Nov. 30, 1954 E. R. PRICE 2,695,500

HYDRAULIC VACUUM POWER UNIT

Filed June 18, 1949 2 Sheets-Sheet 1

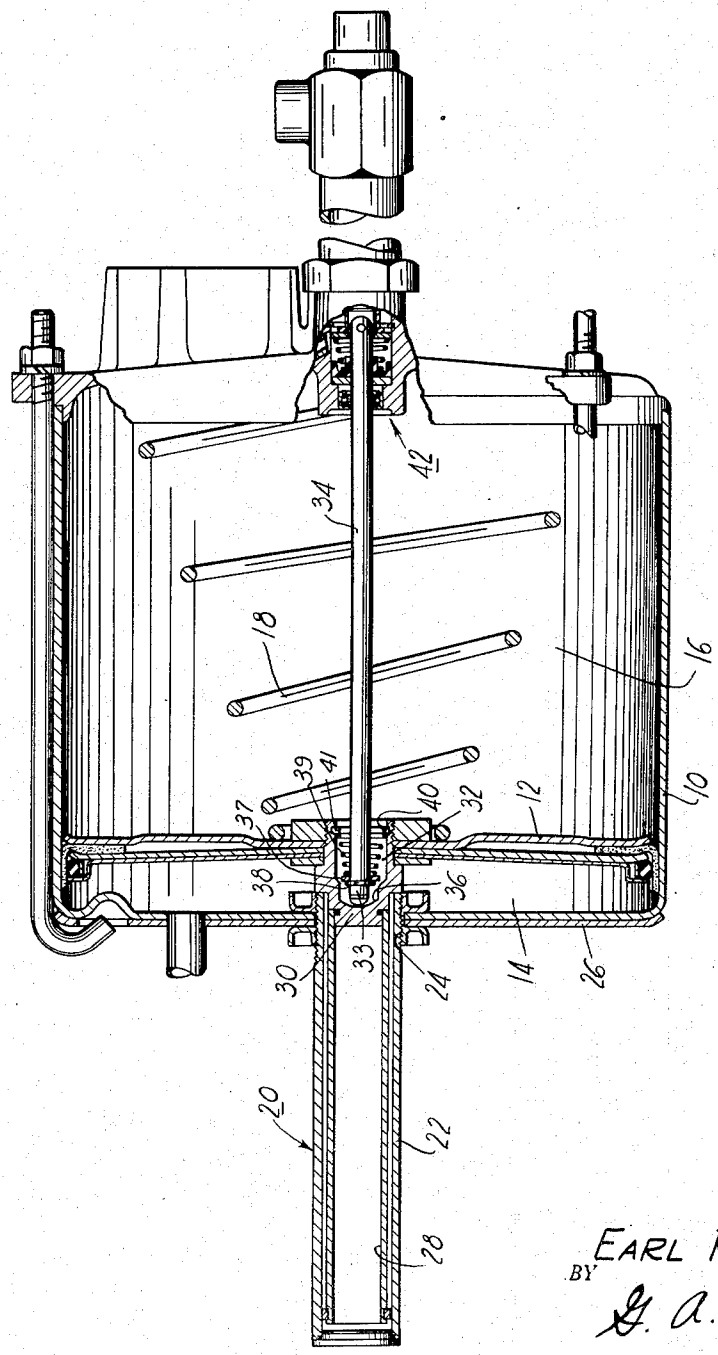


Fig. 1

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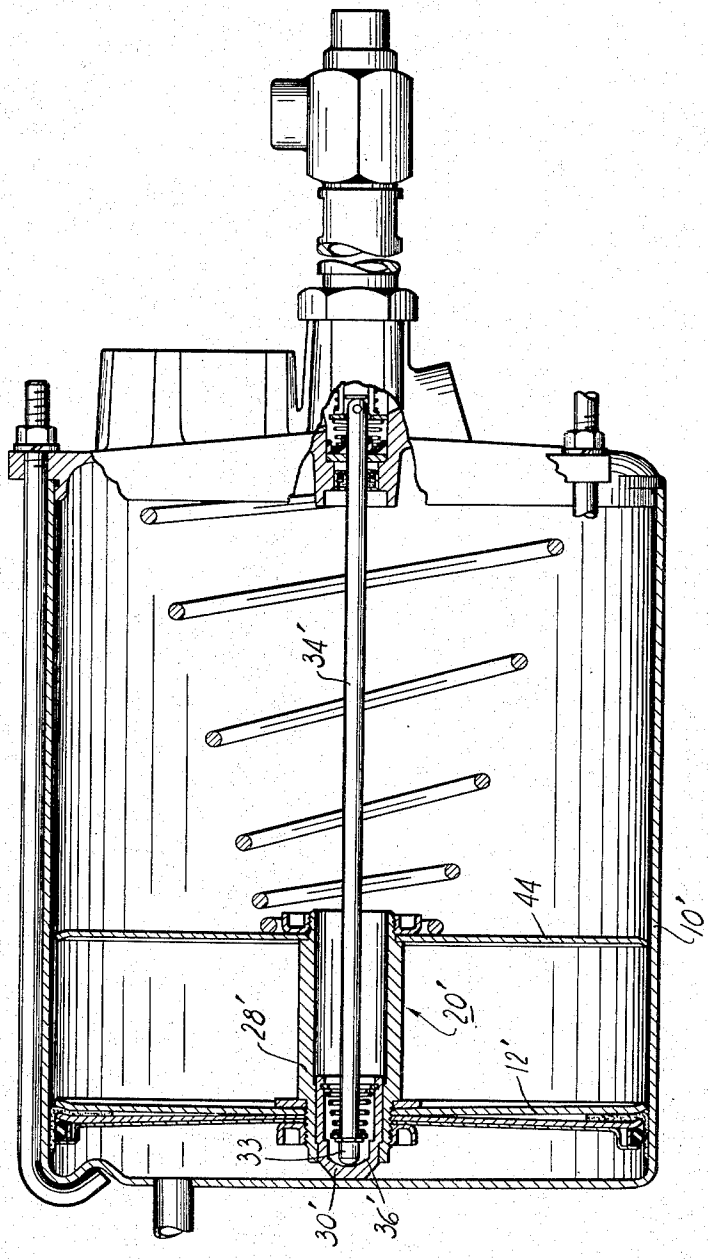


Fig. 2

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HYDRAULIC VACUUM POWER UNIT

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9 Claims. (Cl. 60—54.6)

The present invention relates to an improvement in hydraulic-vacuum power units of the types disclosed in Price Patent No. 2,353,755, Ringer application Serial No. 620,905, filed October 8, 1945, now Patent No. 2,598,604, Price applications Serial No. 581,117, filed March 5, 1945, now Patent No. 2,536,461, and Serial No. 751,283, filed May 29, 1947, now Patent No. 2,654,391.

The primary object of the present invention is to provide a unit similar to the types disclosed in the above identified patents and applications in which the bending tendency on the push rod connected to the power piston is reduced to a minimum or completely eliminated.

It has been found in practice that when the push rod is securely fastened to the power piston, a cocking or tilting of said power piston during the power or return stroke can impose upon the push rod a bending torque which, under certain conditions, will actually bend the rod and cause inoperativeness of the unit as a whole. This bending tendency is obviated in the present invention by guiding or supporting the power piston to prevent it from cocking or tilting during a power stroke.

Another object of the present invention is to provide a fluid servomotor construction whereby the push rod will automatically center itself to compensate for manufacturing tolerances and any slight transverse shifting of either the power piston or the push rod.

Further objects and advantages will become apparent as the description proceeds.

Figure 1 illustrates a partial axial section of an embodiment of the present invention; and

Figure 2 is a similar view of another embodiment thereof.

Referring more particularly to Figure 1 of the drawings, a cylindrical casing **10** houses a fluid pressure responsive member or disc-shaped power piston **12** which defines a fluid tight chamber on each side thereof, such chambers being designated by reference numerals **14** and **16**, respectively. By introducing a pressure differential over piston **12** whereby the fluid pressure in chamber **14** exceeds the pressure in chamber **16**, piston **12** will be urged towards the right, this being the normal direction for actuation movement of the unit. Mechanisms suitable for controlling the pressure differential over piston **12** are well known to the art and are therefore not illustrated nor described. A frusto-conical compression spring **18** biases piston **12** to its off or illustrated position.

