May 16, 1967 KOICHI KOJIMA ET AL 3,319,925

VALVE-ACTUATING DEVICE

Filed Sept. 24, 1965

Fig. 1

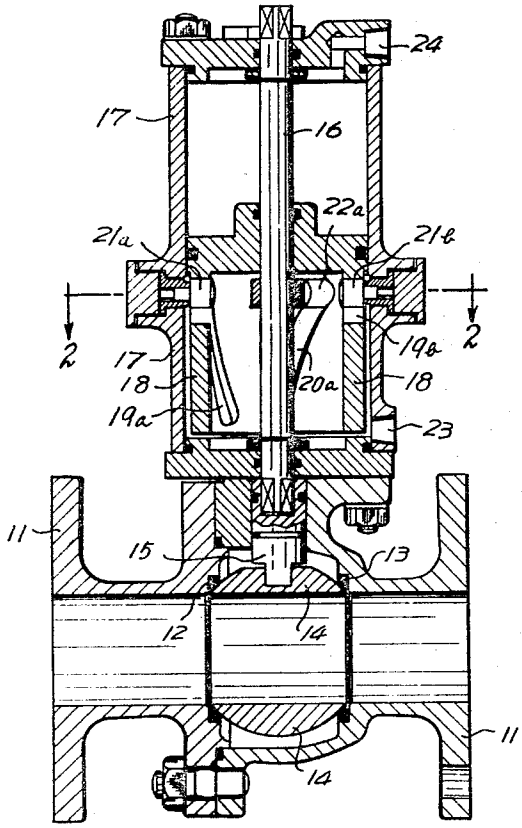



Fig. 2

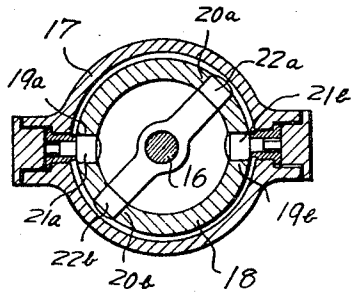



Fig. 3

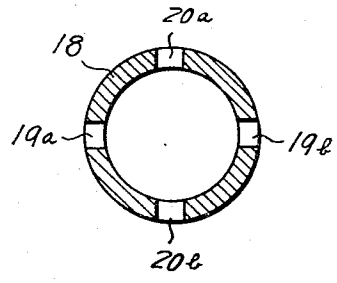
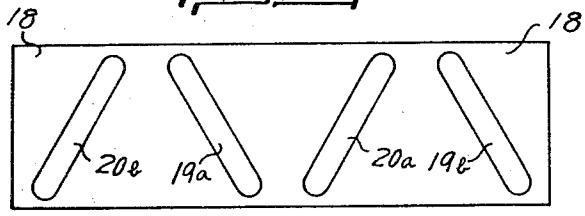



Fig. 4



United States Patent Office 3,319,925 Patented May 16, 1967



3,319,925

# VALVE-ACTUATING DEVICE

Koichi Kojima and Hiroshi Sato, Tokyo, Japan, assignors to T. V. Valve Co., Ltd., Tokyo, Japan

Filed Sept. 24, 1965, Ser. No. 489,826
1 Claim. (Cl. 251—58)

The valve actuating device of this invention is adapted to be secured to a valve body for actuating a valve member by rotating it by means of a unique construction of a cylinder and piston of the actuating device cooperating with a rod coupled to the valve.

More specifically, a cylinder enclosing a walled piston mounted on a valve rod carries inwardly protruding plugs, and the valve rod carries outwardly protruding plugs. The walled piston has inclined guide slots for guiding these protruding plugs, and the inclination of the slots are such that linear movement of the piston will rotate the piston through an angle of arc in one direction due to the cylinder plugs, and this rotation of the piston during reciprocation will rotate the valve rod through an angle of arc in the same direction due to the rod plugs. Thus a large angle of actuation can be obtained by a short stroke of the piston. The cylinder is provided with fluid pressure ports near its ends to allow actuation of the piston and hence the valve by fluid pressure admitted through one of the ports.

A clear understanding of the construction and operation of this invention can be obtained from the following description in which reference is made to the accompanying drawings wherein:

FIG. 1 is a longitudinal sectional front view of a preferred embodiment of this invention;

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

FIG. 3 is a sectional view of a piston employed in this invention; and

FIG. 4 is a developed view of the piston.

Referring to the drawings, a valve body designated generally by **11** is at the intermediate portion thereof provided with suitable valve seats **12** and **13**, against which is mounted a ball-shaped or other suitably shaped valve member **14**. On the upper portion of the valve member **14** a socketed valve stem **15** is provided, and a relatively longer valve actuating rod **16** is coupled to stem **15** to operate the valve member **14**. Upon the valve body **14** an air-tight cylinder **17** is mounted which encloses the valve rod **16**. Within the cylinder **17** and on the rod **16** a cylindrical piston **18** is slidably mounted.

