Sept. 6, 1966 F. J. BLANEY 3,270,624

OSCILLATORY ACTUATOR

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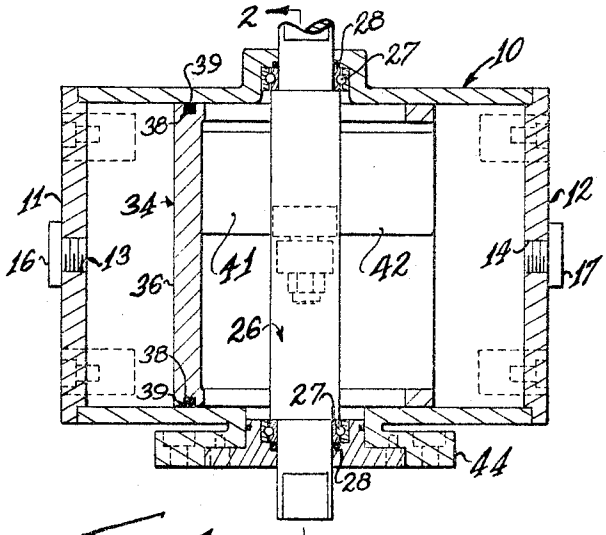


Fig. 1

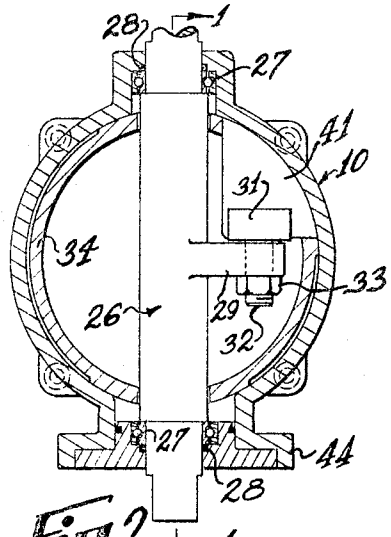


Fig. 2

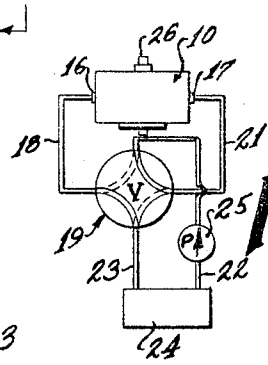


Fig. 5

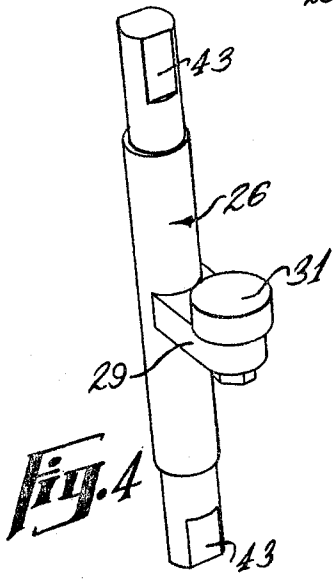


Fig. 4

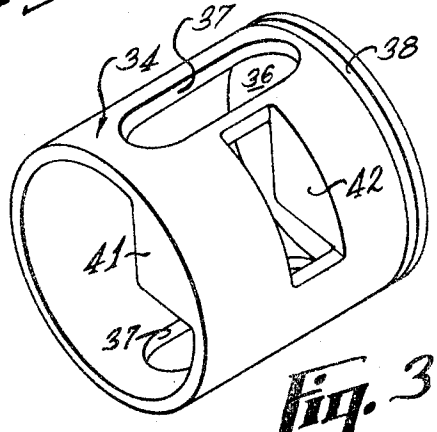


Fig. 3

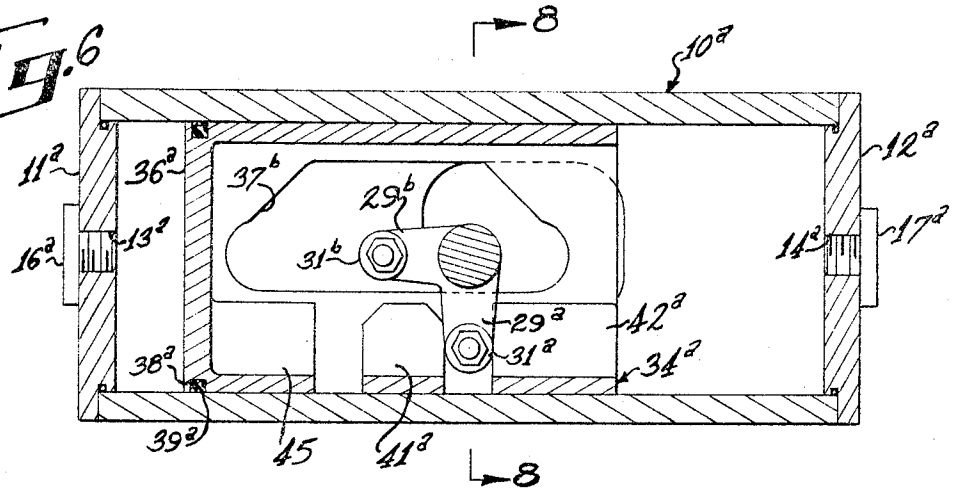
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Fig. 6



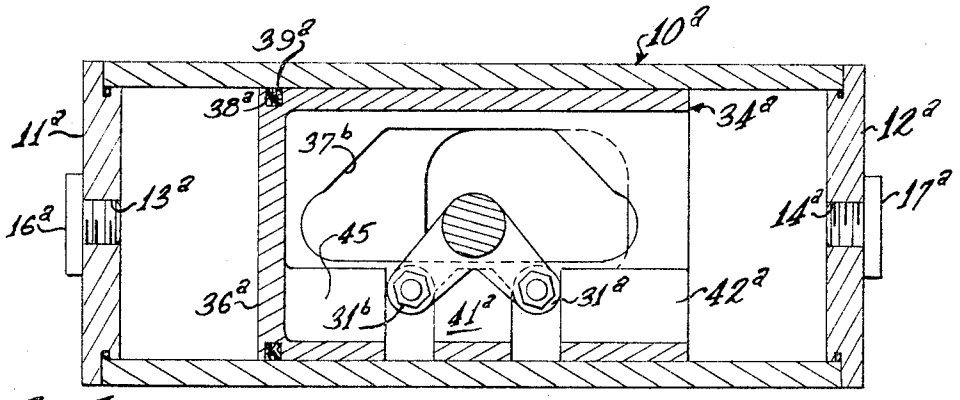


Fig. 7

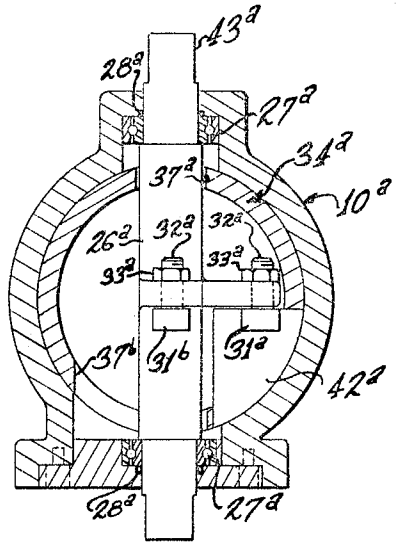


Fig. 8

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OSCILLATORY ACTUATOR

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5 Claims. (Cl. 91—418)

This invention relates to an oscillatory actuator and more particularly to apparatus for converting fluid pressure to an oscillating or rotary motion.

An object of my invention is to provide an actuator for converting fluid pressure to oscillatory motion in which a maximum torque potential is developed with a minimum amount of linear travel of the operating mechanism.

Another object of my invention is to provide an oscillatory actuator of the character designated which shall be particularly adapted for use where relatively low input pressures are employed.

