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SEAL FOR A PNEUMATIC SERVO MOTOR

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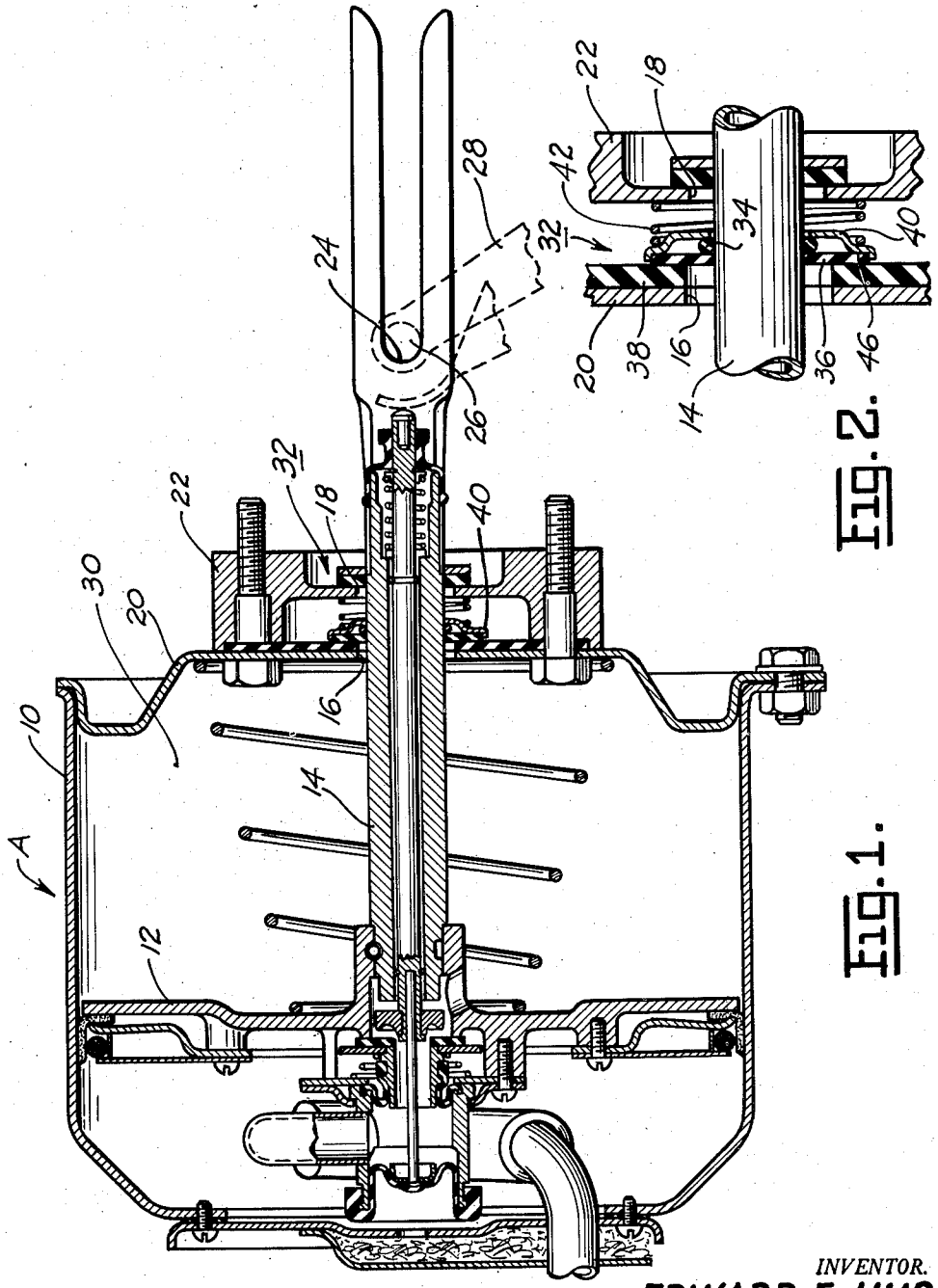

Fig. 2.

Fig. 1.

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SEAL FOR A PNEUMATIC SERVO MOTOR

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The present invention relates to servo-motors of the type having an internal piston provided with a force transmitting member which extends through a wall of the servo-motor, and more particularly to a type of pneumatic seal adaptable for use with such structures and which will accommodate relative lateral movement of the structures between which it extends.

An object of the present invention is the provision of a servo-motor of the above described type having new and improved pneumatic sealing means between its force transmitting member and the housing of the servo-motor which will accommodate lateral movement between the force transmitting member and the housing of the servo-motor.

