United States Patent

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[45] **Sept. 19, 1972**

[54] FLUID PRESSURE DEVICE

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[52] **U.S. Cl.** **104/155,** 104/95

[51] **Int. Cl.** **B61b 13/12**

[58] **Field of Search** ..... 104/95, 155; 198/184; 267/65 B

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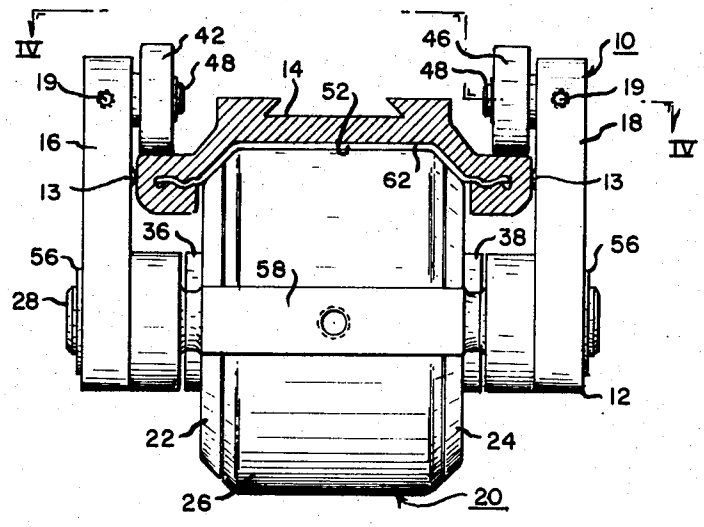
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[57] **ABSTRACT**

A fluid pressure device comprising a carriage and a track, the carriage adapted to ride on and be guided by the track, a fluid pressure-containing membrane and a sealing membrane, each fixedly attached to the track, the fluid pressure membrane enclosing a cavity in the track, pressurizing and exhausting means connected to the track at the cavity to alternately pressurize and exhaust the fluid medium, the carriage having at least two rollers journaled therein, the roller adapted to cooperate with the pressure-containing membrane so as to move along the track in response to the fluid pressure, the sealing membrane effecting a pressure seal between the pressure-containing membrane and the track.

3 Claims, 8 Drawing Figures



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SHEET 1 OF 3

Fig. 1.

