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HYDRAULIC POWER TRANSMISSION UNIT

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FIG. 2.

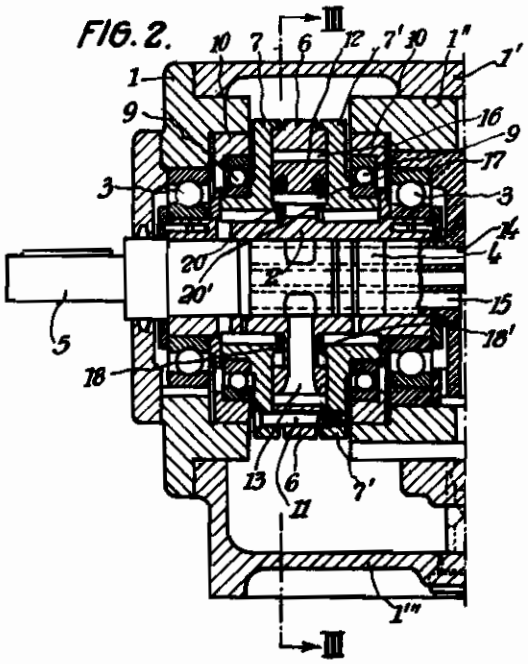


FIG. 1.

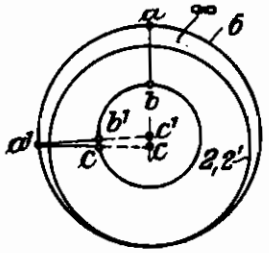


FIG. 4.

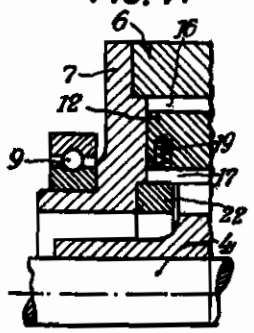


FIG. 3.

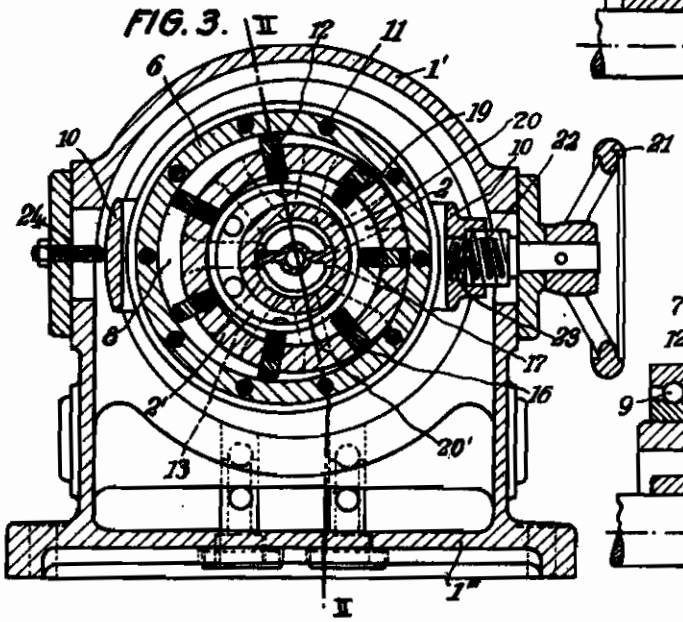
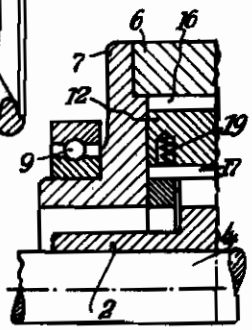


FIG. 5.



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ALIEN PROPERTY CUSTODIAN

HYDRAULIC POWER TRANSMISSION UNIT

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vested in the Alien Property Custodian

Application filed November 7, 1938

My invention relates to hydraulic power transmission units, including pump and motor units, and more particularly to units of that type in which a piston drum equipped with vanes is surrounded by a housing, and the housing is arranged to rotate freely, for the purpose of reducing the hydraulic losses, and to be adjusted eccentrically with respect to the drum, for the purpose of gradual velocity regulation.