Another object of the present invention is the provision of a new and improved pneumatic seal for a shaft adapted to move in and out with respect to another member and comprising an O-ring positioned about such shaft, a sealing washer extending about the shaft and positioned between the O-ring and said other member, and means biasing the O-ring against the sealing washer to cause said sealing washer to abut said other member.

The invention resides in certain constructions and combinations and arrangement of parts and further objects and advantages will be apparent to those skilled in the art to which the invention relates from the following description of the preferred embodiment described with reference to the accompanying drawing forming a part of this specification, in which:

Figure 1 is a longitudinal cross-sectional view of a pneumatic servo-motor embodying the principles of the present invention; and

Figure 2 is a fragmentary cross-sectional view of the new and improved pneumatic sealing means utilized in the pneumatic servo-motor shown in Figure 1.

Referring to the drawing, there is shown a servo-motor A having an enclosed cylinder **10** provided with an internal piston **12** which in turn carries a force transmitting member or tubular shaft **14** which extends through openings **16** and **18** in the end wall **20** and spacer member **22**, respectively, of the servo-motor. The outer end of the force transmitting member **14** is provide with a U-shaped abutment surface **24** adapted to receive the abutment pin **26** affixed to one end of a reaction linkage **28**. The reaction linkage **28** is pivotally supported at a point spaced apart from the abutment pin **26**, such that movement of the piston **12** causes the abutment pin **26** to move in an arcuate path. Because the U-shaped abutment surface **24** engages the top and bottom portions of the pin **26**, arcuate movement of the pin **26** imparts some lateral motion to the force transmitting member **14** as it is moved through the openings **16** and **18** by the piston **12**. For a more complete description of the construction and operation of the servo-motor shown in the drawing, reference may be had to the previously filed Edward E. Hupp et al application entitled, "Pneumatic Servo-Motor Construction."

The servo-motor shown in the drawing employs a new

and improved pneumatic seal between its force transmitting member **14** and the end wall **20** to prevent the atmosphere from entering the partially evacuated cylinder chamber **30** during actuation of the servo-motor. The pneumatic sealing structure shown in the drawing generally comprises an O-ring **34** positioned about the force-transmitting member **14** and positioned externally of the end wall **20** of the cylinder **10**. The O-ring **34** preferably has a normal internal diameter slightly less than the outside diameter of member **14**, such that it tightly engages member **14** when placed about it. A comparatively rigid sealing washer **36** having a smooth surface and preferably made from non-metallic material which will not score member **14**, as for example, nylon or Spauldite (fabric impregnated with a phenolic resin) is positioned about the shaft **14** between the end wall **20** and the O-ring **34**. The external face of the end wall **20** is provided with a facing of a smooth semi-resilient material as, for example, rubber, to provide sealing engagement with the sealing washer **36**. An annular generally cup-shaped retaining ring **40** having a centrally located opening slightly larger than shaft **14** is positioned about the shaft **14** outwardly from the O-ring **34** with its horizontal leg portions engaging the radially outer surface of the sealing washer **36**. The annular retaining ring **40** is biased against the O-ring **34** by a coil spring **42** positioned between the annular retaining ring **40** and the spacer member **22**. The radially outer portion of the bottom of the cup-shaped retaining ring **40** is preferably deformed inwardly to form an abutment or reference surface **46** spaced from the portion which abuts the O-ring **34** a distance which is slightly less than the normal thickness of O-ring **34** to provide a predetermined deformation of the O-ring **34**. Force from the coil spring **42** forces the reference surface **46** of the retaining ring **40** against the sealing washer **36**, to in turn force the sealing washer **36** against the facing **38** and effect a seal therewith. At the same time, the retaining ring **40** forces the O-ring **34** against the sealing washer **36** to effect a seal therewith. In order that angular movement of the force transmitting member **14** can be accommodated by the sealing structure, it is necessary that the total longitudinal thickness of the structure be as short as possible. In the sealing structure of the preferred embodiment, the sealing washer **36** will be made quite thin, and the central opening of the retaining ring **40** will be made large enough such that the retaining ring **40** will not contact the force transmitting member **14** at any time.

During operation of the servo-motor A, the force transmitting member or tubular shaft **14** is moved laterally with respect to the end wall **20**, as previously described. Lateral movement of the shaft **14** is transmitted to the sealing washer **36**, causing the sealing washer **36** to slide laterally over the external surface of the facing material **38**. The spring **42** is adapted to both accommodate this movement and hold the sealing washer **36** in engagement with the facing material **38** to maintain a seal therewith throughout the lateral movement. In the embodiment shown in the drawing, the horizontal leg of the retaining washer **40** engages the peripheral surface of the sealing washer **36** such that the lateral movement of the shaft **14** is transmitted to the sealing washer **36** which in turn carries the retaining washer **40** with it.