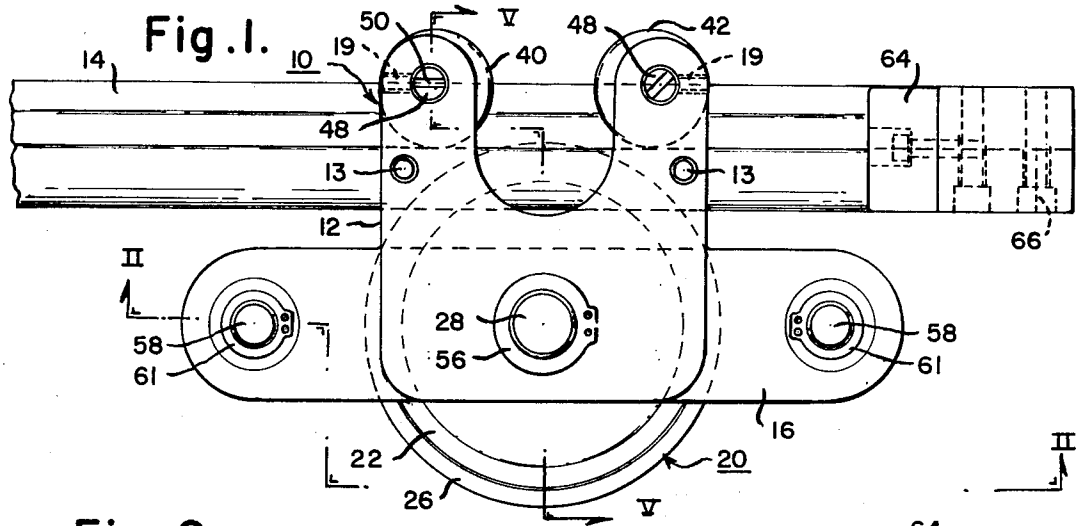
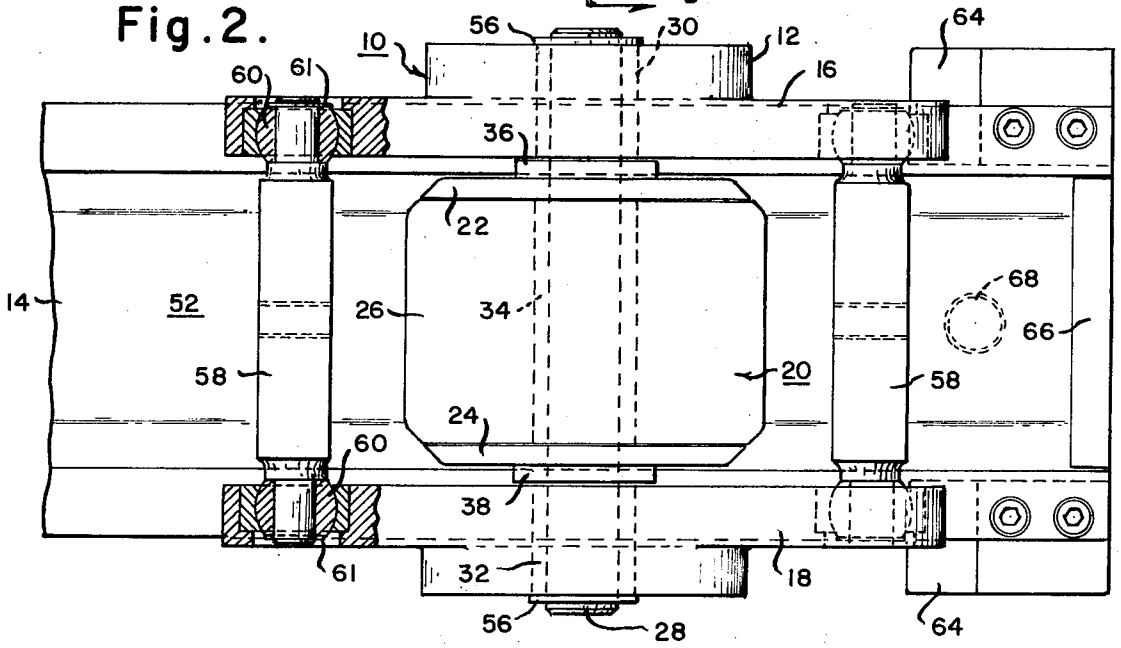


Fig. 2.



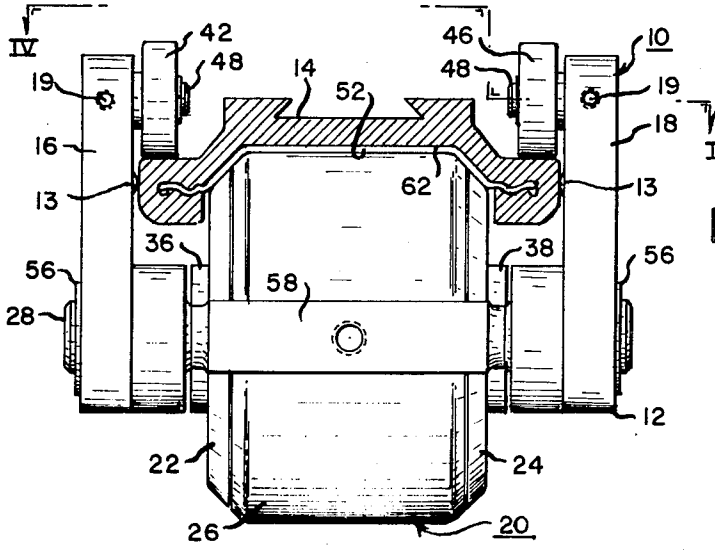


Fig. 3.

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Fig. 4.

