

- [54] **ELECTRO-HYDRAULIC PULSE MOTOR**
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- [58] **Field of Search**..... **251/248; 74/409**

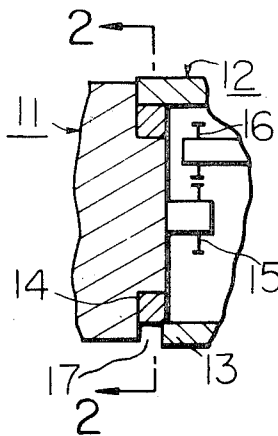
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[57] **ABSTRACT**

This disclosure relates to an improved electro-hydraulic pulse motor wherein an eccentric ring is provided for a joint of the electric pulse motor part and four way pilot valve part so that adjustment of the backlash in the reduction gear between the electric pulse motor part and the four way pilot valve part can be properly carried out from outside, and therefore the electro-hydraulic pulse motor can be adjusted so as to have excellent performances without the interior thereof being contaminated with dust and other foreign material.

5 Claims, 4 Drawing Figures

- [56] **References Cited**
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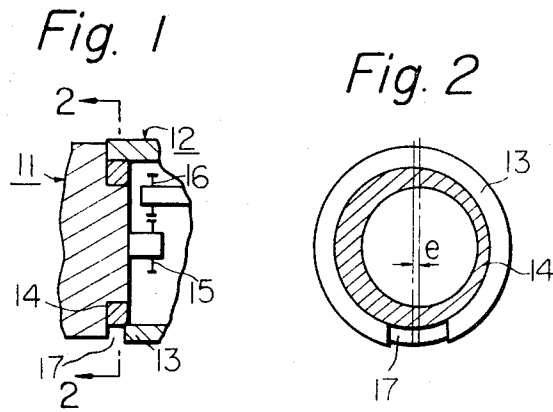


Fig. 3

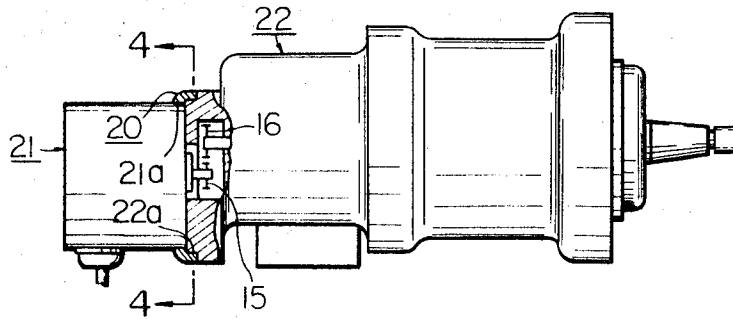
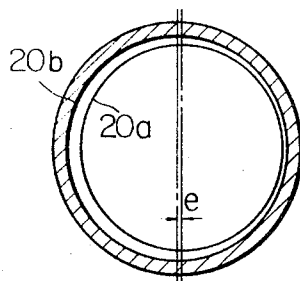


Fig. 4



ELECTRO-HYDRAULIC PULSE MOTOR

DISCLOSURE OF THE INVENTION

The present invention relates to an improvement of an electro-hydraulic pulse motor.

The electro-hydraulic pulse motor has a conventional arrangement in which the principal components thereof, consisting of an electric pulse motor, a rotary type four way pilot valve and an axial piston hydraulic motor, are operatively coupled to each other by a reduction gear and a screw-nut coupling having feedback operation and forming a feedback loop in the hydraulic line of the electro-hydraulic pulse motor.

The above-mentioned conventional electro-hydraulic pulse motor works on an operational principle such as disclosed below.

A predetermined amount of rotation of the electric pulse motor shaft in response to application of an electric pulse or of electric pulse train to the input of the electric pulse motor, is transmitted to the valve spool of the four way pilot valve part by way of a reduction gear so as to cause rotation of the valve spool.

The rotation of the valve spool is transformed into an axial shift of the valve spool by the above-mentioned screw-nut coupling. The axial shift of the valve spool from the initial neutral position opens an oil supply port provided in the four way pilot valve so as to introduce hydraulic fluid from a fluid power source into the hydraulic circuit for actuating the hydraulic motor. This provides a large torque on the shaft of the hydraulic motor, which serves also as the output shaft of the electro-hydraulic pulse motor. The output is used for driving a machine, for example on the one hand. Also the output rotation of the hydraulic motor restores the valve spool of the four way pilot valve to the neutral position thereof whereupon the hydraulic circuit is blocked again by means of the screw-nut coupling, and one cycle of operation of the electro-hydraulic pulse motor is finished with respect to a pulse applied thereto.

Where the electro-hydraulic pulse motor having the above-mentioned arrangement is used as a control element in a control system, the electro-hydraulic pulse motor is required to have the best possible response characteristics with respect to incoming pulses, such as follow-up characteristics of the pilot valve, accuracy of the rotation of the output shaft thereof, and linearity of the output torque relative to change of the incoming inputs.

