

[54] **VACUUM MOTOR**

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[51] Int. Cl. **F01b 19/02**

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91/369, 369 A, 369 B, 357; 251/61; 73/407

[56] **References Cited**

UNITED STATES PATENTS

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[57]

ABSTRACT

The combination comprising a housing and a diaphragm separating said housing into a first and second chamber. An actuating rod is fixed to said diaphragm within said housing and has an end thereof extending through said second chamber to the exterior. A plunger surrounds the rod in the second chamber and a spring between the diaphragm and the plunger yieldingly urging the diaphragm and plunger apart. Interengaging means between the plunger and the rod limit the movement of the said diaphragm and plunger apart under the action of the spring. A second spring in said first chamber yieldingly urging the diaphragm toward the plunger. The first and second chambers have openings therein for communicating selectively with a source of vacuum or the atmosphere, whereby when said openings are in communication with the atmosphere, the diaphragm and the actuating rod are in an intermediate position; when vacuum is supplied to one of said chambers, the diaphragm and the actuating rod are moved to one side axially of said intermediate position; and when vacuum is subsequently supplied to the other chamber and the first-mentioned chamber is vented to atmosphere, the actuating rod is moved to another position on the opposite side of the intermediate position.

13 Claims, 2 Drawing Figures

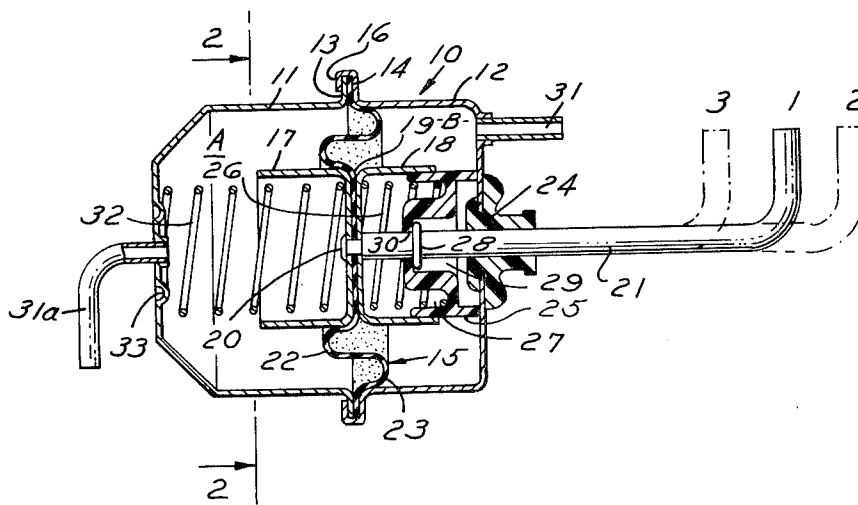


FIG. 1

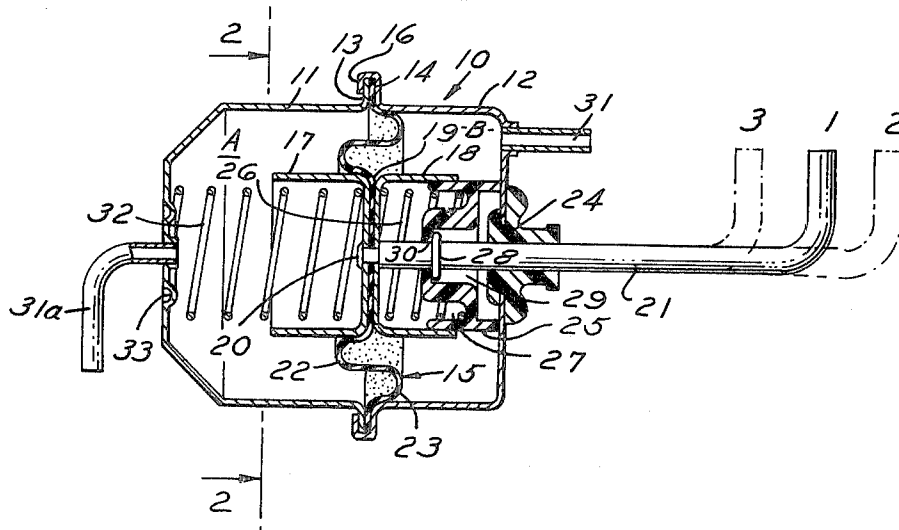
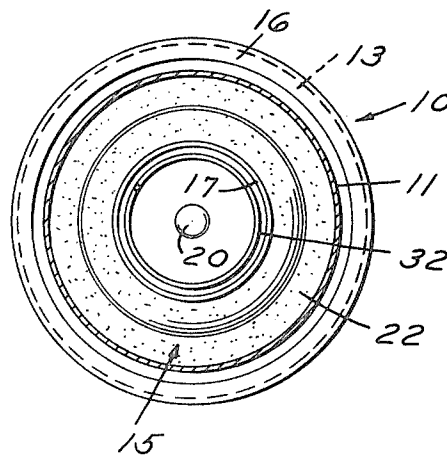


FIG. 2



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VACUUM MOTOR

BACKGROUND OF THE INVENTION

This invention relates to vacuum motors. Vacuum motors have commonly been used for actuating various devices. For example, as shown in the patent to James U.S. Pat. No. 3,380,349, issued Apr. 30, 1968, a vacuum motor is provided for moving an actuating rod to a plurality of positions therein shown as three. In such devices, the actuating rod is conventionally moved from a neutral position to successive positions longitudinally along the axis thereof.