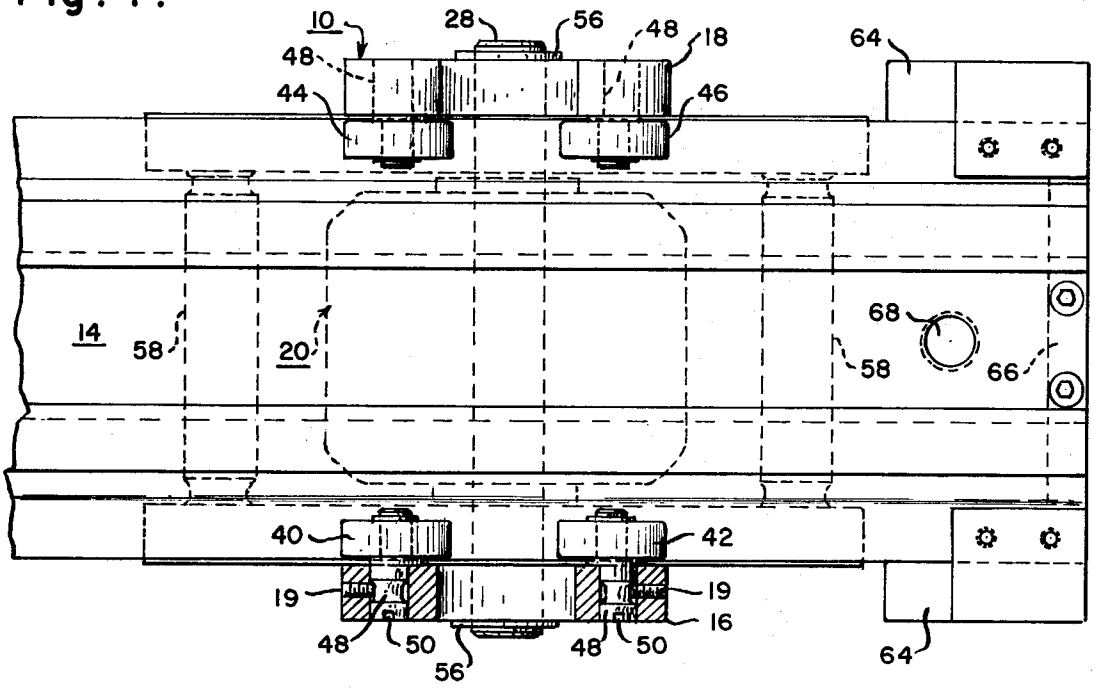
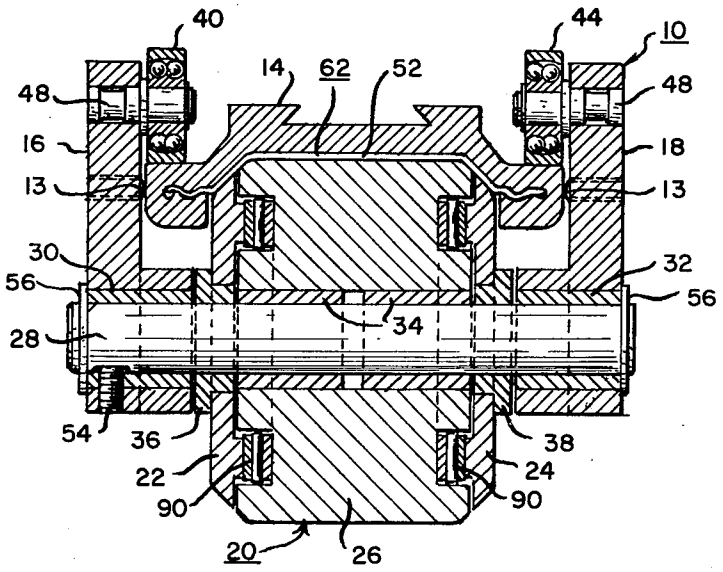


Fig. 5.



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Fig. 6.

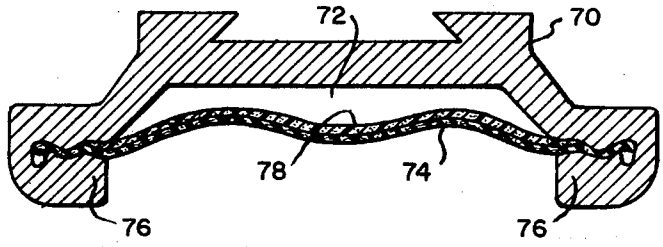


Fig. 7.

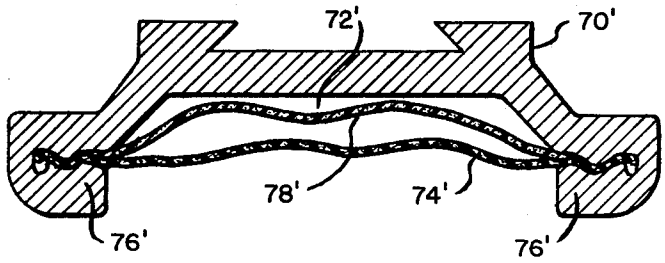
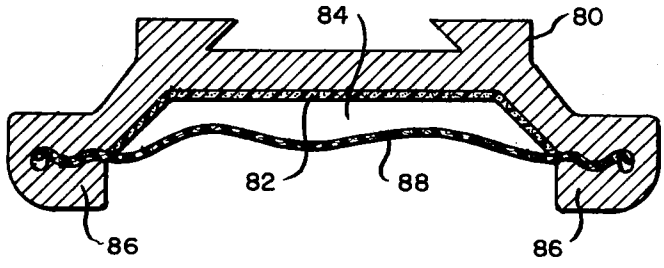


Fig. 8.



