March 21, 1961 P. F. GRACE 2,975,763

VACUUM SERVO SYSTEM

Filed Jan. 6, 1958 3 Sheets-Sheet 1

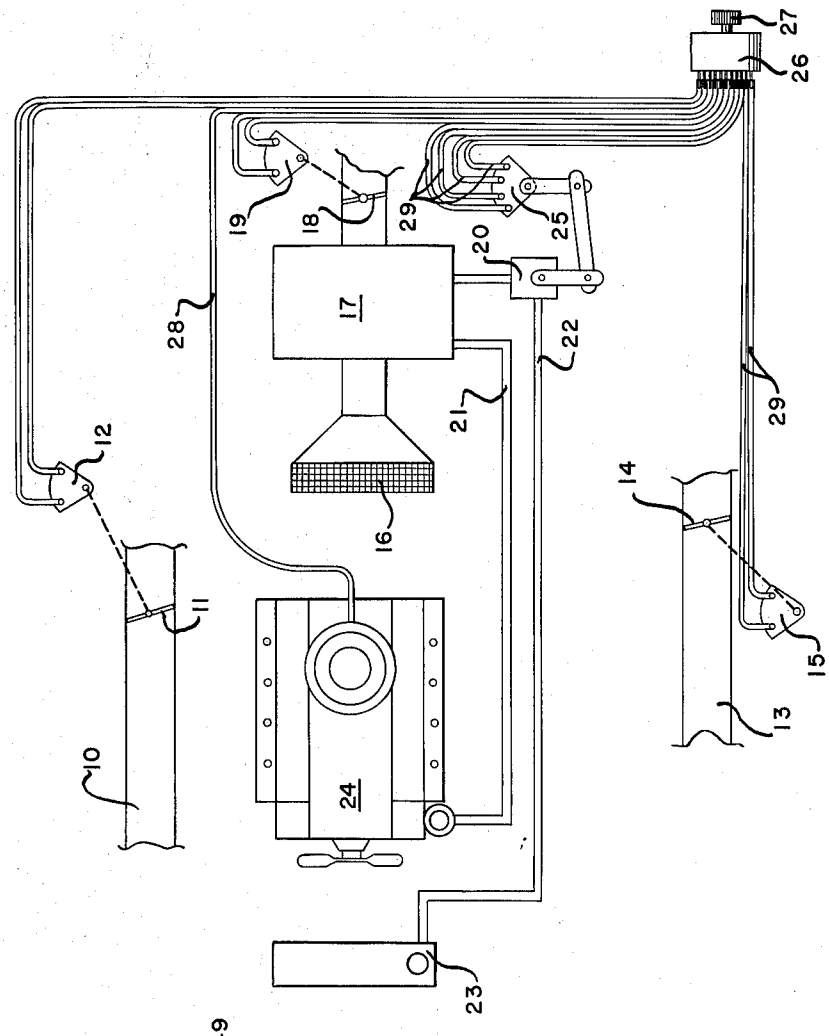


FIG. 1

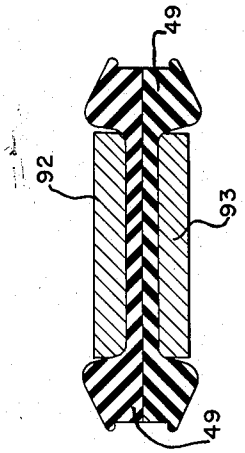


FIG. 5

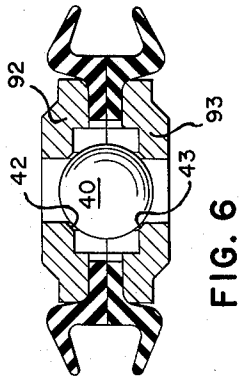


FIG. 6

P. F. GRACE
INVENTOR.

BY E. C. McRae
J. B. Faulkner
F. H. Osted

ATTORNEYS

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VACUUM SERVO SYSTEM

