United States Patent [19]

D'Amata

[11] 3,835,752

[45] Sept. 17, 1974

[54] **CONTROL FOR BALL PISTON FLUID TRANSMISSION DEVICE**

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[22] Filed: **Sept. 28, 1972**

[21] Appl. No.: **292,897**

[52] **U.S. Cl.** **91/492,** 91/497

[51] **Int. Cl.** **F01b 13/06**

[58] **Field of Search** 91/475, 497, 492

[56] **References Cited**

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[57] **ABSTRACT**

A ball piston pump or motor having in the rotor thereof two rows of cylinders is provided with two reaction rings which engage against a swivel so that one reaction ring causes the pistons engaging it to move oppositely from the pistons engaging the other ring. A control for the reaction rings determines stroke length and maximum pressure.

5 Claims, 7 Drawing Figures

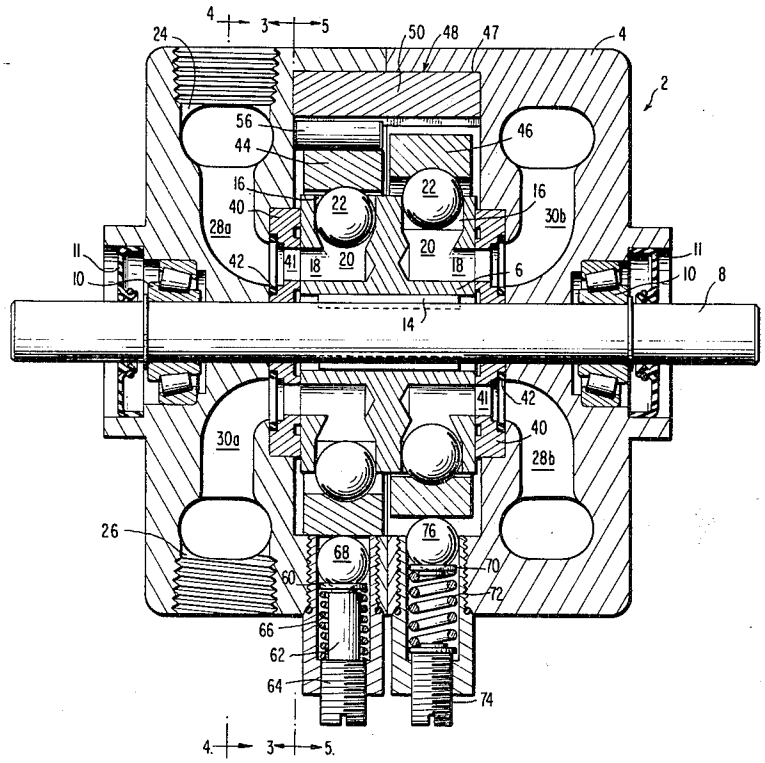


FIG. 1

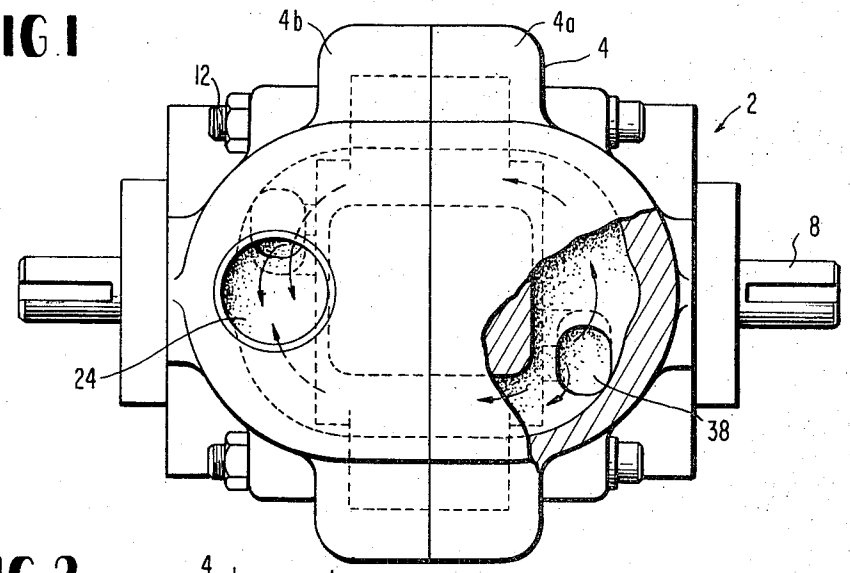
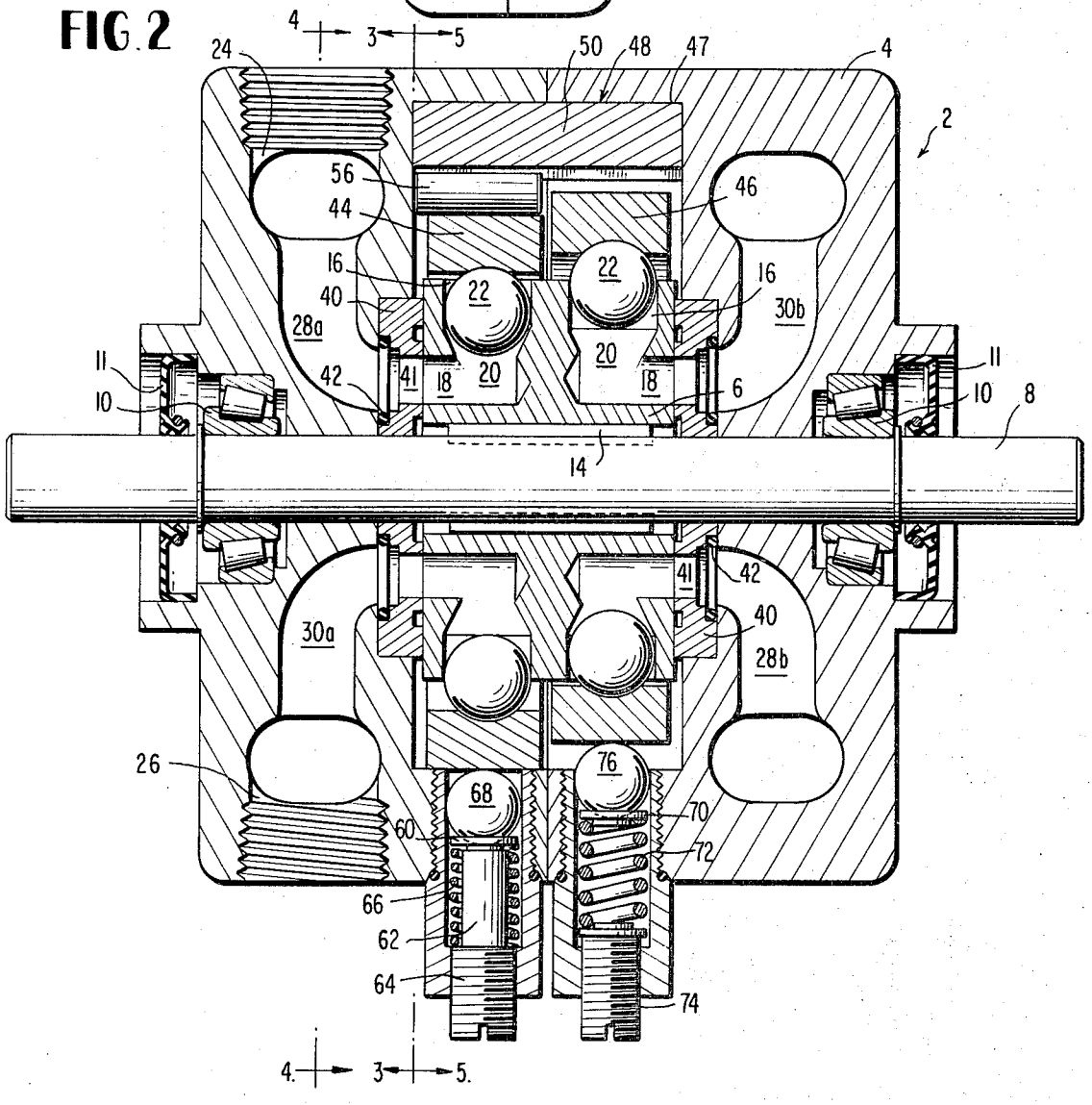

4b
4a
4
12
2
8
24
38

FIG. 2


4
3
5
24
50
48
47
4
2
56
46
44
16
22
22
16
40
30b
28a
11
42
41
18
20
20
18
6
11
10
10
8
14
41
42
30a
40
28b
26
76
68
70
60
72
66
62
64
74
4
3
5