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FLUID PRESSURE DEVICE

BACKGROUND OF THE INVENTION

The present invention relates to a fluid pressure device of the type which has a resilient or flexible membrane fixedly secured to a track section and adapted to impart a propelling motion to a carriage which is guided by and rides upon the track. Such fluid pressure devices have been proposed in various forms. However, they have been found to be generally inefficient and incapable of moving large loads from place to place. Historically, the approach has been to utilize a single reinforced membrane or tube as the fluid pressure chamber, which is pressurized for propelling the carriage along a given path or track. While such a membrane is efficient in containing the fluid medium, it has been found that substantial leakage occurs within the fluid pressure chamber from the pressurized side to the exhaust side of the carriage, thereby markedly reducing the efficiency of the overall device.

Further, the carriages which are propelled by the fluid medium have been typically rigid structures which are not particularly adapatable to negotiating track bends and curvatures. Additionally, the carriage was typically provided with a roller which cooperated with the membrane or tube and this roller was normally a single piece. No provision was made for rollers which through their axes encountered different average speeds of rotation, which resulted in the scuffing and accelerated wear of the membrane or tube.

SUMMARY OF THE INVENTION

It is, therefore, a primary object of the present invention to provide a fluid pressure device having a membrane or tube for propelling a carriage along a given path or track which is provided with a sealing membrane which efficiently effects a seal between the pressure-containing membrane and the track. It is another object of the present invention to provide a fluid pressure device in which a carriage is adapted to negotiate severe variations in the track on which it is guided and rides upon by allowing the sides of the carriage to move independently of each other.

It is yet another object of the present invention to provide a fluid pressure device having a carriage adapted to ride on a track and be propelled thereon by a fluid pressure membrane, the carriage having a segmented roller of at least two parts, each part of the roller having different average rates of rotation.

It is still a further object of the present invention to provide a track for a fluid pressure device which is simple and inexpensive to manufacture and a simple and inexpensive carriage which rides on, and is guided by, the track, a multiple-membrane fluid-pressurized tube disposed on the track for propelling the carriage along the track.

These and other objects of the invention, as well as the advantages thereof over the prior art forms, will become apparent from the following detailed description of the attached drawings and are accomplished by means herein described and claimed.

A fluid pressure device embodying the concept of the present invention is adapted to convey an object from one place to another, such as moving an item through a production line, and the like. In general such a fluid pressure device has a carriage and a track, the carriage being adapted to ride on and be guided by the track. The track is provided with a fluid pressure-containing membrane and a sealing membrane, each fixedly attached to the track, and the fluid pressure-containing membrane enclosing the cavity in the track, thereby containing a pressurized fluid medium contained therein. The carriage is further provided with a frame and a roller having at least two parts journaled in the frame. The roller is adapted to cooperate with the pressure-containing membrane to move along the track in response to a fluid-pressurized medium introduced within the cavity at one side of the carriage and exhausted from the cavity at the other side of the carriage, the movement of the carriage on the track being in the direction toward which the fluid-pressurized medium is exhausted. The sealing membrane is disposed in the cavity between the pressure-containing membrane and the track, whereby it effects the pressure seal between the pressure-containing membrane track at and near the point of cooperation of the rollers with the pressure-containing membrane, the frame of the carriage having additional guide rollers rotatably attached to the frame of the carriage. The frame comprises two side plates, one on each side of the segmented roller and attached to each other so that they may each independently follow the contour of the tracks; that is, they enable the carriage to negotiate extreme curvatures and bends of the track on which it is riding. It can be seen that by so articulating the side plates of the carriage that the guide rollers, which are rotatably attached to the side plates, may each independently follow the line of the track.

