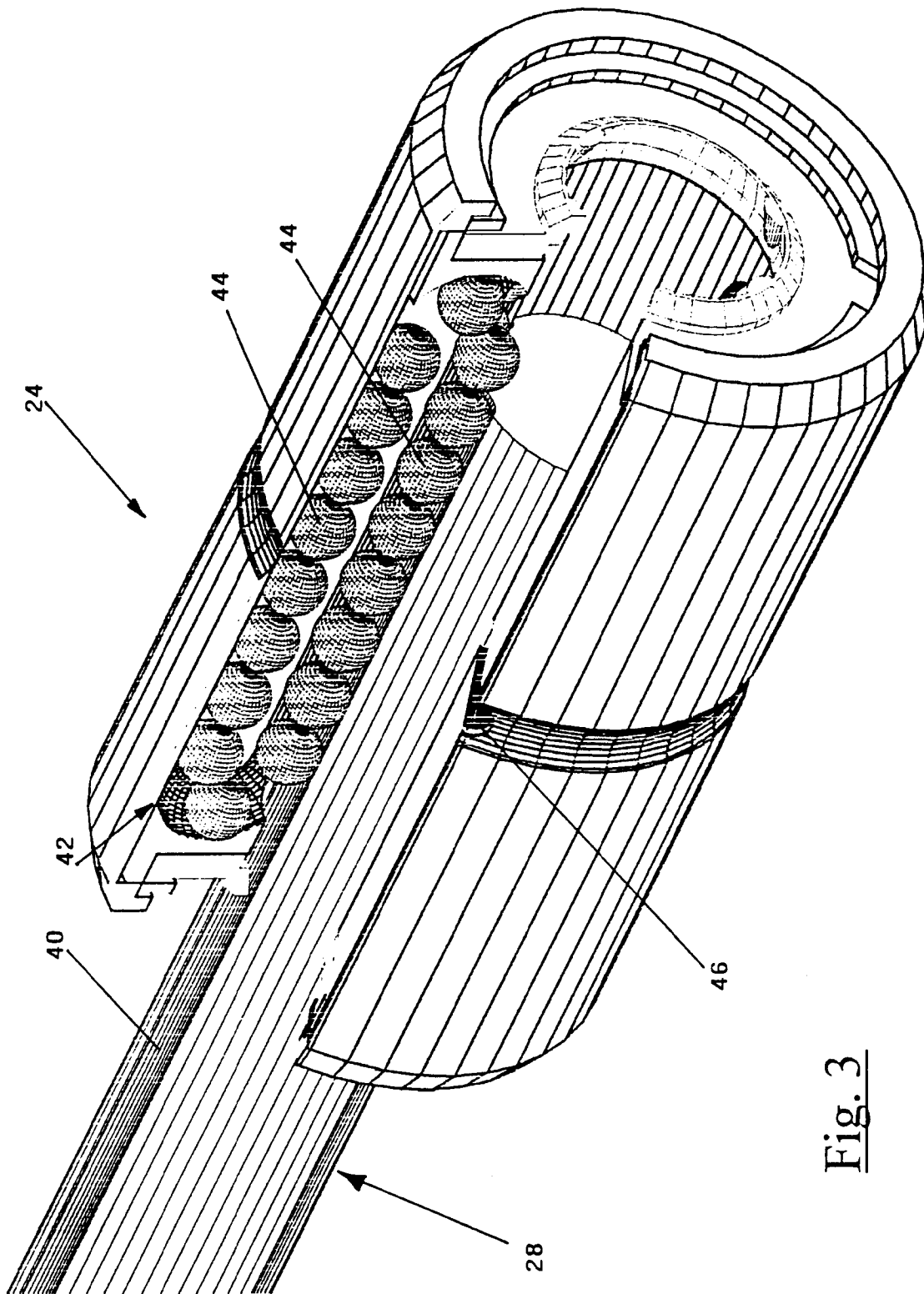


Fig. 3