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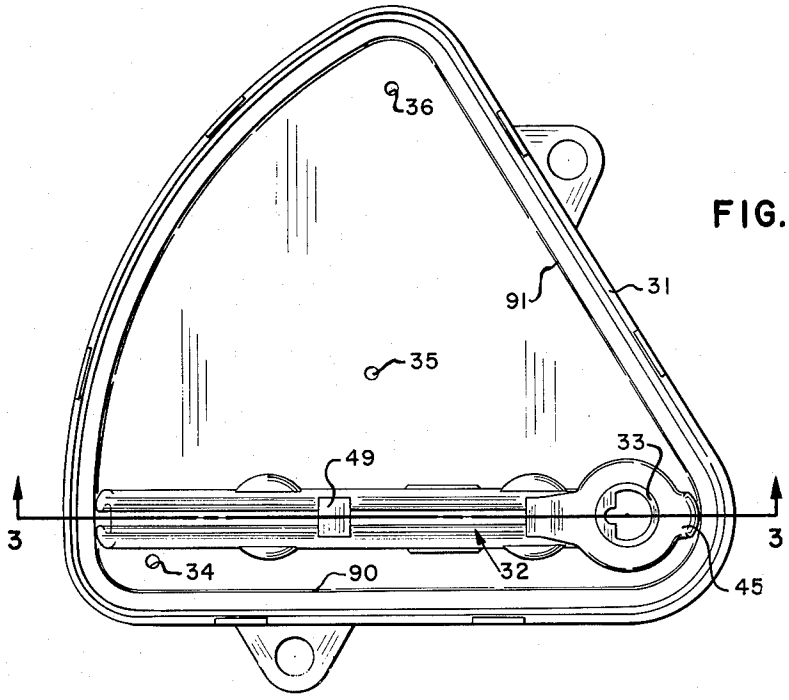


FIG. 2

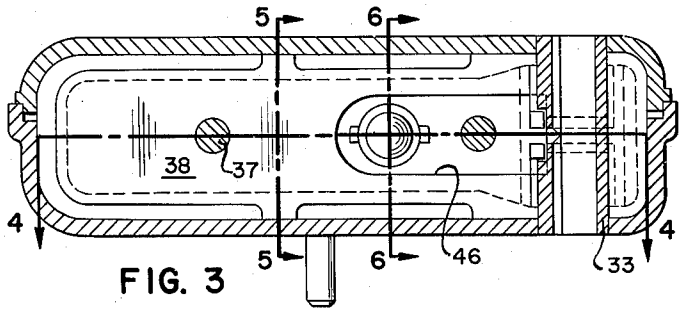


FIG. 3

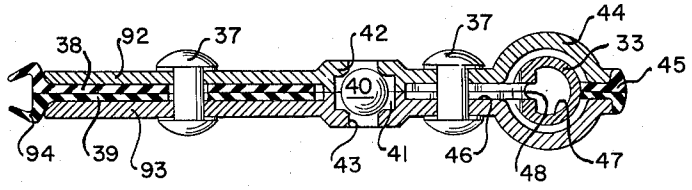


FIG. 4

P. F. GRACE
INVENTOR.

BY E. C. McRae
J. B. Faulkner
D. H. Oster

ATTORNEYS

March 21, 1961 P. F. GRACE 2,975,763

VACUUM SERVO SYSTEM

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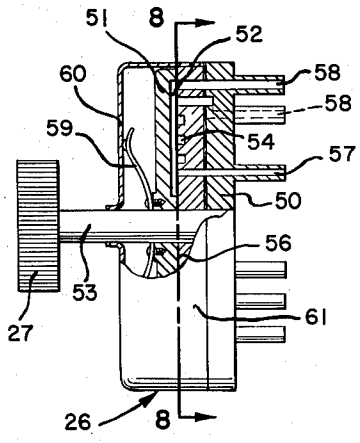