One preferred embodiment of the present invention is shown by way of example in the accompanying drawings and is described in detail without attempting to show all the various forms and modifications in which the invention might be embodied; the invention being measured by the appended claims and not by the details of the specification.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of the device of the present invention with the carriage assembly located at one end thereof;

FIG. 2 is an elevational view, partly in section, taken along line II—II of FIG. 1;

FIG. 3 is a full elevational view of the device of FIG. 1, taken from the left thereof;

FIG. 4 is a top plan view taken along the line IV—IV of FIG. 3;

FIG. 5 is a vertical sectional view taken along line V—V of FIG. 1;

FIG. 6 is an enlarged sectional view of the track section in accordance with the present invention;

FIG. 7 is an enlarged sectional view of another track section in accordance with the present invention;

FIG. 8 is an enlarged sectional view of yet another track section in accordance with the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring more particularly to FIGS. 1—5, a fluid pressure device embodying the concept of the present invention is indicated generally by numeral 10.

The fluid pressure device **10** comprises a carriage **12** and a track **14**. The carriage **12** is adapted to ride on and be guided by the track **14** and the carriage **12** comprises two side plates **16** and **18**. The fluid pressure device **10** as here depicted has its carriage **12** riding below the track **14**. It is to be understood that the overall operation of the fluid pressure device **10** will be substantially the same, irrespective of the relative position of the track, and this will become apparent from the following discussion.

A segmented roller **20** has at least three parts; two side rollers **22, 24** and a center roller **26**. The rollers **22, 24, 26** are rotatably mounted on a shaft **28**, the shaft **28** being journaled in the side plates by means such as bushings **30, 32**. The center roller further rides on bushings **34** while the side rollers **22, 24** ride on bushings **36, 38**, respectively. Guide rollers **40–42** and **44–46** are rotatably mounted on the side plates **16** and **18**, respectively, and support and guide the carriage **12** on the track **14**. The guide rollers **40–42** and **44–46** are rotatably mounted on the side plates **16** and **18** by means of eccentric shafts **48**, which are attached to the side plates **16** and **18** by means such as set screws **19**. The shafts **48** are provided with keyways or slots **50** in their heads, whereby the shaft can be rotated after the set screws **19** are disengaged by means such as turning a screw driver. It can be seen by turning the shafts **48** the clearance between the guide rollers **40–42, 44–46** and the track **14**, as well as the clearance between the center roller **26** and side rollers **22, 24** with respect to the track **14** (and in particular with respect to the fluid pressure-containing membrane **52**, fixedly disposed in the track in a manner later to be described) may be adjusted to achieve the most overall operating efficiency of the fluid pressure device **10**. The carriage **12** may also be provided with a guide bushing **13** to further insure that side plates **16** and **18** do not rub the track while the carriage is being propelled. The guide bushing may be fixedly attached to the side plates **16** and **18** by means such as a force fit and may also be provided with adjusting means (not shown).

Bushings **30** and **32** are held into place in the side plates **16** and **18** by means such as a press fit. The shaft **28** is fixed into a position by means such as retaining rings **56**, or by a retaining ring **56** at one end and a set screw **54** at the other end. The carriage **12** may have loads attached to it at its load bars **58** for the purpose of conveying the load from one place to another. The load, of course, could be hung from the load bars **58** or supported by a separate carriage (not shown) and the separate carriage may itself be connected to the carriage **12** and ride upon track **14**. The carriage **12** could push or pull the so load-carrying carriage on the track **14**. The load bars **58** are pivotally mounted to the side plates **16** and **18** by means such as spherical bearings **60**, the bearings being fixedly attached to the side plates by means such as a press fit. The load bars **58** are retained within the bearings **60** by means such as retaining rings **61** at one end only.