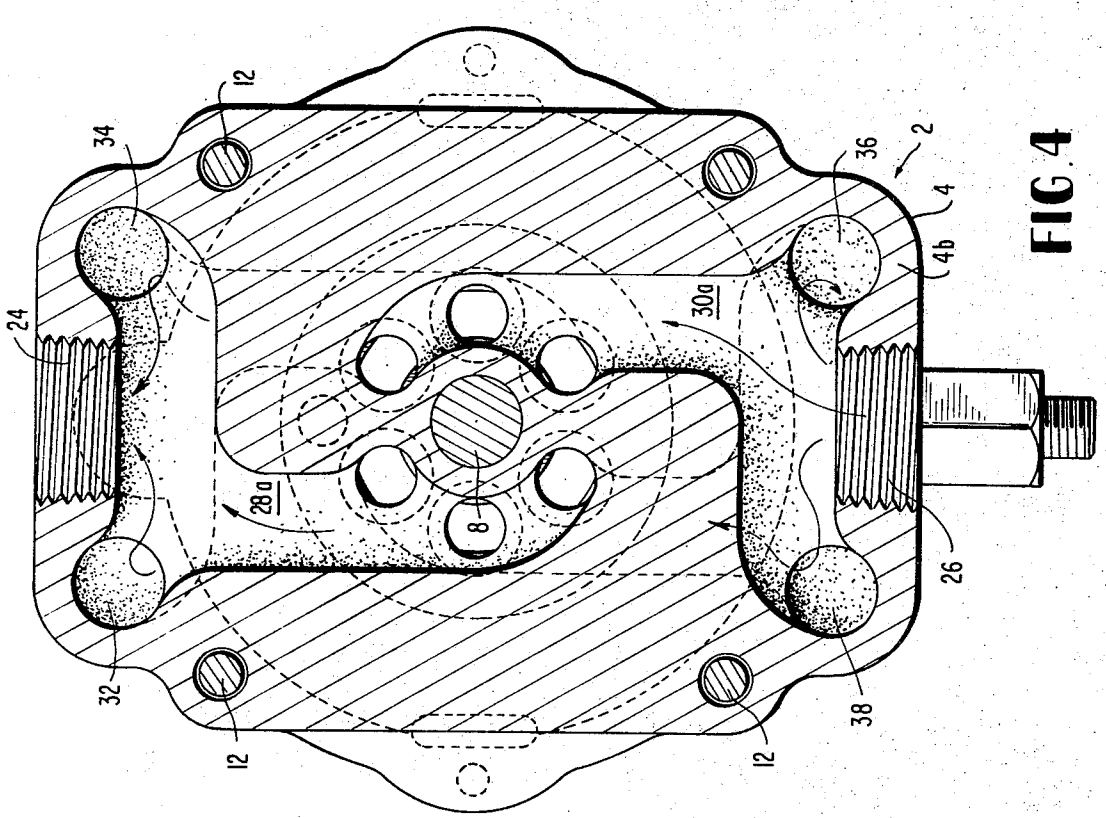

12
34
36
2
4
4b
24
30a
28a
8
26
32
38
12
12

FIG. 4

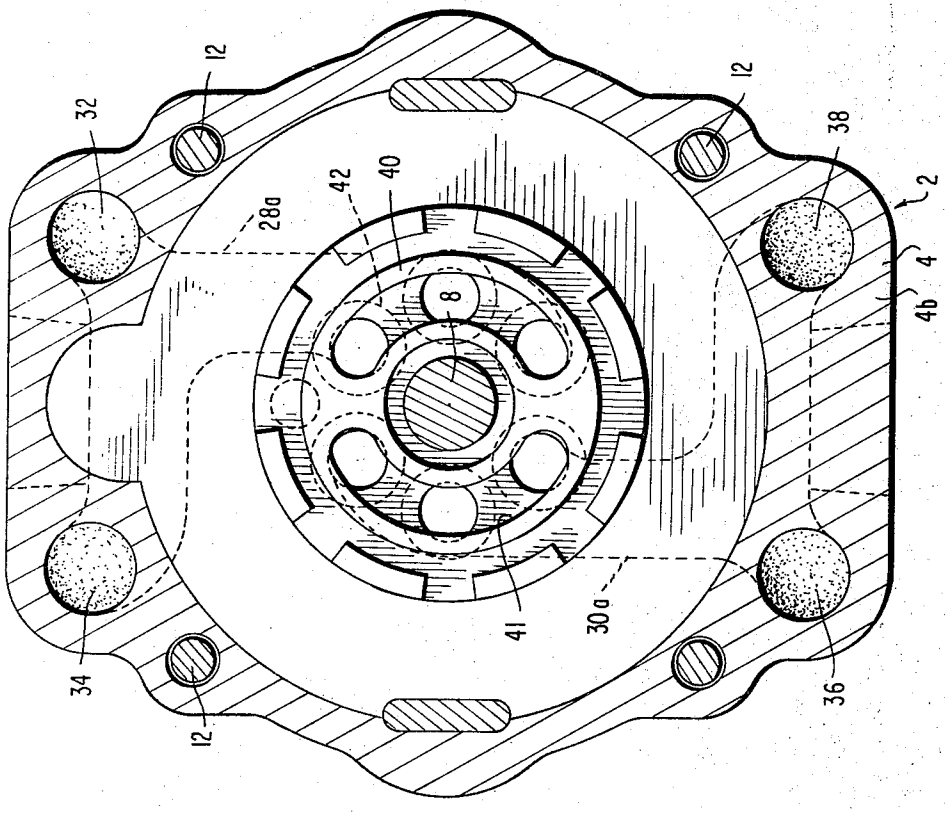

12
12
32
38
2
42
40
28a
4
8
4b
41
30a
34
36
12

FIG. 3

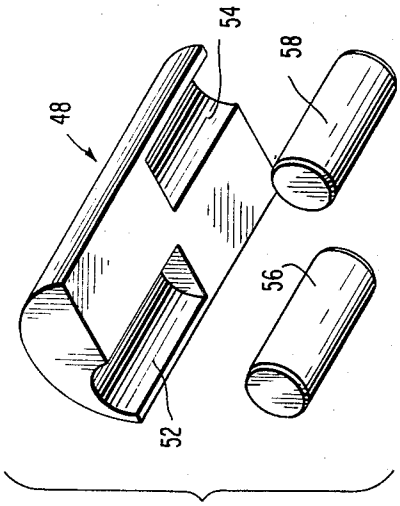


FIG. 6

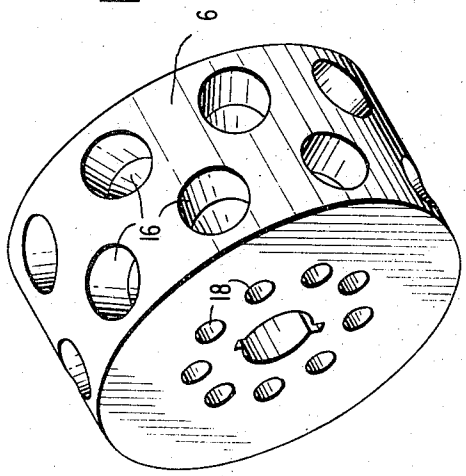


FIG. 7

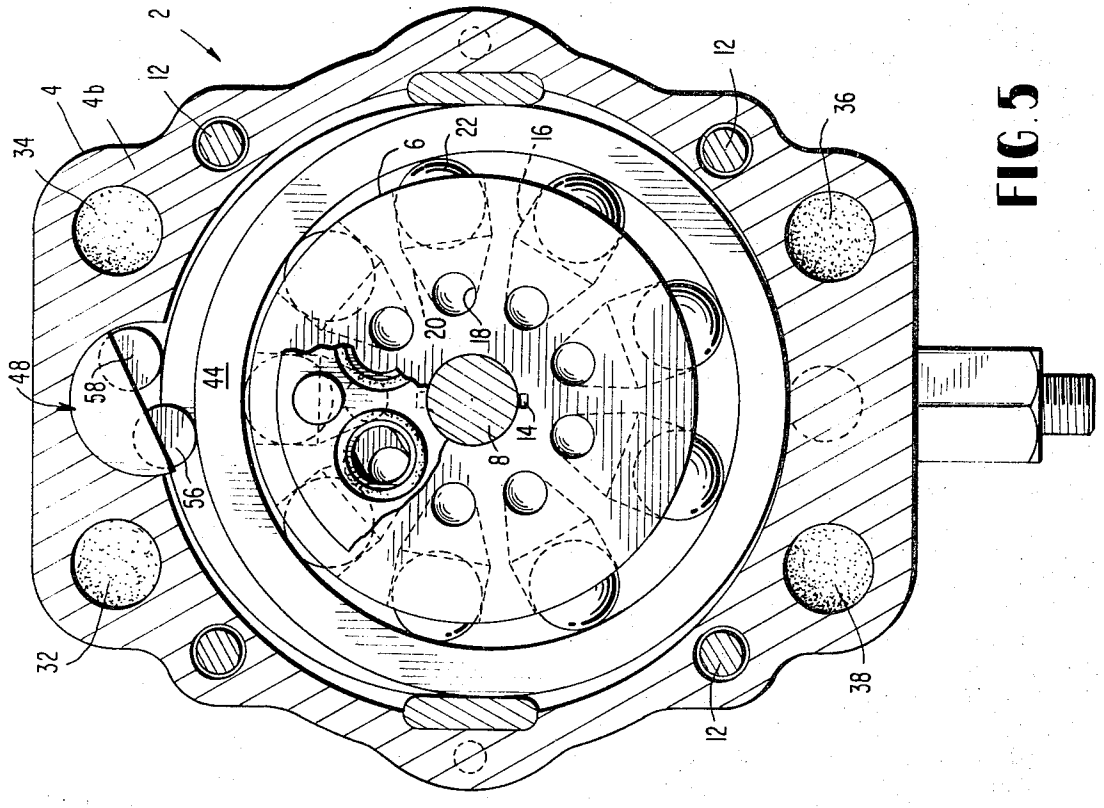


FIG. 5

CONTROL FOR BALL PISTON FLUID TRANSMISSION DEVICE

FIELD OF INVENTION

Motors, Expansible Chamber Type, Radially Disposed Cylinders, Plural Banks and Stroke Control.

OBJECTS

Ball piston pumps and motors having in a rotor double rows of cylinders and oppositely working reaction rings for the pistons are well known. They have many advantageous features, in that they can be fed with fluid at atmospheric pressure and require no supercharging, balance of radial forces on the rotor shaft is inherent, and they can be sealed quite well. Usually the reaction rings are yoked together and oppositely moved by a control member so that, when one ring is moved towards one extremity, the opposite ring is moved towards the opposite extremity. These ring movements determine the lengths of stroke of the pistons. The object of this invention is to provide a control for such an adjustment of stroke length, and to provide in the same control a means for