While the preferred embodiment has been described as utilizing a semi-resilient material, that is, rubber, for the facing **38** and a non-metallic comparatively rigid material for sealing washer **36**, it will be apparent that one or the other of the engaging surfaces of these members might be made of a metallic material, provided it were manufactured with sufficient close tolerances to provide an essentially flat surface. It might also be acceptable in some instances to omit the facing **38**, utilize

a metallic sealing washer **36**, and to lap the sealing washer **36** into sealing engagement with the outer surface of the end wall **20**.

It will be seen that the objects and advantages enumerated, as well as others, have been achieved, and that there is provided a new and improved type of pneumatic seal which will accommodate lateral movement between members which are reciprocated relative to each other.

While the preferred embodiment of the invention has been described in considerable detail, I do not wish to be limited to the particular construction shown which may be varied within the scope of the invention and it is the intention to cover hereby all adaptations, modifications and arrangements thereof, which come within the practice of those skilled in the art to which the invention relates.

I claim:

1. In a fluid pressure seal adapted to accommodate angular and lateral movement: a first member having a flat sealing surface with an opening therein; a second member extending through said opening, said opening in said first member being large enough to accommodate lateral and angular movement of said second member; a generally rigid disc shaped member having a hole therein through which said second member extends positioned about said second member in sealing abutment with said flat sealing surface, a ring of elastic material in abutment with said disc shaped member and tightly engaging the surface of said second member, said disc shaped member being made from a non-galling material and its hole being constructed to accommodate angular movement of said second member without said hole being large enough to permit extrusion of said ring into said hole, a retainer member having an opening therein through which said second member extends positioned about said second member against said ring, the opening in said retainer member being constructed to accommodate the angular movement of said second member, and means biasing said retainer member toward said surface of said first member, whereby angular movement of the second member relative to the seal produces a pivotal action with respect to said disc shaped member.

2. In a fluid pressure seal adapted to accommodate angular and lateral movement: a first member having a flat sealing surface with an opening therein; a second member extending through said opening, said opening in said first member being large enough to accommodate lateral and angular movement of said second member; a generally rigid and relatively thin disc shaped member having a hole therein through which said second member extends positioned about said second member in sealing abutment with said flat sealing surface, a ring packing of elastic material in abutment with said disc shaped member and tightly engaging the surface of said second member, said disc shaped member being made from a non-galling material and being sufficiently thin to enable its hole to accommodate angular movement of said second member without said hole being large enough to permit extrusion of said ring into said hole, a retainer member having an opening therein through which said second member extends positioned about said second member against said ring, said retainer member being laterally secured to said disc shaped member and the opening in said retainer member being large enough to accommodate the angular movement of said second member when said second member engages the side walls of the opening in said disc shaped member and pivots with respect thereto, and means biasing said retainer member toward said surface of said first member, whereby angular movement of the second member relative to the seal produces a pivotal action with respect to said disc shaped member, and the angular movement on either side of the disc shaped member is accommodated by the openings in said first and retainer members respectively.

3. In a fluid pressure seal between reciprocatory members adapted to accommodate angular and lateral movement: a first member having a flat sealing surface with an opening therein; a reciprocable member extending through said opening, said opening in said first member being large enough to accommodate lateral and angular movement of said reciprocable member; a generally rigid disc shaped member having a hole therein through which said reciprocable member extends positioned about said reciprocable member in sealing abutment with said flat sealing surface, a ring of elastic material in abutment with said disc shaped member and tightly engaging the surface of said reciprocable member, said disc shaped member being made from a non-galling material and its hole being constructed to accommodate angular movement of said reciprocable member without said hole being large enough to permit extrusion of said ring into said hole, a stamped sheet metal disc having an opening therein through which said reciprocable member extends positioned about said reciprocable member against said ring and having a bent outer peripheral portion which extends over and confines the outer peripheral portion of said non-galling disc shaped member, the opening in said sheet metal disc being constructed to accommodate pivotal movement of said reciprocable member with respect to said non-galling disc shaped member, and means biasing said sheet metal disc toward said surface of said first member, whereby angular movement of the reciprocable member relative to the seal produces a pivotal action with respect to said disc shaped member and lateral movement of said reciprocable member about said non-galling disc shaped member to carry the sheet metal disc laterally therewith and prevent its galling of said reciprocable member.

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