This fact requires that backlash of the above-mentioned reduction gear should be adjusted to the optimum, since the backlash of the reduction gear has a large effect upon the performance.

Accordingly, for the purpose of properly adjusting the backlash, a rotatably fitted eccentric ring has conventionally been arranged in the prior art at the connecting portion between the electric pulse motor and the four way pilot valve so that the adjusting operation is carried out from the outside through an aperture formed at a suitable position of the outer casing of the electro-hydraulic pulse motor.

However, the presence of the aperture through which the conventional eccentric ring is adjusted, allows intrusion of fine dust or other foreign material into the interior of the electro-hydraulic pulse motor and further, the presence of the aperture detracts from the appearance of the electro-hydraulic pulse motor.

The object of the present invention is to provide an improved electro-hydraulic pulse motor eliminating the above-mentioned defects.

The present invention will be described, hereinafter, in more detail with reference to the accompanying drawings wherein:

FIG. 1 is a sectional view schematically showing a part of the conventional electro-hydraulic pulse motor;

FIG. 2 is a schematic view taken along line 2—2 of FIG. 1;

FIG. 3 is an over-all perspective view including a partially cut out portion of an electro-hydraulic pulse motor according to the present invention;

FIG. 4 is a schematic view taken along line 4—4 of FIG. 3.

Referring to FIGS. 1 and 2 which show a conventional backlash-adjusting mechanism, an eccentric ring 14 is rotatably fitted to an electric pulse motor part 11, while the housing 13 of four way pilot valve part 12 is fitted to the periphery of the eccentric ring 14.

The eccentric ring 14 can be rotated by using a suitable tool through aperture 17 formed at a position in housing 13.

A slight rotation of the eccentric ring 14 causes radial displacement between the electric pulse motor part 11 and the four way pilot valve part 12, so that backlash present between gear 15 of the electric pulse motor part 11 and gear 16 of the four way pilot valve part 12 changes. Therefore, a properly adjusted rotation of eccentric ring 14 provides a properly adjusted backlash between the engagement of gears 15 and 16 which act as reduction gears.

As mentioned before, however the presence of the aperture 17 has the defect that fine dust or other foreign material enters the interior of the four way pilot valve 12 through aperture 17 and the junction of eccentric ring 14 and housing 13.

Referring now to FIGS. 3 and 4 which show the present invention, a specific eccentric ring 20 is arranged so that the ring 20 is rotatably fitted to the periphery of one end 21a of the electric pulse motor part 21 and the periphery of one end 22a of the four way pilot valve part 22.

The eccentric ring 20 can be rotated by applying a slight turning force from outside so that the backlash of the reduction gears consisting of gears 15 and 16 may be adjusted.

As clearly shown in FIG. 4, the inner side of this eccentric ring 20 is provided with one internal surface 20a which is fitted to the periphery of one end 21a of the electric pulse motor part 21 and another internal surface 20b which is fitted to the periphery of the end 22a of the four way pilot valve part 22, and these two internal surfaces 20a and 20b are formed so as to be eccentric to each other by a preselected amount, e .

In accordance with the arrangement of the eccentric ring 20 of the present invention, backlash present between gears 15 and 16 can be properly adjusted by rotating the eccentric ring 20 from outside, since the rotation of the eccentric ring 20 results in a radial displacement between the electric pulse motor part 21 and the four way pilot valve part 22 depending upon the eccentricity e .

Thus, the properly adjusted electro-hydraulic pulse motor has an excellent performance.

Further, in accordance with the present invention, the interior of the electro-hydraulic pulse motor is

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completely shielded from the possibility Of contamination by fine dust or other foreign material.

What we claim is:

I claim:

- 1. An electro-hydraulic pulse motor comprising:
 - a. a housing for said motor,
 - b. a housing for a hydraulic valve having one end disposed adjacent one end of said motor housing,
 - c. a motor shaft extending outwardly toward said valve housing from said end of said motor housing and having a first gear disposed thereon,
 - d. a valve shaft within said valve housing and having a second gear disposed therein, aid gears being disposed to mesh with one another, and
 - e. a ring having two internal circular surfaces which are mutually eccentric, one of said surfaces being rotatably connected to an external peripheral sur-

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face of said end of said motor housing and the other internal surface being rotatably connected to an external peripheral surface of said end of said valve housing.

2. The pulse motor according to claim 1 wherein said peripheral surface of said end of said motor housing has a diameter smaller than that of said peripheral surface of said end of said valve housing.

3. The pulse motor according to claim 1 wherein said ends of said motor and valve housings are contiguous.

4. The pulse motor according to claim 1 wherein said ring is rigid and is free from any apertures transverse to its axis.

5. The pulse motor according to claim 1 wherein said internal surfaces are adjacent one another and have different diameters.

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