pre-determining maximum pump pressure. Thus, when the pump output pressure reaches a predetermined limit, the reaction rings automatically move toward positions in which they reduce the piston stroke lengths.

These and other objects will be apparent from the following specifications and drawings, in which:

FIG. 1 is a top plan view of the pump;

FIG. 2 is a cross-sectional view of the pump;

FIG. 3 is a cross-section along the line 3—3 of FIG. 2, looking in the direction of the arrows;

FIG. 4 is a cross-sectional view along the line 4—4 of FIG. 2, looking in the direction of the arrows;

FIG. 5 is a cross-sectional view along the line 5—5 of FIG. 2, looking in the direction of the arrows;

FIG. 6 is an exploded view of the swivel which couples the reaction rings; and,

FIG. 7 is a perspective view of the rotor.

Referring now to the drawings, in which like reference numerals denote similar elements, the pump 2 comprises a casing 4 in which a rotor 6 is affixed to a shaft 8. Shaft 8 is rotatably supported by bearings 10 which are sealed as indicated at 11. A key 14 couples rotor 6 to shaft 8, and the casing 4 is formed of two casings 4*a* and 4*b* held together by cross bolts 12.

Rotor 6 contains two rows of radial cylinders 16, the cylinders in one row being staggered with respect to those in the other as indicated at FIG. 7, and in the opposite sides of the rotor are ports 18, one port for each cylinder. As seen best in FIG. 2 ports 18 connect with the reduced inner ends 20 of the cylinders. In each cylinder is a ball piston 22.

In casing half 4*b* are two service ports 24 and 26. For purposes of explanation, it will be assumed that port 24 is the high pressure or outlet port and port 26 is the low pressure or inlet port. The pressure relationships of these ports reverses upon reversal of rotation of shaft 8. Reversal is also achieved by moving the reaction rings beyond neutral. The high pressure port 24 communicates with a kidney-shape manifold 28*a* on the left hand side of the pump as seen in FIG. 2 and also with a similar manifold 28*b* on the right hand side of the pump (FIG. 2). Port 26 communicates with a kidney-shape manifold 30*a* on the left hand side of the pump

and likewise with a similar manifold 30*b* on the right hand side of the pump. These communications are established by cross connections 32, 34, 36 and 38, and the manifolds for each port are offset 180°. Engaged in annular recesses in the inner sides of the casing halves are floating sealing rings 40 which have ports 41 sealed to the casing sides by O-rings 42.