In order to hold piston **12** against tilting or cocking, a guiding or supporting assembly generally indicated by reference numeral **20** is provided. In the illustrated version, assembly **20** consists of an elongated cylindrical housing **22** coaxially secured at one of its ends by any suitable means, such as the threaded portion **24**, to the end wall **26** of casing **10**. Telescopically mounted in housing **22** is a guide or piston support member in the form of a solid bar or a tube **28** which is coaxially secured at one of its ends to piston **12**. Tube **28** is illustrated as being suitably secured to piston **12** by means of the centrally located piston hub **30** which is threadedly received in the central portion of piston **12**. This piston support member **28** could obviously be formed integral with either the central portion of piston **12** or the hub **30**. Thus the piston **12** is actually constituted by the disc portion of the piston itself and the elongated guide or support member **28**. Any tendency for piston **12** to cock is prevented by this tube **28**.

Hub **30** is provided with a recessed portion **32** for receiving the rounded end of thrust transmitting member or push rod **34** whose axis is collinear with that of the guide or support assembly **20**. The rear wall **36** of recess **32** is preferably formed with a slight concavity or curvature having a radius substantially equal to the length of the push rod **34**, this curvature being exaggerated in the illustrations for purposes of clarity, for a reason to be explained hereafter. To hold the convex end **33** of push rod **34** against concave wall **36**, a frusto-conical shaped spring **39** surrounds such end to bear against a collar **38** and washer **37** on rod **34** and a retainer ring **40** nested in a peripheral groove **41** in the wall of the recess **32**. Since retainer **40** is secured in groove **41** in recess **32** of hub **30**, and spring **39** is compressed between collar **38** and washer **37** adjacent thereto on rod **34**, the convex end of rod **34** is urged into contact with the concave wall **36** of recess **32**. Furthermore, inasmuch as the rod is of a diameter smaller than recess **32**, lateral sliding contact is permitted between the rod end and recess limited only by the width of said recess. The other end of push rod **34** is connected to the hydraulic piston assembly generally indicated by reference numeral **42**.

In operation, as explained previously, a pressure differential over piston **12** wherein the pressure in chamber **14** exceeds that in chamber **16**, piston **12** will be moved towards the right thereby pushing rod **34** against whatever reaction might be present on the piston assembly **42**. The curvature of the wall in recess **32** permits the mating end **33** of rod **34** to move along the wall surface until the rod becomes centered. It is readily apparent that the support member **28** which is shown as screwed into hub **30**, is in effect integral with piston **12**, and maintains piston **12**, through housing **22**, in a fixed reciprocable relationship with respect to housing **10** of the power unit. Thus if the casing **10** and the piston **12** or any of the other parts are out of concentricity, the rod **34** will find its own center through the previously mentioned flexible sliding connection with respect to hub **30** which is a part of piston **12** and will take, under operation, only nonbending compressive forces.

In Figure 2 is illustrated another embodiment of the present invention, like parts carrying the same reference numerals with prime marks, in which the guide construction **20'** is disposed oppositely to that of Figure 1. In this embodiment, a support tube **28'** is coaxially secured to piston **12'** on one end and is similarly secured to a guide disc **44**, which lies in a plane parallel to piston **12'**, on its other end. Suitably coaxially secured to the interior of tube **28'** is a socket member **30'** constructed similarly to that of hub **30** in Figure 1. Here, as in Figure 1, the tube **28'** may be formed integrally with the central portion of piston **12'** or hub **30'**.

Any tendency of piston **12'** to cock or tilt is prevented by the engagement of disc **44** with the wall of casing **10'**, and any eccentricity of the power cylinder parts will be compensated for by the sliding movement of the push rod **34'** on the curved end wall **36'** of socket member **30'**.

Although only two embodiments of the invention have been illustrated and described, various changes in the form and relative arrangements of the parts may be made to suit requirements.