A further object of my invention is to provide an oscillatory actuator for converting fluid pressure to oscillatory motion which shall be compact whereby a minimum of space is required for installation, storage and shipment.

A still further object of my invention is to provide an oscillatory actuator of the character designated which shall be simple of construction, economical of manufacture and one which is light in weight.

Heretofore in the art to which my invention relates, various type oscillatory actuators have been devised. Such actuators usually embody complicated mechanism for converting fluid pressure into oscillatory motion.

Briefly, my improved actuator comprises an actuator shaft extending transversely through a cylinder and adapted for oscillation relative thereto. A piston is mounted for longitudinal movement within the cylinder and the piston is provided with elongated openings which extend longitudinally of the cylinder in position to receive the shaft whereby the piston is adapted for movement relative to the shaft. Fluid under pressure is introduced and exhausted selectively adjacent opposite ends of the cylinder to move the piston selectively in opposite directions. An arm extends outwardly from the shaft in position to engage detents carried by the piston whereby the outer portion of the arm moves with the piston to impart oscillatory motion to the shaft.

Apparatus embodying features of my invention is illustrated in the accompanying drawings, forming a part of this application, in which:

FIG. 1 is a vertical sectional view of the oscillatory actuator taken generally along the line 1—1 of FIG. 2;

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

FIG. 3 is an isometric view showing the piston removed from the remainder of the apparatus;

FIG. 4 is an isometric view showing the actuator shaft;

FIG. 5 is a diagrammatic view showing the means for introducing fluid under pressure selectively at opposite ends of the cylinder;

FIG. 6 is a horizontal sectional view showing a modified form of my invention in which the actuator shaft is adapted to oscillate approximately 180°;

FIG. 7 is a horizontal sectional view corresponding to FIG. 6 showing the actuator shaft and piston moved to different positions; and

FIG. 8 is a vertical sectional view taken generally along the line 8—8 of FIG. 6.

Referring now to the drawings for a better understanding of my invention, I show an elongated cylinder 10 having end closure members 11 and 12. Suitable openings 13 and 14 are provided in the closure members 11 and 12, respectively, for receiving fittings 16 and 17, as shown in FIG. 1.

Communicating with the fitting 16 is one end of a conduit 18. The other end of the conduit 18 communicates with one side of a four-way valve indicated generally at 19. Communicating with the fitting 17 is one end of a conduit 21. The other end of conduit 21 communicates with the four-way valve 19, as shown in FIG. 5. Fluid under pressure, such as air, water, hydraulic fluid and the like, is introduced and exhausted from the four-way valve 19 by conduits 22 and 23, respectively, which communicate with a reservoir 24. A pump 25 is provided in the line 22 for supplying fluid under pressure to the four-way valve 19.

Extending transversely through the cylinder 10 is an actuator shaft 26. Suitable openings are provided in the cylinder 10 for receiving the shaft 26, as shown in FIGS. 1 and 2. Bearing units 27 are provided at opposite sides of the cylinder 10 in position to surround the actuator shaft 26 whereby the actuator shaft is adapted for rotation relative to the cylinder. Also, annular packing rings 28 surround the shaft 26 adjacent the bearing units 27 to form a fluid-tight seal between the shaft 26 and the cylinder 10.

Formed integrally with the shaft 26 is an outwardly projecting arm 29. Mounted for rotation adjacent the outer or free end of the arm 29 is a roller 31. The roller 31 is carried by a bolt 32 which is secured to the outer end of the arm 29 by suitable means, such as a nut 33.

Mounted for longitudinal movement within the cylinder 10 is a piston 34. Preferably, the piston 34 is in the form of a generally cylindrical member having a closed end wall 36. Elongated openings 37 are provided in the piston 34 in position to receive the shaft 26 with a sliding fit whereby the piston 34 is adapted for movement relative to the shaft 26 and the cylinder 10. An annular groove 38 is provided in the outer wall of the piston 34 in position to receive an annular packing ring 39 whereby a fluid-tight seal is provided between the piston 34 and the cylinder 10.

