United States Patent

[11] 3,545,340

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[54] **AXIAL PISTON UNIT**
7 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **92/57,** 103/162
[51] **Int. Cl.** **F01b 13/04,** F04b 1/02
[50] **Field of Search** ..... 92/55, 57, 58, 56; 103/162, 162(A), 162(B), 162(P), (Inquired), 41.7; 151/14.5(Inquired)

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ABSTRACT: An axial piston unit of the type having an inclined axis, comprising a support body means and a pivotal head means. A pivotal body means including pivot pin means serves to mount the pivotal body means by means of such pivot pin means at the aforesaid pivotal head means, said pivotal body means being pivotable relative to said support body means. Means serve for detachably connecting the pivotal head means with the support body means through the provision of a frictional contact connection.

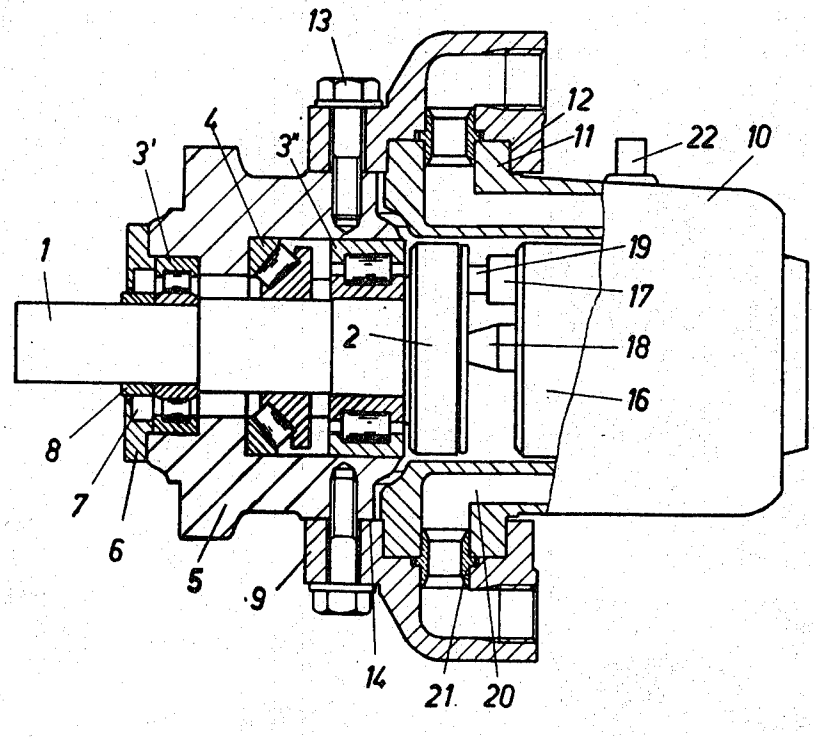

Fig.1

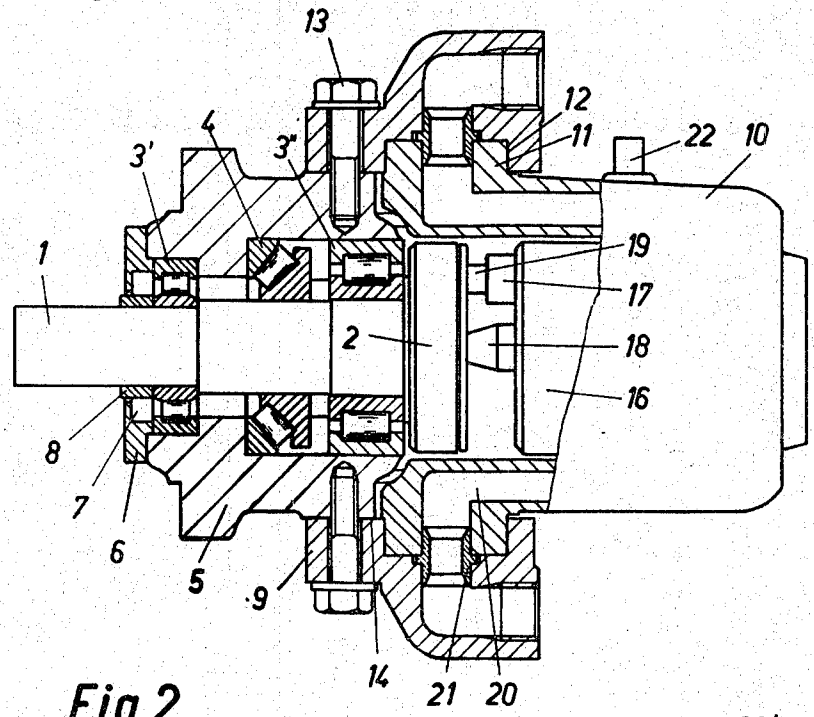

Fig.2

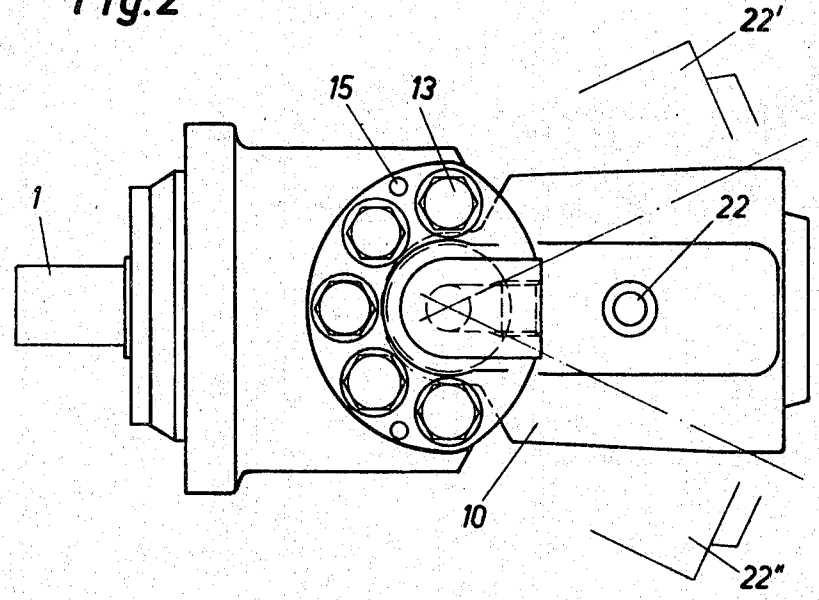

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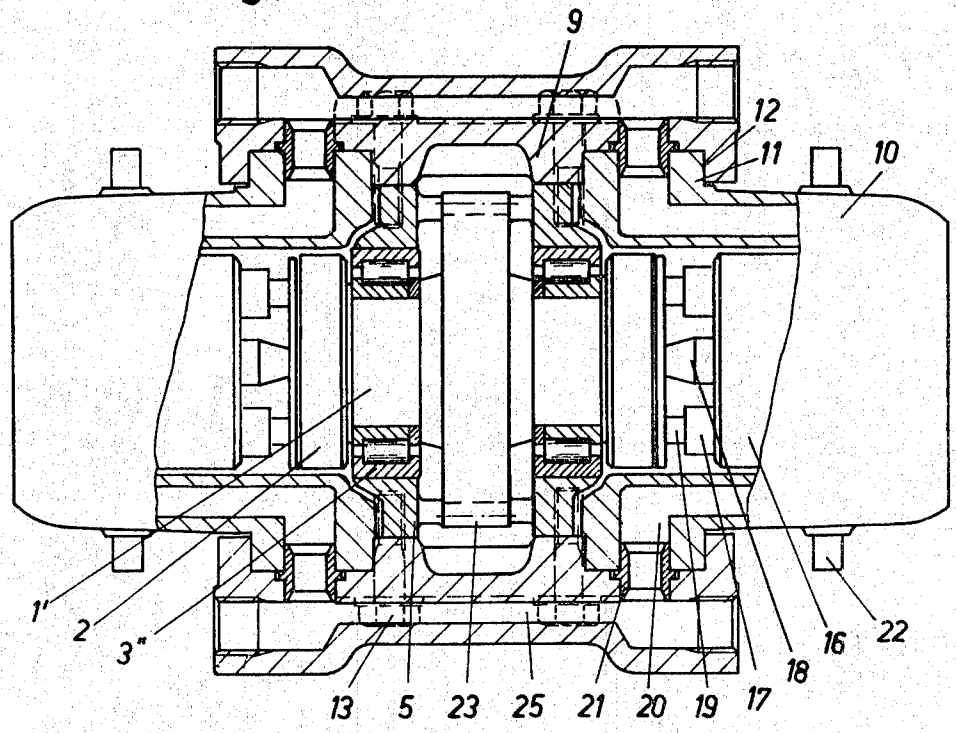
Fig.3