FIG. 7

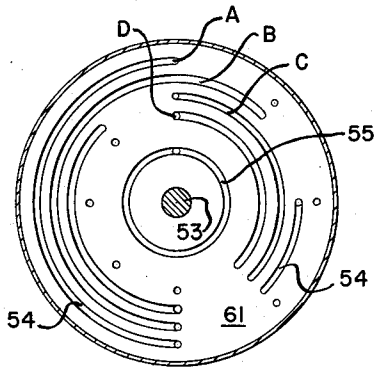


FIG. 8

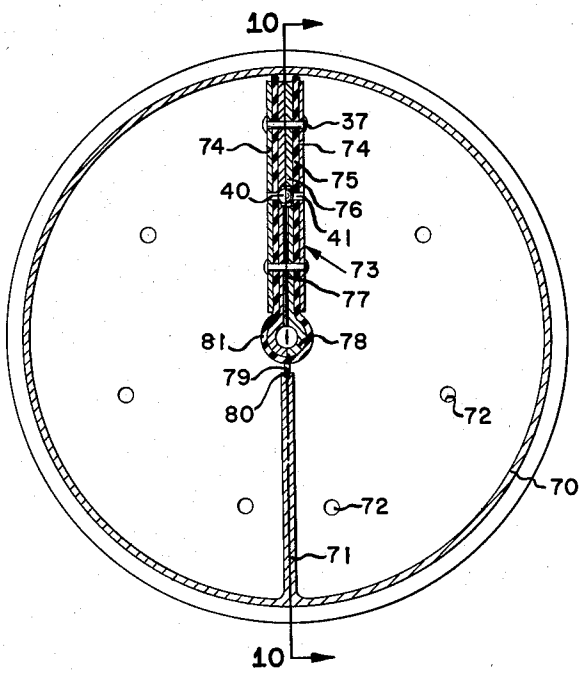


FIG. 9

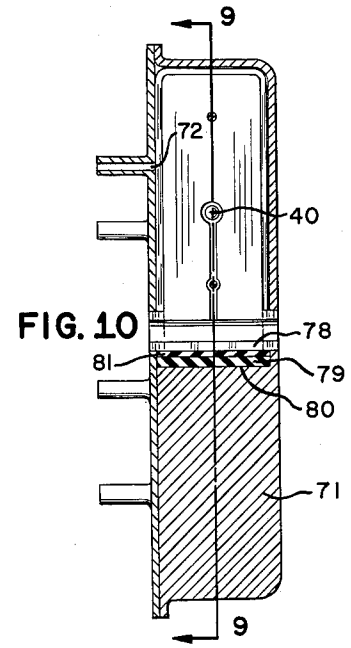


FIG. 10

P. F. GRACE
INVENTOR.

BY E. C. McRae
J. C. Faulkner
T. H. Oster

ATTORNEYS

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2,975,763

VACUUM SERVO SYSTEM

Philip F. Grace, Wayne, Mich., assignor to Ford Motor Company, Dearborn, Mich., a corporation of Delaware

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7 Claims. (Cl. 121—41)

My invention pertains to pressure servos and more particularly to a vacuum servo follow-up control system suitable for positioning controllable and movable portions of a motor car's air conditioning system.

An object of this invention is to provide a master control system wherein air conditioning controls are positioned from a single control point.

A further object is to provide a vacuum position indicator suitable for orienting a shaft in a plurality of predetermined positions.

Another advantage is the provision of a pressure motor for holding a shaft in any one of a plurality of positions.

A still further object is to provide a pressure follow-up system operable from a single pressure source.

These and other objects and advantages of my invention will become apparent from the following detailed description of an embodiment in which:

Figure 1 is a diagram of my invention as used to control a motor car's air conditioning system;

Figure 2 is a plan view of a position follow-up motor with the cover removed;

Figure 3 is a section through the motor along the line 3—3 of Figure 2;

Figure 4 is a cross-section of the motor vane taken along line 4—4 of Figure 3;

Figure 5 is a cross-section of the vane taken along line 5—5 of Figure 4;

Figure 6 is a further cross-section of the vane showing the air valve and taken along line 6—6 of Figure 3;

Figure 7 is a partial broken-away section of the control head;

Figure 8 is a plan view of the distributor block in the control head taken along line 8—8 of Figure 7;

Figure 9 is a sectional view of a vacuum follow-up motor with the cover removed and modified for greater than 180° rotation; and

Figure 10 is a section taken along line 10—10 of Figure 9.

In Figure 1 is a simplified motor car air condition or heating-ventilating arrangement on which my novel control system has been installed to position the movable system control shafts. A right-hand fresh air duct 10 has a damper valve 11 with its shaft mechanically linked to vacuum follow-up motor 12. Similarly, a left-hand fresh air duct 13 includes a damper valve 14 controlled by vacuum motor 15. A heater fresh air inlet duct 16 provides air for heater 17. A damper valve 18 in the heater controls the admittance of heated air into the passenger compartment. Damper 18 is positioned by vacuum motor 19.

Hot water is brought from engine block 24 to heater 17 through hose 21 and returned to radiator 23 through hose 22. Interposed in the water return hose 22 is temperature control valve 20. The position of valve 20 is controlled by vacuum motor 25.

Control or position selector head 26 receives vacuum through lead 28, and sends a vacuum signal to the several vacuum motors through leads 29 in accordance with the

position of knob 27, in a manner which will be subsequently explained in full in connection with the description of the operational units.

Referring to Figure 2, a vacuum position follow-up motor is seen having a case 31 in the form of a cylindrical segment. Case 31 has wall portions 90 and 91 forming vane reaction walls. Vane 32 is rotatably carried therein on shaft 33. Vacuum inlets 34, 35 and 36 are formed in one side of the case 31. The number of these vacuum inlets may be varied depending upon the total number of positions which it is desired that vane 32 be stopped and held.