I claim:

1. In a fluid-operated power cylinder, a disc-shaped piston having a hub centrally secured thereto, an elongated tubular member coaxially secured to said hub, a stationary supporting cylinder telescopically receiving and being axially coextensive with said tubular member when said piston is in retracted position, the end of said tubular member being continuously inside said supporting cylinder for the entire protractile stroke of said piston, said hub being formed with an axial recess on its side opposite said tubular member, the end wall of said recess being formed with a concave surface, a push rod collinearly disposed with respect to said tubular member having one end in contact with said concave surface, said end of said rod being formed with a curved end surface, a spring retainer on said rod near said curved end within said recess, a second spring retainer on the interior of said recess near the mouth thereof,

and a frusto-conical compression spring surrounding said push rod and compressed between said spring retainers to urge the curved end of said rod against said concave surface and to coaxially center said rod with respect to said piston.

2. In a fluid-operated power cylinder, a reciprocable disc-shaped piston having a hub secured thereto, an elongated tubular member coaxially secured to said hub, a stationary supporting cylinder telescopically fitted over said tubular member, the end of said tubular member opposite said piston fitting within said supporting cylinder for the entire reciprocal stroke of said piston, said hub being formed with an axial recess on its side opposite said tubular member, the end wall of said recess being formed with a spherical surface, a push rod collinearly disposed with respect to said tubular member having one end in contact with said spherical surface, a spring retainer on said rod near said end within said recess, a second spring retainer on the interior of said recess near the mouth thereof, and a frusto-conical compression spring surrounding said push rod and compressed between said spring retainers to urge said end of said rod against said spherical surface and to center said rod with respect to said piston.

3. In a fluid-operated power cylinder, a fluid pressure responsive member, a support member coaxially secured to said pressure responsive member, a stationary guide member cooperatively associated with said support member to allow only axial movement thereof, a recess including a curved surface centrally located on said pressure responsive member on the side opposite said support member, a thrust transmitting member having its axis substantially coincident with that of said pressure responsive member and having one end curved and in lateral sliding engagement with said curved surface of said recess, said thrust transmitting member being proportioned with respect to said recess so that the thrust member in said recess has substantial lateral movement therein to compensate for axial misalignment of the reciprocable parts in said fluid-operated power cylinder, and a compression spring surrounding said pressure transmitting member to urge it into engagement with said curved surface and into line with the axis of said fluid responsive member.

4. In a fluid-operated power cylinder, a fluid pressure responsive member, a support member coaxially secured to said fluid responsive member, a stationary guide member cooperatively associated with said support member to allow only axial movement thereof, a concave surface centrally located in a recess on said fluid responsive member on the side opposite said support member, a thrust transmitting member having its axis substantially coincident with that of said fluid responsive member and having one convex end in lateral sliding engagement with said concave surface of said recess, said thrust transmitting member being of a substantially smaller width than that of said recess, said thrust member being operable to move laterally within said recess to compensate for axial misalignment of the parts of the fluid-operated power cylinder, and means engaged between said pressure responsive member and thrust member yieldably urging said thrust transmitting member into its aforementioned axial position and into engagement with said concave surface.

5. In a fluid-operated power cylinder, a fluid pressure responsive member, a support member coaxially secured to said fluid responsive member, a stationary guide member cooperatively associated with said support member to allow only axial movement thereof, a thrust surface centrally located in a recess on said fluid responsive member on the side opposite said support member, a pressure transmitting member having its axis substantially coincident with that of said fluid responsive member and having one end in lateral sliding engagement with said thrust surface, of said recess, said thrust transmitting member being proportioned with respect to said recess and operable to move laterally therein, permitting compensation for axial misalignment of the fluid pressure responsive member and the pressure transmitting member, and means engaged between the fluid pressure responsive member and the thrust transmitting member yieldably urging said pressure transmitting member into its aforementioned axial position.