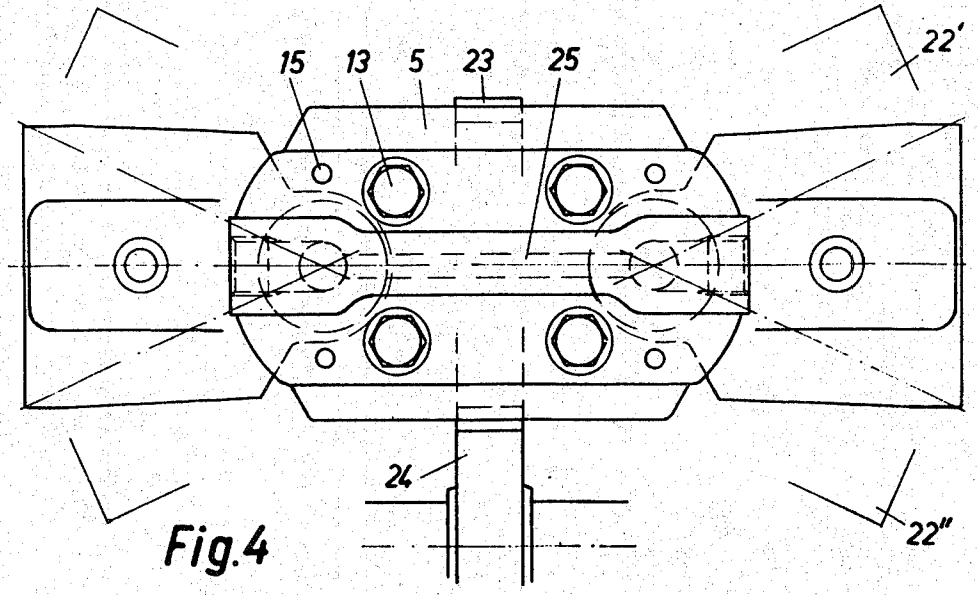


Fig.4

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AXIAL PISTON UNIT

BACKGROUND OF THE INVENTION

The present invention relates to a new and improved axial piston unit. These units are employed in larger numbers nowadays in the hydraulic oil art as pumps and motors, also as adjustable units as well as constant or invariable units, above all mainly in two constructional embodiments, namely as a unit where the axis is at an inclination and also as a unit where the plate is at an inclination.

With these pivotal units of the type where where the axis is at an inclination, when there is undertaken an adjustment of the stroke the axis of the cylinder block is inclined with respect to the axis of the drive shaft and the drive flange or plate which is rigidly connected thereto. The stroke is therefore proportional to the inclined position of the cylinder axis with respect to the axis of the drive shaft. With a zero stroke the inclined position is also zero, in other words, both axes coincide.

It is a characteristic or feature of axial piston units which are used as hydraulic pumps or hydraulic motors that they produce an axial force by virtue of the pressure prevailing in the bores of the cylinder, and such force must be taken up or absorbed in a suitable manner. In the case of the so-called constant units this function is assumed by the housing. In the case of the pivotal units of the type wherein the axis is at an inclination, this function is also assigned to the housing, yet there must be ensured for the degree of pivoting of the cylinder. It was therefore apparent to those versed in the art to provide the pivotal body member, which accommodates the cylinder with the pistons and the control plate, with cylindrical pivot pins which permit a pivotal motion about an axis at the entrainment plane of the drive plate or flange. The infeed and outfeed of the driving medium takes place via the aforementioned pivot pins which, for this purpose, have been bored hollow and via a rotary packing box lead to the stationary housing portion.

The drive shaft with the drive plate or flange is mounted in a stationary housing which is generally designated as a support or bearing body. This housing, in addition to absorbing the radial forces, also takes up axial forces. The drive shaft is generally mounted by means of two radial bearings and an axial bearing in the support body. The connection between the pivotal body and the support body generally takes place via two straps or brackets which are threaded to the support body and a respective bore for receiving one of the cylindrical pivot pins of the pivotal body. Pivot heads are screwed to these brackets and sealing sleeves or bushings are mounted in such pivot heads which also possess conduit portions, such as elbows or pipe studs or connections at which there can be attached the connection conduits.

The connection of the brackets with the support body takes place by means of screws and fitting pins. On account of the larger axial forces, which for instance with a seven-piston unit having a piston diameter of 25 millimeters and an operating pressure of 200 atmospheres absolute and with four loaded pistons, amounts to about 4 tons, these fitting pins are greatly loaded. Thus, these fitting pins together with the corresponding bores are plastically deformed owing to the concentration of stresses which occurs at the parting or separating surfaces. Since, additionally, there occur so-called spreading forces on account of the pressure in the infeed and delivery components, a this connection lacks any sufficient rigidity and therefore, is only usable for very small pressures.