The vane itself is formed as a sandwich of plates 92 and 93 and rubber gaskets 39 and 38. This sandwich is held together by rivets 37. A double acting check valve 41 is formed in the metal plates 92, 93 with a ball seat 42 in plate 92 and ball seat 43 in plate 93. Ball 40 is loosely held between the plates and may move in either direction to form a seal. Check valve 41 is in communication with hollow D portion 47 of shaft 33 by air passageway 46. Shaft 33 has a semi-circular recess 48 through which air may pass, and is generally D-shaped as shown to concentrically receive a similarly shaped control shaft of a movable air conditioning control.

Plates 92 and 93 form a semi-circular portion 44 surrounding shaft 33, and rubber gaskets 38 and 39 also take on this configuration and together form a held portion 45 which seals the bottom of vane 32 within case 31. Gaskets 38 and 39 are identical in form and include sealing flanges 94 which are compressed by case 31 to form an air tight seal. The portions of the gasket 38 and 39 which pass over vacuum inlet 35 are formed of a solid block of rubber 49 (Figure 5) to form an airtight seal over the inlet.

In the operation of the vacuum motor, a vacuum signal is applied to one of the inlets 34, 35, or 36 as determined by the manual setting of knob 27 on control head 26. The vane 32 will then be urged to move in accordance with the pressure differential across it. Valve 41 prevents air lock by admitting air to the opposite side of vane 32. Inlets 34 and 36 are shown at the extremity of vane movement, and are preferably positioned just beyond the free movement of vane 32 as a means for securely holding the vane in these end positions when vacuum is applied to one of these end inlets. Intermediate inlet 35 is positioned to coincide with solid rubber section 49 of vane 32 in order that the inlet may be completely sealed from air when the vane is centered over it. An advantage of this motor is that with vacuum applied at an intermediate inlet such as 35 the force of vacuum will always tend to keep the vane centered over the inlet. Of course, any number of intermediate inlets 35 may be used in accordance with the number of intermediate positions which it is desired to hold and maintain by the motor. For instance, when operating an air vent, one or two intermediate positions may be sufficient to provide the desired selectivity, but when controlling a heat control valve, such as by motor 25 on Figure 1, additional intermediate stopping positions may be desirable.

The transfer of ball 40 in check valve 41 is such as to seal the side on which the vacuum has been applied through a vacuum inlet and to provide an air inlet from recess 48 through passageway 46 formed between rubber gaskets 38 and 39 to the opposite side of the vane.

A control head or position selector 26 is shown in Figure 7. A distributor disc or rotor 51 is rotatably mounted on shaft 53 to turn within body 50. Distributor disc 51 has a radial distributing groove 52 formed in one side and communicates with concentric grooves and openings 54 in body 50. As best seen in Figure 8, body 50 forms a distributor or manifold 61 with a vacuum ring 55 and a plurality of vacuum pick-up stations

defining slots 54 cut into a planar face in cooperative relationship to the planar face 56 of distributor disc 51.

Vacuum is applied to the control head through inlet 57 in communication with vacuum groove 55, and is distributed to any of the outlet tubes 58 through radial groove 52. The position of groove 52 is controlled by the operator in accordance with the function which he wishes to select in the air conditioning system. Spring 59 assists in holding distributor disc 51 against manifold 61, and detents may be provided into cover plate 60 to assist the operator in selecting the desired function. Tubes 58 lead to vacuum motor positioning inlets such as inlet 35 in motor 31. The inlets of each vacuum position follow-up motor occupies its own radius of ports in the manifold. Each radius represents a different vacuum motor, and the control knob 60 may be rotated in a full 360°. In this example four radii A, B, C, and D are used representing the four vacuum motors 12, 15, 19, and 25 shown in Figure 1. By this manner a plurality of vacuum motors may be controlled from a single control head to "set in" a plurality of operating conditions.