6. In a fluid-operated power cylinder, a disc-shaped piston responsive to differential fluid pressure, a tubular member coaxially secured to said piston at one end and movable with the piston to allow only axial movement thereof, a disc-shaped guide member lying in a plane parallel to the plane of said piston and coaxially secured to the other end of said tubular member, the periphery of said guide member slidably engaging the interior of the power cylinder, a concave wall formed in the end of said tubular member adjacent said piston, a push rod extending into said tubular member and having its axis substantially coincident with the axis of said tubular member, one end of said rod being convex to conform with the concave wall and being in lateral sliding engagement with said wall, said rod being proportioned with respect to said concave wall permitting substantial lateral movement in said tubular member and resilient means between said tubular members and said rod urging said one end of said rod into engagement with said wall and said rod into the aforementioned axial coincidence.

7. In a fluid-operated power cylinder, a substantially flat disk-shaped piston adapted to reciprocate in the power cylinder, a hub rigidly supported in the central portion of said piston and having a cylindrical recess formed on an axis substantially coincident with the axis of said piston, an elongated tubular member coaxially and rigidly secured with respect to the cylindrical recess of said hub, a guide means surrounding the end of said tubular member opposite the piston throughout the entire piston stroke to allow substantially only translatory axial movement of said tubular member and said piston, a concave surface formed in the end wall of the hub recess, the center of curvature of which lies substantially on the axis of said piston, a push rod collinearly disposed with respect to the axis of said piston and having one end in sliding contact with said concave surface, said end of said rod being rounded and having a radius which will permit sliding contact with said concave surface, a spring retainer on said rod near said rounded end and within said recess, a second spring retainer carried in the hub recess near the mouth thereof, and a compression spring surrounding said push rod and being compressed between said spring retainers to urge the corresponding end of said rod into contact with said concave surface and to maintain said rod substantially axially centered, with respect to said piston, on said concave surface, the aforementioned sliding contact permitting slight shifting movement of said push rod with respect to said piston during movement of the latter to reduce the bending tendency imposed on said rod caused by slight eccentricities between the piston and rod.

8. In a fluid-operated power cylinder, a substantially flat disk-shaped piston adapted to reciprocate in the power cylinder, a hub rigidly supported in the central portion of said piston and having a recess formed therein, an elongated tubular member coaxially and rigidly secured with respect to the recess of said hub, a guide means telescopically associated with said tubular member to allow substantially only translatory axial movement of said tubular member and said piston, said guide means surrounding the end of said tubular member opposite said piston throughout the entire piston stroke, a concave surface formed in the end wall of the hub recess, the center of curvature of which lies substantially on the axis of said piston, a push rod collinearly disposed with respect to the axis of said piston and having one end in sliding contact with said concave surface, said end of said rod being rounded and having a radius which will permit sliding contact with said concave surface, a spring retainer on said rod near said rounded end, a second spring retainer carried in the hub recess near the mouth thereof, and a compression spring surrounding said push rod and being compressed between said spring retainers to urge the corresponding end of said rod into contact with said concave surface and to maintain said rod substantially axially centered, with respect to said piston, on said concave surface, the aforementioned sliding contact permitting slight shifting movement of said push rod with respect to said piston during movement of the latter to reduce the bending tendency imposed on said rod caused by slight eccentricities between the piston and rod.

9. In a fluid-operated power cylinder, a piston adapted to reciprocate in the power cylinder and having a concave surface formed in a recess in the central portion thereof with the center of curvature lying substantially on the axis of said piston, a push rod operatively connected to said piston and having an axis extending sub-

stantially coincident with that of said piston, one end of said rod being convex and being in lateral sliding engagement with said concave surface, said rod having a diameter which is substantially smaller than the recess which will permit the aforementioned sliding engagement, a spring retainer on said rod near said convex end, a second spring retainer rigidly supported with respect to said piston and being axially spaced from said first retainer, and a compression spring surrounding said push rod and being compressed between said spring retainers to urge the corresponding end of said rod into contact with said concave surface and to maintain said rod substantially axially centered with respect to said piston on said concave surface, the aforementioned sliding contact permitting lateral shifting movement of said push rod with respect to said piston during movement of the latter to reduce the bending tendency imposed on said rod caused by slight eccentricities between the piston and rod, and a support member coaxially secured to said piston and a stationary guide member cooperatively associated with said support member to allow only axial movement of said piston, whereby the lateral shifting movement of said rod compensates for axial misalignment of said piston and rod upon actuation of the power piston.

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