In the case of higher operating pressures, a physical construction is employed in which both of the brackets or straps form a single piece together with the support body. Consequently, there is indeed eliminated the highly loaded screw and fitting pin-connections, but for the purpose of introducing the pivot pins of the pivotal body in the bracket portions of the support body, there must be provided a milled slot or recess corresponding to the width of the diameter of a pivot pin. This milled portion or slot is bridged by the support ring for the pivot pins which is laterally introduced into the bracket portions.

Furthermore, this milled slot or recess at the highly loaded bracket portions results in a weakening thereof and since such, owing to the conditions determining the available space, which are limited by the space requirements for the adjustment brackets, cannot be constructed to possess any unlimited thickness, there exists a limitation upon the maximum permissible operating pressure.

With these embodiments the pivot head is secured to the bracket portion and has the function of forming a suitable connection for the conduit means which are to be connected. A great many of such axial piston units have been developed, but all rely upon a bracket construction with a separate pivot head, and therefore, must be content with the aforementioned drawbacks.

SUMMARY OF THE INVENTION

Accordingly, it is a primary object of the present invention to provide an improved axial piston unit which over comes the aforementioned drawbacks of the prior art structures.

Another, more specific object of the present invention relates to an improved axial piston unit which can be effectively employed as a hydraulic pump or a hydraulic motor, and which is relatively simple in construction, quite economical to manufacture, highly reliable in operation, and not readily subject to breakdown.

Now, in order to implement these and still further objects of the present invention, and to specifically overcome the aforementioned drawbacks noted above, the inventive construction is generally characterized by the features that the pivot head accommodates the support means for the pivot pins and such is detachably connected with the support body by a frictional contact connection.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood, and objects other than than those set forth above, will become apparent, when consideration is given to the following detailed description thereof. Such description makes reference to the annexed drawings wherein:

FIG. 1 is an elevational view, partly in section, of a preferred embodiment of a pivotal type of axial piston unit;

FIG. 2 is a top plan view of the unit shown in FIG. 1;

FIG. 3 is an elevational view, partially in section, of a twin or double an axial piston unit; and

FIG. 4 is a top plan view of the double axial piston unit depicted in FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Describing now the drawings, in FIGS. 1 and 2, reference numeral 1 designates the drive shaft, and reference numeral 2 the drive plate or flange which is rigidly connected with the drive shaft 1 or formed of one piece together with such shaft. The drive shaft 1 as well as the drive plate 2 are mounted at a support or bearing body member 5 by means of both of the radial bearing 3'and 3'' and the axial bearing 4, here constructed and illustrated as an inclined roller bearing, by way of example. The support body 5 is sealed towards the outside by means of the cover member 6, the sealing means 7, for instance in the form of a lip-sealing arrangement not shown in greater detail, and the traveling ring 8 for such lip-sealing arrangement.

The pivot head 9, in which the pivotal body member 10 with its pivot pins or trunnion means 11 is mounted in a slide or sleeve bearing means 12 which has not been illustrated in greater detail, is threadably connected by means of the screws 13 or the like with the support body 5 in such a way that the frictional force at the contact or connection surface means 14 is greater than the effective axial force. As a result, the screw members 13 and the fitting pins 15 provided for positional fixing are not subjected to shear forces.

AT the pivotal body 10, the cylinder 16 provided with the piston members 17 is mounted at the guide rod 18. The pistons 17 together with the piston rods 19 and the guide rod 18 are articulated by means of suitable ball and socket joints to the drive plate of flange 2. The conduits 20 provided at the pivotal body member 10 and which serve for the infeed and outfeed of the operating medium lead via the sealing sleeve members 21 into the pivotable head member 9, from which location the further conveying of the operating medium takes place through the agency of nonillustrated conduits. The adjustment of the pivotal body member 10 occurs at the adjustment pins 22 until reaching the momentary terminal positions 22' and 22''.

In FIGS. 3 and 4 there is depicted the application of the teachings of the invention for a so-called double or twin axial piston unit. In this construction both of the drive shafts are combined into a single drive shaft 1', at both sides of which there is provided a drive plate or flange 2. In order that both of the radial bearings 3'' can be mounted, the fixed connection between the drive shaft 1' and the drive plate or flange 2 must be detachable. The drive or power takeoff, as the case may be, takes place via a gear 23 which meshes with a gear 24.

Since the axial forces of both units are directed towards one another and because the balancing of pressure which occurs via the channel 25 is of the same magnitude, it is possible to dispense with the axial bearings.