Inwardly extending detents 41 and 42 are carried by the piston 34 in position to engage opposite sides of the roller 31 whereby upon movement of the piston 34 relative to the cylinder 10, the outer end of the arm 29 is moved to thereby impart oscillatory motion to the actuator shaft 26. As shown in FIGS. 1 and 2, the lower surface of the detents 41 and 42 is slightly above the upper surface of the arm 29 whereby the arm 29 is adapted to move relative to the detents while the roller 31 engages the detents upon movement of the piston 34 relative to the cylinder 10. Preferably, the detents 41 and 42 are defined by a cut-out in the piston 34 opposite the arm 29.

As clearly shown in FIG. 4, the ends of the actuator shaft 26 are provided with flattened portions 43 for opera-

tively connecting the actuator shaft to the mechanism which is to be rotated thereby, such as a valve, or the like. Also, a mounting bracket 44 is provided at one side of the cylinder 10 for mounting the actuator mechanism on a suitable supporting structure.

From the foregoing description, the operation of my improved oscillatory actuator will be readily understood. The actuator shaft 26 is operatively connected to the mechanism to be rotated such as a valve and the fittings 16 and 17 are connected to conduits 18 and 21, respectively, whereby fluid under pressure may be introduced selectively at opposite ends of the cylinder 10 upon rotating the four-way valve 19 to selected positions. Upon introducing the fluid under pressure adjacent one end of the cylinder 10, the piston 34 is moved relative to the cylinder 10 and the actuator shaft 26. That is, the elongated openings 37 in the piston 34 permit the piston to move within the cylinder 10 relative to the shaft 26. Since the roller 31 carried by the outer end of the arm 29 is positioned between the inwardly projecting detents 41 and 42, longitudinal movement of the piston 34 imparts oscillatory motion to the actuator shaft 26 whereby the mechanism connected thereto is rotated. To rotate the actuator shaft 26 in the opposite direction, the four-way valve 19 is positioned to direct fluid under pressure adjacent the opposite end of the cylinder 10 whereupon the piston 34 is moved in the opposite direction to thereby move the roller 31 and the outer end of the arm 29 in a direction to impart oscillation to the shaft 26 in the opposite direction.

Referring now to FIGS. 6–8 of the drawings, I show a modified form of my invention wherein the actuator shaft is adapted for greater angular movement than the apparatus shown in FIGS. 1–4. The apparatus comprises an elongated cylinder 10^a having end closure members 11^a and 12^a. Opening 13^a and 14^a are provided in the closure members 11^a and 12^a, respectively, for receiving fittings 16^a and 17^a which in turn communicate with the conduits 18 and 21 associated with the four-way valve described hereinabove.

Extending transversely through suitable openings in the cylinder 10^a is an actuator shaft 26^a which is adapted to rotate in bearing units 27^a provided at opposite sides of the cylinder 10^a. Also, annular packing rings 28^a surround the shaft 26a, as shown, to form a fluid-tight seal.

Secured to or formed integrally with the shaft 26^a are outwardly projecting arms 29^a and 29^b having rollers 31^a and 31^b, respectively, mounted for rotation adjacent the outer or free ends thereof. The rollers are secured to the outer ends of the arms 29^a and 29^b by suitable means, such as bolts 32^a having nuts 33^a.

Mounted for longitudinal movement within the cylinder 10^a is a piston 34^a which is preferably cylindrical and is provided wtih a closed end wall 36^a. Elongated openings 37^a and 37^b are provided in the piston 34^a in position to receive the shaft 26^a with a sliding fit whereby the piston is adapted for movement relative to the shaft 26^a and the cylinder 10^a. The opening 37^b is of a size and shape to receive the shaft 26^a and the arms carried thereby to thus facilitate assembly. An annular groove 38^a is provided in the outer wall of the piston in position to receive an annular packing ring 39^a, as shown.