The wall of the cylindrical piston **18** includes two pairs of guide slots **19***a*, **19***b* and **20***a*, **20***b*, as illustrated in development in FIGS. 3 and 4. These guide slots are inclined at a common angle. In one pair of guide slots **19***a* and **19***b* are fitted a pair of plugs **21***a* and **21***b* which are like cam-followers and protrude from the inside wall of cylinder **17**. Similarly, the other pair of guide slots **20***a* and **20***b* guide a pair of protruding plugs **22***a* and **22***b* which are like cam-followers in shape and extend from valve rod **16**. When the piston **18** moves vertically from its lowermost position to its uppermost position, the piston **18** rotates about 45 degrees by the inclination or twist of the guiding slots **19***a* and **19***b* into which are fitted the protruding plugs **21***a* and **21***b*, and at the same time by means of the other pair of guide slots **20***a* and **20***b* cooperating with the valve rod protruding plugs **22***a* and **22***b*, so that the valve rod **16** is also rotated 45°. In other words, in order that the valve rod **16** or the valve body **14** be rotated as much as 90° of angle, each pair of guide slots **19***a* and **19***b* and **20***a* and **20***b* must extend 90° of the cylinder wall. Thus the degree of rotation of the valve member **14** is determined by the inclination of the guide slots, the length of the piston **18**, or the stroke thereof. As illustrated in FIG. 4, due to cooperating action of the protruding plugs **21***a* and **21***b* and the inclined guide slots **19***a* and **19***b*, the piston **18** is rotated through a predetermined angle. The piston is further rotated relative to the valve stem by means of the other pair of guide slots **20***a* and **20***b* and valve rod protruding plugs **22***a* and **22***b*, thus the rotational velocity of the valve body **14** is doubled.



Ports **23** and **24** are provided in the ends of cylinder **17** for air pressure or the like. Through either of the ports air under pressure of, for example, 2 kg./cm.$^2$ is charged into the cylinder **17** to thereby drive the piston through a predetermined stroke either upwardly or downwardly.

With the construction described above, the piston **18** is rotated relative to the cylinder **17** corresponding to the twist or the inclination angle of one pair of guide slots **19***a* and **19***b*. The valve rod **16** is rotated through an angle corresponding to the sum of the angle that the piston was rotated and that caused by the inclination of the other pair of guide slots **20***a* and **20***b*. Thus the valve body **14** coupled to the valve rod **16** can be quickly rotated so that opening and closing of the valve may be quickly accomplished.

As described above, according to this invention the valve is rotated through an angle which is remarkably large as compared with the constant stroke of the specially constructed piston by utilizing air under relatively lower pressure. As a result of the above, the auxiliary mechanism required for pressure operation may be compact and simple in construction. Further, since the whole construction of the valve according to the present invention is relatively simple, operation of the valve is simplified and the manufacture of the valve can be carried out inexpensively and without trouble. The valve according to the present invention may be employed in the automatic control systems requiring high reliability but is not limited thereto as it has many other uses due to the unique features disclosed herein.

The invention has been described in detail with particular reference to a preferred embodiment thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention as described hereinabove and defined in the appended claim.

We claim:

A valve actuating device comprising a cylinder attached to the outside of a valve body; a valve rod which is adapted to actuate a valve rotatably mounted within the cylinder, a housed cylindrical piston within the cylinder slidably mounted on the rod; a first plurality of guide slots in the wall of the piston and inclined relative to the longitudinal axis of said piston, a second plurality of guide slots in the wall of the piston and inclined relative to the longitudinal axis of said piston, said second plurality of guide slots being oppositely inclined with respect to said first plurality of guide slots; a first plurality of protruding plugs secured to the cylinder wall and extending into said first plurality of guide slots, a second plurality of

protruding plugs secured to the valve rod and extending therefrom into said second plurality of guide slots; means for reciprocating the piston by fluid pressure alternately charged into the cylinder from axially spaced ports provided in the proximities of the ends of the cylinder, wherein reciprocation of said piston produces rotary motion of said valve consisting of the superposition of the rotary motion of said piston caused by the first plurality of guide slots and protruding plugs, and the rotary motion of the valve rod caused by the second plurality of guide slots and protruding plugs, whereby providing a greater valve rotation in a shorter piston displacement.



**References Cited by the Examiner**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 2,998,805 | 9/1961 | Usab | 251—58 XR |
| 3,078,065 | 2/1963 | Vickery | 251—58 |

M. CARY NELSON, *Primary Examiner.*

W. JOHNSON, *Assistant Examiner.*