In Figures 9 and 10 is seen a modified vacuum motor which incorporates the principles of the vacuum motor shown in Figure 2 but is adapted for greater than 180° of useable rotation. A body 70 takes the form of a cylinder with a vane 73 rotatably carried therein on its shaft 78. The body 70 contains a wall or reaction portion 71 which serves to divide the internal compartment into two portions and provides a reaction surface against which the differential pressures will operate to move the vane. Inlets 72 are formed in case 70 and are spaced from each other to provide a plurality of vane stopping positions. The vane itself is shown as having a slightly modified construction. A pair of inner plates 76 form the two halves of shaft 78 and provide a recess for the double acting check valve 41. Ball 40 of check valve 41 is loosely carried between plates 76. Plate 76 further provides an air passageway 77 which places check valve 41 in communication with air at atmospheric pressure. A single piece rubber gasket 75 is formed around inner plates 76 and provides the means of sealing the vane within the compartment. A pair of outer plates 74 are placed over the gasket 75 and serve to hold the gasket in place against the inner plates 74. The vane is held together by rivets 37. A recess 80 formed in the end of wall 71 serves to retain insert 79 which rides against the annular portion 81 of gasket 75. Insert 79 may be formed of hard rubber, felt, or any other material suitable to forming relatively air-tight gasket between the vane and wall 71. The operation of this embodiment is the same as that described in connection with the vacuum motor shown in Figure 2. However, this construction permits rotation exceeding 180° and the embodiment is useful for the control of positionable shafts where such greater rotation is desirable.

Although my invention has been described as employing vacuum as the motivating power, it is obvious that a pressure greater than atmospheric may be substituted therefore without departing from the scope of my invention as defined by the appended claims.

I claim:

1. In a vacuum motor, a vane housing, a pressure vane rotatably carried in said housing, a vane reaction wall in said housing, double acting valve means carried by said vane, said vane defining a passageway having one end in communication with said valve means and the other end opened into air at atmospheric pressure, said housing defining a plurality of vacuum inlets distributed at spaced intervals about the path of rotation of said vane, one of said vacuum inlets being disposed at each end of the housing outwardly of the path of rotation of said vane, said valve means operable upon application of vacuum to one of said inlets to seal one side of said vane from said passageway and at the same time to place the other side of said vane into communication with said passageway.

2. A pressure motor for positioning a movable element comprising a housing, a rotatable vane pivotally mounted within said housing and movable in an arc in sealing relationship to said housing, a plurality of spaced pressure inlets adapted to be selectively connected to a source of pressure for applying a differential pressure to said vane, a passageway in said vane open to both sides of the vane, valve means in said passageway; said valve means operable to seal off said passageway on one side of the vane upon the application of differential pressure to said vane.

3. A vacuum motor adapted to be connected to a source of vacuum and adapted to position a movable element in response to the application of vacuum comprising a chamber, a vane member pivotally mounted in said chamber for reciprocating movement therein, sealing means on said vane in engagement with said chamber, a plurality of spaced vacuum inlets in said chamber and adapted to be connected to the source of vacuum, a first passage extending transversely through said vane, a second passage connecting said first passage to atmosphere, and valve means interposed in said first passage operable upon the application of vacuum to block off said first passage on the side of the vane adjacent to said application of vacuum.

4. A vacuum motor adapted to be connected to a source of vacuum and adapted to position a movable element in response to a predetermined vacuum signal comprising a chamber, a vane member, means pivotally mounting said vane member within said chamber for a predetermined reciprocal arcuate movement in response to a predetermined vacuum signal, a vacuum inlet adapted to be connected to the source of vacuum disposed in the chamber at each end of the chamber to define the outer extremes of the arcuate path of the vane member, at least one additional vacuum inlet adapted to be connected to the source of vacuum disposed between said first mentioned inlets in the path of said vane, a transversely extending passageway in said vane having an opening on each side of said vane, a ball member freely movable in said passageway to one of three positions, one of said positions closing the opening on one side of the vane, another of said positions closing the opening on the opposite side of said vane, and the last of said positions being disposed in said passageway in a non-closing position to said openings, a second passageway open to said first passageway and to atmosphere whereby the application of vacuum through one of said vacuum inlets will cause a differential pressure upon said vane causing said ball to move to one of said three positions.

5. The structure defined by claim 4 which is further characterized in that said means pivotally mounting said vane within said chamber comprises a shaft journaled in said vane, that said second passageway is disposed longitudinally through said vane, and an opening adjacent to said shaft communicating with atmosphere.

6. The structure defined by claim 4 which is further characterized in that said vacuum inlets at each end of the chamber are disposed outwardly of said vane travel whereby a continuous vacuum signal may be maintained to hold said vane in a predetermined extreme position.

7. The structure defined by claim 4 which is further characterized in that at least one of said vacuum inlets disposed between said first mentioned inlets will upon the application of vacuum through said inlet cause said vane to move arcuately until said vane has covered said vacuum inlet and shut off said vacuum.

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5

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