Surrounding the outer ends of the cylinder rows are two reaction rings 44 and 46 which define the outer extremities of the strokes of ball 22. The reaction rings are controlled so that when any given ball 22 is at the inner end of its stroke, the adjacent balls on the other row are about at their outer ends of their strokes. All of the foregoing is known in the art. This invention is concerned with the control mechanism for the reaction rings.

As seen best in FIGS. 2 and 6, there is rotatably mounted in a half cylindrical recess 47 in the upper part of the casing a swivel denoted generally at 48, and consisting of a half cylindrical bar 40 in the flat side of which are half cylindrical sockets 52 and 54 for accommodating rollers 56 and 58. These sockets could also be semi-spherical, in which case balls would be used instead of rollers. Sockets 42 and 54 are offset 180° from one another so that when one roller 56 is in its downward position as seen in FIG. 2, the other roller 58 will be in its upper position, and vice versa.

Mounted in the casing opposite swivel 48 are two plungers, the first plunger 60 being slidable in a hollow rod end 62 of a screw plug 64. Plunger 60 is biased inwardly by a relatively weak follower spring 66 so that its ball bearing 68 is always engaged between it and reaction ring 44. Cooperating with reaction ring 56 is another plunger 70 which is forced inwardly by a relatively strong compression spring 72 engaging against screw plug 74. Ball bearing 76 is engaged between plunger 70 and reaction ring 46.

FIG. 2 shows plunger 60 adjusted so that the pump will operate with maximum length strokes. If the output pressure of the pump tends to rise above some predetermined desired limit, plunger 70 will be forced against a compression spring 72 by the reaction forces of ring 46, swivel 48 will rock, and reaction ring 48 will move upwardly from the position shown in FIG. 2, thereby reducing the stroke length of the pump. The stroke length can also be reduced by screwing in screw plug 64. The pump pressure at which stroke length will be automatically reduced is determined by inward or outward adjustment of screw plug 74 which, of course, determines the pressure applied by compression spring 72.

The control illustrated is a pressure compensated control which automatically reduces oil flow at a predetermined pressure setting. The rotating pistons exert a newtralizing or centering force against reaction rings 46 and 44. This centering force is directly proportional to the pressure being pumped. Spring 72 is adjusted to overcome the centering force exerted by the reaction rings up to its setting.

While the fluid transmission device has been described as a pump, it will be understood by those skilled in the art that it can operate as a motor.

I claim:

1. In a fluid transmission device comprising

a hollow casing, a rotor rotatably mounted in said casing by a rotor shaft, said rotor having two rows of radial cylinders therein, pistons in said cylinders,

and a reaction ring surrounding each row of cylinders for bearing against the outer ends of the pistons, the improvement which comprises

a swivel disposed on one side of said casing outwardly of said reaction rings, said swivel having two reaction ring-engaging members offset 180° from one another, first control means in said casing diametrically opposite said swivel and engaging one of said reaction rings for forcing the same in one direction towards said swivel,

and second control means in said casing diametrically opposite said swivel and engaging the other reaction ring for limiting the movement of said other reaction ring in the opposite direction,

said swivel comprising a bar having one side of half-cylindrical shape and the opposite side flat, said casing having a half-cylindrical recess into which the half-cylindrical side of said bar engages, said flat side having therein a pair of half-round recesses offset 180° apart, said reaction ring-engaging members comprising round members engaged in the recesses in the flat side of the bar.

2. The improvement recited in claim **1,** said second control means comprising a plunger and a reaction bar-engaging element therefor, and means engaged in said casing for moving said plunger towards and away from said swivel.

3. The improvement recited in claim **1,** said second control means comprising a screw plug threadedly engaged in said casing, a plunger slidably mounted on said screw plug, a bearing element engaged between said plunger and said other reaction ring, and a follower spring compressed between said screw plug and said plunger.

4. The improvement recited in claim **1,** said first control means comprising a plunger and a reaction bar-engaging bearing element therefor, a compression spring engaging said plunger, and means engaged in said casing for adjusting the compression of said spring.

5. The improvement recited in claim **4,** the means for adjusting the compression of said spring comprising a screw plug threadedly engaged in said casing.

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