It has been found that in units of this type the fit of the outer edges of the vanes against the inner wall of the housing is not uniform throughout the circular movement of the vanes through the housing. From the apex, i. e., the point where the extension of the eccentricity between the drum and the housing intersects the inner wall of the housing, the fit becomes gradually poorer and at 90 degs. from the apex there is a gap between the outer edge of each vane and the inner wall of the housing. The gaps at the individual vanes are qulte small but they produce losses which must be avoided under all conditions. The difficulty of obtaining a proper fit is particularly serious under the up-to-date exigencies of high speed and high hydraulic pressures, in conjunction with the requirements of exchangeability of parts, and of low manufacturing cost. The present methods of making the vanes, and of guiding them, do not constitute satisfactory solutions of the problem.

I have found—and this had not been recognized before—that the problem must be solved by the combination of several features, part of which are old in this art.

To this end, I provide, in combination with the drum and the housing, as described, and annular supporting means, or spigots, in the housing, for the inner edges of the vanes to abut against, a strip arranged to turn in the outer edge of each vane and having a surface adapted to slide on, and to make a tight fit with, the inner wall of the housing, and a similar strip in the inner end of each vane, having a surface adapted to slide on the annular supporting means, or spigots. Not less than one spring for each vane is abutted against the strip in the inner edge of the vane with one end, so as to force the strip in the outer edge of the vane against the inner wall of the housing with its other end.

The strips in the inner and outer edges of each vane are segmental in cross-section, and, since they are free to turn in their seats in the vane edges, the faces of the strips in the outer edge are always in contact with the inner wall of the housing, whatever may be the angular position of the corresponding vane, and so gap loss and back pressure against the vanes are eliminated.

The segmental strips are one of the features of my invention. Another feature is the—not less than one—spring for each vane which holds the corresponding strip in its outer edge against the inner wall of the housing and effects a perfect seal in all positions of the vane. A third and very important feature of my combination is the rotary housing which revolves with the vanes. It has been found that with fixed housings the wear of the housing and the vanes is excessive while with a rotary housing the relative movement of the vanes and the housing is very small and there is practically no wear between the parts in contact. The distance for which the vane springs are expanded or compressed, is also very small with this arrangement, and so the springs are not subjected to fatigue and failure.

To facilitate the building-in of the vanes, I preferably arrange in the housing an annular abutment, preferably a pair of rings adjacent the inner sides of the circular supporting means, or spigots, having an outside diameter which is substantially equal to the outside diameter of the supporting means, or spigots. This annular abutment forces the strips in the inner edges of the vanes to the outer side so far that the end plates of the housing, with their spigots, can be inserted without difficulty.

I may also dispense with the annular abutment, or spigots, altogether, and place the annular abutment, or rings, partly into recesses in the inner faces of the side plates, so that the strips in the inner ends of the vanes bear on their exposed portions, or I may place the rings flat against the plane inner faces of the side plates with their outer sides.

In the accompanying drawing, a pump unit embodying my invention is illustrated by way of example.

In the drawing

Fig. 1 is a diagram showing the drum and the housing of the unit.

Fig. 2 is a section of the unit on the line II—II in Fig. 3.

Fig. 3 is a section on the line III—III in Fig. 2.

Figs. 4 and 5 are part sections on the plane of the line II—II in Fig. 3, drawn to a larger scale and showing, respectively, a ring inserted in, and placed flat against, one of the housing's end plates.

Referring now to the drawing, and first to Figs. 2 and 3, the casing of the pump unit com-

prises a pair of end plates 1 and 1'', a barrel 1', and a base or sump 1'''. The motor unit, not shown, is arranged at the right-hand side of the dot-and-dash line in Fig. 2. A drum which comprises a sleeve 2 and an annular member 2', with slots therein for vanes 12, is mounted in ball bearings 3 for rotation about a central control valve 4, with an inlet passage 14, and an outlet passage 15. Radial passages 13 are formed in the drum 2, 2' for connection with the passages 14 and 15 in the valve 4. The sleeve 2 of the drum is driven by a shaft 5 projecting from the casing 1.