In this embodiment, the pivot body members 10 are of the same construction as in FIGS. 1 and 2, as well as the components which are mounted therein, such as the cylinders 16, the piston members 17, the piston rods 19, the guide rods 18 and the channels 20 for the infeed and outfeed or delivery of the operating medium. In this case there is similarly provided the mounting of the pivot pins 11 in the slide or sleeve bearing means 12 of the associated pivot head 9. The pivot heads 9 are constructed as double heads which are threadably connected to the support body 5 by means of the screws 13 or equivalent structure and at each end receive a pivot pin means 11. For the purpose of sealing the channels 20 with respect to the channels located in the pivot head 9 there is provided the sealing sleeve means 21. The channel 25 which serves for balancing the pressure of both units can also be enlarged in order to lead the channels 20 together and then to connect them via a single pipe stud or flange to the further conduits. It is not necessary to take into consideration the axial forces in order to secure a pivot head 9 at the support body 5, since such axial forces are absorbed by the pivot head 9. The screws 13 and the fitting pins 15, in this case, serve for the mutual positional fixing and stiffening of the support body 5. The adjustment of the pivot or pivotal body 10 takes place at the adjustment pins 22 until reaching the terminal positions 22' and 22''.

The advantage of the invention with respect to the known axial piston units resides in the fact that the pivot head is connected with frictional contact with the support body, which approaches a construction formed of one piece. Additionally, the combining of the bracket constructions with the pivot head into a single body results in a simplification of the mounting of the unit in a manner which was not heretofore known since the pivot head can be completely removed. Furthermore, owing to the absence of the separation or partition surfaces the pivot head can be constructed to be much stronger, for which reason larger operating pressures can be employed. The pivot head additionally will be recognized as defining a combined pivot pin or trunnion accommodating and supporting head means wherein the pivot pin accommodating recess means thereof provide bearing seating means for the pins.

Moreover, the pivot head, which in contrast to the previous constructions not only serves for the conveying of the operating medium in a suitable direction but rather also for transmitting or absorbing the flow of forces, also exhibits sufficiently large wall thicknesses which enable the provision of further channels, similar to the equilibrium or balancing channel 25 shown in FIGS. 3 and 4, for instance for the purpose of lubricating the bearings and the gears or for control and regulation purposes.

In order that the threaded connection which produces the frictional contact need not be constructed too bulky or heavy, it is possible to advantageously employ means for increasing the coefficient of friction at the partition surfaces, for instance single and dual component adhesives.

It should be apparent from the foregoing detailed description, that the objects set forth at the outset to the specification have been successfully achieved.

1. An axial piston unit of the type having an inclined axis, comprising a support body means, a pivotal body means, pivot pin means rigid with said pivotal body means for mounting said pivotal body means to tilt relative to said support body means, combined pivot pin accommodating and supporting head means having pivot pin accommodating recess means therein providing bearing seat means for said pivot pin means and a supporting surface area facing said support body means, said support body means having a supporting surface area facing said last mentioned supporting surface area, and means for detachably connecting said supporting head means with said support body means through the provision of a frictional contact connection between said supporting surface areas.

We claim:

2. An axial piston unit as defined in claim 1, wherein said pivotal head means is provided with channel means for the inflow and outflow of an operating medium, and further channel means branching off from the first mentioned channel means.

3. An axial piston unit as defined in claim 1 and means for increasing the coefficient of friction between said supporting surface areas.

4. An axial piston unit as defined in claim 3, wherein said means for increasing the coefficient of friction comprises an adhesive material.

5. An axial piston unit as defined in claim 4, wherein said adhesive material is selected from the group comprising single and dual component adhesives.

6. An axial piston unit as defined in claim 1, further including a common drive shaft means, said pivotal body means comprising two pivotal body members operable by said common drive shaft means, said pivotal head means being common to said two pivotal body members, said two pivotal body members each being provided with two oppositely situated pivot pin means which are mounted in said common pivotal head means.

7. An axial piston unit of the type having an inclined axis, comprising a support body means, a pivotal means, trunnion means extending outwardly of said pivotal means, said trunnion means being rigid with said pivotal means and constituting an axis about which said pivotal means can tilt relative to said support body means, combined trunnion accommodating and supporting head means having trunnion accommodating recess means providing bearing seat means for rotatably receiving said trunnion means, said combined trunnion accommodating and supporting head means having bore means therethrough and a contacting surface area surrounding said bore means and facing said support body means, said support body means having threaded bore means therein and a contacting surface area surrounding said threaded bore means and facing said first mentioned surface area, an adhesive material between said surface areas and headed screw means releasably accommodated in said bore means and threaded bore means so as to provide a releasable connection between said combined trunnion accommodating and supporting head means and said support body means and said adhesive material strengthening said connection so as to minimize adverse bending moments and shear forces on said headed screw means.