Among the objects of the present invention are to provide a vacuum motor wherein the actuation rod is normally in intermediate position and when one source of vacuum is connected thereto, the actuating rod is moved to one side of the intermediate position, while when vacuum is supplied from the other source to the motor, the actuating rod is moved to another position on the opposite side of the intermediate position; which motor is relatively simple, includes positive means for insuring the proper positioning of the actuating rod; and which is relatively low in cost.

SUMMARY OF THE INVENTION

In accordance with the invention, the vacuum motor comprises a housing and a diaphragm separating said housing into a first and second chamber. An actuating rod is fixed to said diaphragm within said housing and has an end thereof extending through said second chamber to the exterior. A plunger surrounds the rod in the second chamber and a spring between the diaphragm and the plunger yieldingly urging the diaphragm and plunger apart. Interengaging means between the plunger and the rod limit the movement of the said diaphragm and plunger apart under the action of the spring. A second spring in said first chamber yieldingly urging the diaphragm toward the plunger. The first and second chambers have openings therein for communicating selectively with a source of vacuum or the atmosphere, whereby when said openings are in communication with the atmosphere, the diaphragm and the actuating rod are in an intermediate position; when vacuum is supplied to one of said chambers, the diaphragm and the actuating rod are moved to one side axially of said intermediate position; and when vacuum is subsequently supplied to the other chamber and the first-mentioned chamber is vented to atmosphere, the actuating rod is moved to another position on the opposite side of the intermediate position.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a longitudinal sectional view through a vacuum motor embodying the invention.

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

DESCRIPTION

Referring to FIG. 1, the vacuum motor 10 comprises a housing made of two generally cup-shaped metal halves 11, 12 which have flanges 13, 14 between which the periphery of a diaphragm 15 of resilient material is interposed. A portion 16 of flange 14 is turned over the flange 13 to clamp the diaphragm in position.

Cup-shaped washers 17, 18 are fixed on the central portion 19 of the diaphragm 15 by a rivet 20 on the end of an actuating rod 21 so that the assembly of the rod 21 and washers 17, 18 provides a connection to the diaphragm 15. The diaphragm 15 further includes a first annular portion 22 that is generally U-shaped in cross section and extends axially of the housing in one direction and a second U-shaped portion 23 that is generally U-shaped and extends axially in the opposite direction from the periphery of the first portion 22.

As further shown in FIG. 1, the rod 21 projects through the end of the housing half 12 and a resilient seal 24 of rubber or the like is provided between the rod and the housing.

A plunger 25 of rigid plastic or the like is telescoped over the actuating rod and within the cup-shaped portion of washer 18, the relationship between the outer diameter of the plunger 25 and the inner diameter of the washer 18 being such that air or vacuum can flow freely between the periphery of the plunger 25 and the interior of washer 18.

A spring 26 is interposed between washer 18 and the plunger 25, the spring being received in an annular groove 27 of the plunger. A ring 28 on the actuating rod 21 forms a shoulder that extends into a bore 29 of the plunger 25 and is adapted to engage a flange 30 to limit the extent to which the spring 26 can move the plunger 25 away from the washer 18.

By the construction shown, the housing 10 is divided into a chamber A and a chamber B.

Pipes 31a, 31 are provided to chambers A and B to provide for connection to a source for vacuum or to atmosphere. A spring 32 is interposed between the housing half 11 and the washer 17 to urge the diaphragm to the right as viewed in FIG. 1. The spring is located axially by an annular rib 33 in the end of the housing half 11.

In operation, when the openings of pipes 31a, 31 are vented to atmosphere, the diaphragm and in turn the actuating rod are in initial position 1 as shown in FIG. 1. In this position, the spring 26 exerts a force to the left on washer 18 and the actuating rod 21. The same spring 26 simultaneously exerts a force to the right on the plunger 25 causing the flange 30 to abut the shoulder 28 on the actuating rod. This holds the parts rigidly in the position shown. The spring 32 produces a force that tends to move the entire assembly toward the right until the plunger 25 engages the housing half 12.

When vacuum is supplied to pipe 31 and the chamber A is bled to the atmosphere, a pressure differential is provided on the diaphragm 15 causing the spring 32 to overcome the force of the spring 26 and move the diaphragm and in turn the actuating rod 21 to the right until the open end of the washer 18 engages the housing half 12. This moves the actuating rod to the broken line position 2 as shown in FIG. 1.