Inwardly extending detents 41^a, 42^a and 45 are carried by the piston 34^a in position to engage opposite sides of the rollers 31^a and 31^b, as shown in FIGS. 6 and 7 whereby upon movement of the piston 34^a relative to the cylinder 10^a, the outer ends of the arms 29^a and 29^b are moved to thereby impart rotary motion to the actuator shaft 26^a. That is, the roller 31^a is adapted to move between the detents 41^a and 42^a while the roller 31^b is adapted to move between the detents 41^a and 45. As shown in FIG. 8, the upper surfaces of the detents 41^a, 42^a and 45 are slightly below the under surfaces of the arms 29^a and 29^b whereby the arms are adapted to move relative to the detents while the rollers engage the detents upon movement of the piston 34^a. Preferably, the detents are defined by a cut-out in the piston 34^a in position to receive the arms 29^a and 29^b.

While I have shown the detents as being on one side of the piston 34^a, it will be apparent that a pair of detents could be provided at opposite sides of the piston 34^a and the arms 29^a and 29^b could be so arranged that they would engage their respective pairs of detents upon movement of the piston 34^a.

The ends of the actuator shaft 26 are provided with flattened portions 43^a, as described hereinabove relative to the apparatus shown in FIGS. 1–4, for operatively connecting the actuator shaft to the mechanism which is to be oscillated thereby.

The operation of the apparatus shown in FIGS. 6–8 is substantially identical to the operation of the apparatus shown in FIGS. 1–5. Instead of providing a single arm and roller for engaging the detents carried by the piston, more than one arm is provided whereby the shaft 26^a may be rotated a distance greater than 90°. For example, the apparatus shown in FIGS. 6–8 can be rotated through an annular distance of approximately 180°. As the piston 34^a is moved in a direction for one arm to leave the detents associated therewith, the other arm is in position to engage its recess whereby continued linear motion of the piston 34^a imparts oscillatory motion to the shaft 26^a.

From the foregoing, it will be seen that I have devised an improved oscillatory actuator in which maximum torque potential is developed with a minimum amount of linear travel of the operating mechanism. By forming the outwardly projecting arm as an integral part of the actuator shaft and providing detents within the piston 34 in position to engage the roller carried at the outer end of the arm, my improved apparatus embodies a minimum of parts and at the same time a light and compact unit is provided. Furthermore, my improved oscillatory actuator is adapted to be operated where relatively low input pressures are employed, such as in the range of 100 pounds per square inch 300 pounds per square inch.

While I have shown my invention in two forms, it will be obvious to those skilled in the art that it is not so limited but is susceptible of various other changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are specifically set forth in the appended claims.

What I claim is:

1. An actuator for converting fluid pressure to oscillatory motion comprising:
   (a) a cylinder,
   (b) an actuator shaft extending transversely through said cylinder and disposed for oscillation relative thereto,
   (c) a piston mounted for longitudinal movement within said cylinder,
   (d) there being at least one elongated opening through said piston extending longitudinally of said cylinder in position to receive said shaft whereby said piston is adapted for movement relative to said shaft,
   (e) means to introduce and exhaust fluid selectively adjacent opposite ends of said cylinder to move said piston selectively in opposite directions,
   (f) angularly spaced arms extending outwardly from said shaft, and
   (g) longitudinally spaced detents carried by said piston in position to engage outer portions of said arms and limit relative movement of said piston and said outer portions of said arms whereby said outer portions of the arms move with said piston to impart oscillatory motion to said shaft.

2. An actuator for converting fluid pressure to oscillatory motion as defined in claim 1 in which the piston is generally hollow with one end thereof being closed.

3. An actuator for converting fluid pressure to oscillatory motion as defined in claim 1 in which the detents

are defined by cut-out portions in said piston in position to receive said arms.

4. An actuator for converting fluid pressure to oscillatory motion as defined in claim 1 in which a rotatable element is carried by the outer end of each of said arms in position to lie between a pair of said detents.

5. An actuator for converting fluid pressure to oscillatory motion as defined in claim 1 in which said arms are formed integrally with said shaft.

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