The drum 2, 2' is enclosed in a housing which comprises a pair of end plates 7, 7' and a barrel 6 which is connected to the end plates by screw bolts 11. The end plates have each an inwardly projecting circular supporting member, or spigot, 18 and 18', respectively, projecting from their inner, and seating sleeves for ball bearings 8 projecting from their outer faces. The ball bearings 9 are inserted in the side shields 10 and 10' of a frame 10, so that the housing 6, 7, 7' is free to rotate in the frame 16, which has the advantages set out above. Means such as a hand wheel 21 mounted to rotate in the casing, a threaded portion 22 on the shaft of the hand wheel, a threaded sleeve 23 on the frame 10, and an adjustable abutment 24, are provided for adjusting the frame 10 and the housing 6 which the frame supports, with respect to the axis of the drum 2, 2'.

Figs. 1 and 3 show the drum 2 and the housing 6 in that position in which the eccentricity, that is, the distance of the housing axis C' and the drum axis C, is a maximum. The housing and the drum define a crescent-shaped pressure chamber 8. It will appear from Fig. 1 that a vane *a*—*b* makes a proper fit with the inner wall of the housing 6 only at the apex *a*, that is, at the point where the extension of the eccentricity C—C' intersects the inner wall of the housing 6. The same is obviously true for the diametrally opposite point. When the drum rotates anti-clockwise, the fit of the outer vane edge against the inner wall of the housing 6 is gradually deteriorated on account of the eccentricity. This is worst when the vane has moved through an angle of 90 degs. In order to be in the proper radial position with respect to the housing 6 at this point, the vane ought to occupy the position *a'*—*b'*—C', while in fact the drum 2, 2' compels it to occupy the non-radial position *a'*—*c*—C'. The difference between the lengths of the two lines produces a gap which is equal to such difference. Not withstanding the smallness of such gap, it should not be present, for the reasons stated.

This difficulty is eliminated by the movable strips 16 and 17 at the inner and outer ends, respectively, of each vane. The ends of the vane are grooved to form semi-cylinders for the reception of the strips which have segmental cross-section and project slightly from the grooves in which they are mounted to turn at the ends of the vanes. The flattened outer sides of the strips 16 at the outer ends of the vanes abut against the inner wall of the housing 6, and the corresponding faces of the strips 17 at the inner ends of the vanes are supported by the spigots 18 and 18' on the side plates 7 and 7' of the housing. Springs 19 are inserted in bores in the vanes 12, with their inner ends bearing against the strips 17, and with their outer ends tending to force the strips 16 against the inner wall of the housing 6. The springs make up for small irregularities in the housing and the spigots, and hold the strips 16 against the inner wall of the housing 6 in all positions. The strips 16, being mounted to turn in the outer ends of the vanes 12, together with the springs 19, equalize the difference between the lines *a'*—*b'* C' and *a*—*c*—C and prevent the formation of gaps, with the losses involved thereby. The tight fit is facilitated by the fact that the housing 6, 7, 7' rotates with the drum and so the relative displacement of contacting surfaces is a minimum.

In order to facilitate the assembling of the unit, I provide an annular abutment for the inner strips 17 which is here shown as a pair of rings 20 each of which is abutted against one of the spigots 18, 18' with its outer side. The outside diameter of the rings 20 is substantially equal to the outside of the spigots 18, 18' but slightly greater so that the rings force the strips 17 away from the axis of the drum, and their ends do not interfere with the insertion of the spigots 18, 18' of the end plates 7 and 7'.

Referring now to Fig. 4, the spigots 18 and 18' may be dispensed with altogether, and the end plates 7 and 7' recessed for the reception of the rings 20, as shown for the end plate 7 at the left. The rings make a loose fit in the end plates and the strips 17 bear on the inwardly projecting portions of the rings.

Referring now to Fig. 5, the inner surfaces of the end plates 7 and 7' may be plane and the rings 20 abutted against the surfaces with their outer sides. This is again illustrated only for the end plate 7 at the left. This arrangement has the advantages that the rings 20 rotate with the vanes 12, to the extraordinary reduction of friction and wear on the rings and the strips, and that the end plates 7, 7', being without spigots or recesses, are easier to machine.

ERWIN STURM.