It can be clearly seen that the side plates **16** and **18** can themselves partially rotate about the shaft **28** and such articulation of the side plates **16** and **18** enables the carriage **12** to negotiate severe bends and curvatures of the track **14** making the fluid pressure device adaptable to environments where many obstructions are encountered. As indicated above, the track **14** is provided with a fluid pressure containing membrane **52**, which is fixedly disposed within the track **14**. The track **14** is provided with a cavity or channel-like portion **62** which generally conforms to the shape of the side rollers **22, 24** and the center roller **26**. The track is further provided with carriage bumpers **64** for cushioning the carriage **12** as it comes to a stop at the end of track **14**. The track is also provided with a sealing block **66** which is provided at the terminal portions of the track **14** to seal the end thereof. Attached to the track at port **68** (other port or ports not shown) is a fluid pressurizing and exhaust means (not shown) with appropriate valving, whereby a pressurized fluid may be introduced into cavity **62** of track **14**. The pressurized fluid medium is contained within the cavity by the fluid pressure-containing membrane **52**, whereby a propelling force is applied to the rollers **22, 24, 26** by the fluid pressure-containing membrane **52** propelling the carriage **12** along the track **14**. The direction of movement of the carriage **12** will be away from the connection to the cavity wherein the fluid-pressurized medium is being introduced and toward the point in the cavity where the fluid-pressurized medium is being, or has been, exhausted. While it has been shown in FIGS. **1–5** that the carriage **12** rides on and is substantially supported by the track **14**, it is to be understood that the fluid pressure device of the present invention is particularly suited to be adapted to apparatus which already has its guide and/or support structure. For example, the fluid pressure device of the present invention may be adapted to actuator valves whose valve stem is already guided and supported within the guide body and all that is required is the selective application of force to that valve stem for the appropriate actuation thereof.

Referring now to FIGS. **6–8**, there is shown several forms of track embodying the present invention. In FIG. **6** there is shown track **70** having fluid pressure-containing membrane **74** fixedly attached to the track **70** as by jaws **76**. A sealing membrane **78** is also fixedly attached to track **70** and bonded to the fluid pressure-containing membrane **74**. The two membranes **72, 74** may be fixedly secured within the track by deforming the jaws **76** in such a manner as to clamp the membranes therein. It is to be noted that fluid pressure-containing membrane **74** protrudes completely into the jaws while the sealing membrane protrudes only slightly therein. By so disposing the fluid pressure-containing membrane **74** and sealing membrane **76** with respect to the jaws, a most efficient securing action is achieved. It has been found that the sealing membrane, which may be made of an adhesive-backed, soft polyurethane foam, such as manufactured by 3M Company, will tend to extrude out and reduce the integrity of the clamping action, if it is disposed entirely within the jaws **76**. While the pressure-containing membrane **74**, which may be a fabric-reinforced elastomer, such as nylon-reinforced neoprene, can be effectively clamped without appreciable extrusion, and, accordingly, the ends of the membrane **74** are disposed entirely within the jaws **76**.

The track **70'** disclosed in FIG. **7** is substantially the same as the track **70** of FIG. **6** except that the sealing membrane **78'** is not bonded to the fluid pressure-con-

taining membrane 74' but is allowed to operate independently therefrom. The membranes 74', 78' are fixedly secured to the track 70' by means of jaws 76' in the same manner as indicated in FIG. 6.

The track 80 shown in FIG. 8 is different from the tracks 70 and 70' of FIGS. 6 and 7 in that the sealing membranes 82 are bonded to the track 80 within the cavity 84 and the sealing membrane 82 does not protrude within the jaws 86. The sides of the fluid pressure-containing membrane 88 are secured in jaws 86 in a manner similar to that shown in FIGS. 6 and 7.

While it is shown in FIGS. 6–8 that the membranes may be secured by deforming the jaws 76, 76' and 86, other means for securing the membranes may be used. For example, the jaws could be separate from the track such that the jaws could be attached to the track by attaching means such as bolts, welding studs, C-clamps, and the like. Further, the membranes could be so disposed within the track that the pressurized medium itself may tend to secure the membranes within the track.

The fluid pressure device 10 is operated by introducing a pressurized fluid medium, such as pressurized air, oil or gas, to the cavity of track 14. The fluid-pressurized medium is contained within the cavity by the fluid pressure-containing membrane 52. By controlling the appropriate valving mechanism (not shown) of the fluid pressurizing and exhausting means, the carriage can be made to travel along the track 14 at a predetermined speed and can be programmed such that the carriage 12 may, during certain portions of travel on track 14, speed up, slow down, stop, etc., according to a predetermined plan. This, of course, makes it highly adaptable to high volume production techniques wherein certain production operations require more time than others and the part being conveyed by the carriage 12 on the track 14 can be so-programmed as to accommodate these variations in production. The fluid-pressurized medium acts on the fluid pressure-containing membrane 52 and the force is accordingly transmitted to the rollers 22, 24, 26. As this force is transmitted to the rollers, the carriage moves along the track 14 and the guide rollers 40–42, 44–46 guide the carriage through its path of travel. As the carriage 12 encounters curves, turns and other variations in the track, the side plates 16 and 18 independently negotiate the track variations, which enable the carriage to move along the track smoothly, thereby avoiding the introduction of any forces which would tend to bind the carriage and, in particular, tend to bind the rotation of the rollers 22, 24, 26. The rollers 22, 24, 26 are each rotatable mounted on the shaft 28 in such a manner that they each may rotate independently. A thrust bearing arrangement 90 may be provided between the side rollers 22, 24 and the center roller 26 to absorb any axial force which would tend to bind the rollers against each other. By so providing such a multiple-part roller, the roller may be shaped in such a way as to accommodate irregular surfaces.