To move the actuating rod to position 3 on the opposite side of the intermediate position axially of the housing, chamber B is bled to atmosphere through opening 31. At the same time, vacuum is applied to chamber A through opening of pipe 31a. The differential pressure operating on the diaphragm provides an unbalanced force sufficient to overcome the force of the spring 32 to move the diaphragm to the left as viewed in FIG. 1 until the open end of the washer 17 engages the housing half 11. It may be noted that the spring 26 does not perform any function in moving the actuating rod to position 3 because the interengagement of the flange 30 and shoulder 28 is not broken when the actuating rod 21 moves to the left.

It can thus be seen that there has been provided a vacuum motor which has a neutral or intermediate position and when one source of vacuum is connected thereto, the actuating rod of the motor is moved to one side of the intermediate position while when vacuum is applied from another source or to another portion of the motor, the actuating rod is moved to a position on the opposite side of the intermediate position.

I claim:

1. The combination comprising

a housing,

a diaphragm separating said housing into a first and second chamber,

an actuating rod mounted for movement with said housing and having one end thereof fixed to said diaphragm and the other end extending through said second chamber, means providing a seal between said rod and said housing, a plunger in said second chamber surrounding said rod and positioned entirely within said second chamber,

first spring means between said diaphragm and said plunger yieldingly urging said diaphragm and said plunger apart, interengaging means between said plunger and said rod for limiting the movement of said diaphragm and plunger apart under the action of said first spring means,

second spring means in said first chamber yieldingly urging said diaphragm toward said plunger,

said first and second chambers having openings therein for communicating selectively with a source of vacuum or the atmosphere,

whereby when said openings are in communication with the atmosphere, said diaphragm and the actuating rod are in an intermediate position; and when vacuum is supplied to said first chamber and said second chamber is vented to atmosphere, said diaphragm and said actuating rod are moved to one side axially of said intermediate position against the action of said first spring means; and when vacuum is subsequently supplied to the second chamber and the first chamber is vented to atmosphere, the actuating rod is moved to another position on the opposite side of the intermediate position against the action of said second spring means.

2. The combination set forth in claim 1 including means limiting the extent of movement of said diaphragm and, in turn, the actuating rod in each of said directions away from said intermediate position.

3. The combination set forth in claim 2 wherein said last-mentioned means are provided on the diaphragm.

4. The combination set forth in claim 3 wherein said last-mentioned means comprises cup-shaped washers having free edges adapted to engage the housing.

5. The combination set forth in claim 1 wherein said interengaging means between said plunger and said actuating rod comprises a shoulder on one of said actuating rod and plunger and a flange on the other of said actuating rod and said plunger.

6. The combination set forth in claim 5 wherein said shoulder is on said actuating rod and said flange is on said plunger.

7. The combination set forth in claim 1 wherein said diaphragm has an intermediate generally flat portion, an outer annular portion which is generally U-shaped in cross section and extends in one axial direction, and a second annular portion connected to the periphery of said first annular portion which is generally U-shaped and extends in the opposite axial direction from said first diaphragm portion.

8. The combination set forth in claim 1 including locating means on said housing for locating said second spring means axially of said housing.

9. The combination comprising

a housing,
a diaphragm separating said housing into a first and second chamber,
an actuating rod mounted for movement with said housing and having one end thereof fixed to said diaphragm and the other end extending through said second chamber,

means providing a seal between said rod and said housing, means providing a seal between said rod and said housing, a plastic plunger in said second chamber surrounding said rod and positioned entirely within said second chamber, first spring means between said diaphragm and said plunger yieldingly urging said diaphragm and said plunger apart, interengaging means between said plunger and said rod for limiting the movement of said diaphragm and plunger apart under the action of said first spring means, second spring means in said first chamber yieldingly urging said diaphragm toward said plunger, said first and second chambers having openings therein for communicating selectively with a source of vacuum or the atmosphere,

whereby when said openings are in communication with the atmosphere, said diaphragm and the actuating rod are in an intermediate position; and when vacuum is supplied to one of said first chamber and said second chamber is vented to atmosphere, said diaphragm and said actuating rod are moved to one side axially of said intermediate position against the action of said first spring means; and when vacuum is subsequently supplied to the second chamber and the first chamber is vented to atmosphere, the actuating rod is moved to another position on the opposite side of the intermediate position against the action of said second spring means,

means on said diaphragm adapted to engage said housing to limit the extent of movement of said diaphragm and, in turn, the actuating rod in each of said directions away from said intermediate position.

10. The combination set forth in claim 9 wherein said last-mentioned means comprises cup-shaped washers having free edges adapted to engage the housing, one of said washers being adapted to telescope over said plunger.

11. The combination set forth in claim 10 wherein said interengaging means between said plunger and said actuating rod comprises a shoulder on one of said actuating rod and plunger and a flange on the other of said actuating rod and said plunger.

12. The combination set forth in claim 11 wherein said shoulder is on said actuating rod and said flange is on said plunger.

13. The combination set forth in claim 11 wherein said diaphragm has an intermediate generally flat portion, an outer annular portion which is generally U-shaped in cross section and extends in one axial direction, and a second annular portion connected to the periphery of said first annular portion which is generally U-shaped and extends in the opposite axial direction from said first diaphragm portion.

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