Accordingly, the cavity 62 may be shaped in such a manner that the fluid pressure-containing membrane is not exposed to undue tearing and shearing force when it is made to conform to the shape of the cavity 62 as it is when it is contacted by the rollers 22, 24, 26 of the carriage 12. If the roller was a single piece, severe scuffing and bruising of the fluid pressure-containing membrane 52 would occur. The rollers 22 and 24, which have a shorter radius of rotation and accordingly would tend to rotate faster than the center roller 26, will not scuff or bruise the membrane 52 as the carriage moves on the track. Apart from being able to finely adjust the various tolerances of the carriage 12 with respect to the track 14 which results in extremely effective sealing efficiency, the sealing efficiency is further improved by the provision of a sealing membrane. The sealing membrane, as the name implies, does not contain the fluid pressure medium within the cavity, but insures that the seal between the pressurized side of the track is sealed from the exhaust side of the track. This is achieved by providing the sealing membrane of a low durometer plastic or rubber substance which seals the channel and maintains the seal even when the track 14 is irregularly shaped. The sealing membrane 78 may be bonded, as shown in FIG. 6, to the pressure-containing membrane 74 or, as shown in FIG. 7, the sealing membrane 78' may be disposed within the cavity 72' independent of the fluid pressure-containing membrane 74', or, as shown in FIG. 8, the sealing membrane 78 may be bonded to the track 84.

The various components of the carriage 12 and tracks (70, 70', 86) 14 of the fluid pressure device 10, as well as the various membranes attached thereto, can be made from a wide variety of materials. The carriage 12, for example, could have its side plates made of aluminum or plastic. The membranes 74, 74', 88 may be made from solid neoprene or polyurethane or rubber reinforced with fabric of rayon, nylon, fiberglass, and the like, as for example, duPont "Fairprene" No. 12–003. The sealing membranes 78, 78', 82 may be coated with pressure-sensitive adhesive, which will assist when it is assembled with the track. Sealing membranes 78, 78', 82 may be made of open-cell polyurethane foam of approximately 1/16 inch, as for example, 3M Company "Scotchfoam" No. Y–4526.

Also, rollers 22, 24, 26 may be made from nylon, urethane, and the rollers may be of solid or hollow construction. The load bars 58 may be made of any suitably strong metal, such as steel, and the shaft 28 may be made of steel or aluminum. Rollers 40, 42, 44, 46 may be any suitable commercially available ball bearing, such as the steel ball bearings manufactured by SKF, No. R6B22.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by Letters Patent is:

1. A fluid pressure device comprising a carriage and a track, said carriage adapted to ride on and be guided by the track, a fluid pressure-containing membrane and a sealing membrane, each fixedly attached to the track, the fluid pressure membrane enclosing a cavity in the track, pressurizing and exhausting means connected to the track at the cavity to alternately pressurize and ex-

haust the fluid medium, the carriage having a segmented roller journaled therein, the roller adapted to cooperate with said pressure-containing membrane so as to move along the track in response to the fluid pressure, said sealing membrane effecting a pressure seal between the pressure-containing membrane and the track, said carriage being provided with side plates, a shaft rotatably mounted in said side plates and restrained at its ends to prevent axial movement thereof, said roller being segmented in at least three separate parts and rotatably mounted on said shaft, guiding means on said carriage and adapted to guide the carriage in the track, load-carrying means pivotally attached to said side plates for carrying and conveying loads, said side plates so adapted to move independently of each other, whereby the carriage may move smoothly along irregular shaped portions of said track.

2. A fluid pressure device according to claim 1 wherein said sealing membrane is bonded to said track in said cavity.

3. A fluid pressure device according to claim 1 wherein said sealing membrane is free to move within said cavity independent of said pressure-containing membrane.

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