

Description

This invention relates to pneumatic positioners. More particularly, but not exclusively, the invention relates to pneumatic converters in positioners which employ an air supply to drive a piston or diaphragm of a pneumatic actuator to a position called for by a control signal.

In a known type of pneumatic positioner, a signal capsule is attached to one end of a vane and a relay structure is attached to the other end of the vane. A nozzle is positioned proximate to the vane intermediate the signal capsule and relay structure. The nozzle is continually pressurized by a source of compressed air. In operation, an increasing pneumatic input control signal applied to the signal capsule moves the vane towards the nozzle so as to decrease the clearance between the vane and the nozzle and thereby increase the nozzle back pressure. The back pressure, acting against a supply pressure, moves the relay structure so as to proportionately open and close air supply and exhaust valves to regulate the air supply or exhaust and provide a signal pressure differential that displaces a final control element. The amount by which the relay structure moves is determined by the distance the vane moves away from the nozzle, decreasing nozzle back pressure, and causing the motion of the relay structure to cease. The displacement motion of the final control element is fed back to the vane by a range spring. When a force balance is reached between the range spring and the input signal, the relay structure returns to a neutral position. The final control element is then in equilibrium with the input control signal. A decreasing input control signal reverses the sequence.

The nozzle essentially functions as a fulcrum in relation to the signal capsule and relay structure on the vane. The operational relationship between the signal capsule, the nozzle, and the relay structure is dependent upon the positions of these three parts along the vane. For a given position, the motions are fixed.

US Patent No. US-A-3 047 002 discloses a pneumatic positioner comprising a nozzle connected to a source of air under pressure, a flat vane juxtaposed adjacent to the outlet of the nozzle, input means operatively connected to the vane for pivotally moving the vane relative to the outlet to variably restrict the outflow of air from the outlet and vary the backpressure of the nozzle, output means operatively connected to the vane and responsive to the nozzle backpressure to provide negative feedback to the vane, and mounting means mounting the nozzle for movement with respect to the vane.

According to the invention there is provided a pneumatic positioner as set forth in the preceding paragraph, characterised in that the output means is a signal generating means for generating an output signal, the vane comprises an elongate strip having an O-shaped recess disposed between opposed legs of the strip, the input

means and the output means are connected to first and second ends, respectively, of the vane, the nozzle is juxtaposed to a portion of the vane intermediate the first and second ends, the mounting means comprises an elongate stem that extends into the O-shaped recess between the legs of the strip and a disc that is mounted on the stem for rotation, and the nozzle is mounted in the disc for movement therewith with the outlet of the nozzle continuously aligned with the vane along a path between the first and second ends.

In a preferred embodiment of the invention described hereinbelow, the magnitude of the motion of the signal generating means (relay structure) and, hence, the amount of air supply or exhaust, is changed by varying the position of the nozzle relative to the vane, the input means (signal capsule) and the relay structure. Since the travel of the signal capsule is fixed for any signal pressure change greater than one percent of the input span, the motion or travel of the relay structure is dependent upon the position of the nozzle. The actual motion of the centre of the relay structure is dependent on the position of the nozzle in relation to the signal capsule and relay structure. If the fulcrum established by the nozzle is positioned midway between the signal capsule and relay structure, the motion of the centre structure is equal to the motion of the signal capsule. If the fulcrum established by the nozzle is moved closer to the signal capsule, the centre structure must move farther to restore the nozzle back pressure to its balance level. Locating the fulcrum established by the nozzle closer to the centre structure results in the centre structure having to move less to restore nozzle back pressure. Since the amount which the supply and exhaust valves open is directly related to the motion of the centre structure, the position of the nozzle will control the air delivery or gain of the positioner. In this way, the positioner gain can be adjusted over a broad span. In the preferred embodiment, rotation of the disc moves the nozzle along the length of the vane so that air issuing from the outlet of the nozzle can impinge upon the vane at different locations along the length of the vane.

The invention will now be further described, by way of illustrative and non-limiting example, with reference to the accompanying drawings, in which like reference numerals designate like or corresponding parts throughout, and in which:

Figure 1 is a vertical side section of a pneumatic positioner embodying the invention;

Figure 2 is a schematic illustration of a positioner embodying the invention;

Figure 3 is a plan view of the vane of Figure 1; and

Figure 4 is an elevational view of the vane of Figure 3.

A pneumatic positioner 10, shown in Figure 1, comprises an input or signal capsule assembly 11 mounted to a relay housing 12.

The signal capsule assembly 11 has a rod 13 connected to a central support 14 that is movable

within a cylinder type housing 15. The central support 14 is radially bounded by axially spaced diaphragms 16, 17 that are mechanically interconnected to upper or lower end portions of the central support 14 and the housing 15 to define a chamber 18. The central support 14 may move in response to the pressure within the chamber 18.

A vane assembly comprises a link 21 which is connected to the axially lower end of the central support 14 as oriented in the figures. The link 21 is connected to a first end of a vane 22 by a first flexible membrane 23 attached to the link 21 to define a first pivot point for the vane. The vane 22 has the form of an elongate strip (see Figure 3); more specifically, it comprises an O-shaped recess disposed between opposed legs of the strip. The opposite, second end of the vane 22 is connected via a second flexible membrane 24 to a vertical connection link 25 that is suspended from the second flexible membrane and terminates in a transversely extending stub 26 at its lower end.

A nozzle 30 is juxtaposed in vertical alignment with the vane 22. The nozzle 30 is connected to a source of air under pressure as is shown schematically in Figure 2. Air issuing from the outlet of the nozzle 30 impinges upon the vane 22. The nozzle 30 is mounted within a disc 31 which is rotatably fitted about a central stem 32. The stem 32 extends through the O-shaped recess in the vane 22. Rotation of the disc 31 about the stem 32 repositions the nozzle 30 relative to the length of the vane 22 between the ends of the legs of the vane along an arc so that the outlet of the nozzle 30 is continuously vertically aligned with the vane 22. Movement of the vane 22 towards and away from the nozzle 30 outlet varies the restriction formed therebetween and, hence, changes the air outflow and back pressure in a nozzle back pressure line 39 upstream of the nozzle.

The vertical connection link 25, as shown in Figure 1, is attached to a connection link 27 of a relay centre structure 28, whereby the relay centre structure is connected to the second end of the vane 22 via the flexible membrane 24.

The relay centre structure 28 is mounted for rectilinear movement, in a direction parallel with the vertical connection link 25, within an elongate portion of the relay housing 12.

Figure 2 is a flow diagram schematically representing the pneumatic passages, chambers and valves of the positioner in relation to the vane, nozzle, input capsule and relay structure.

In operation, a stream of air is continuously discharged through the outlet of the nozzle 30 which is connected to a source (not shown) of air under pressure and directed to impinge upon the vane 22 which is movably attached to the central support 14 and relay centre structure 28. An increasing input to the chamber 18 will move the signal capsule 11 and vane 22 towards the nozzle 30. As the vane 22 is caused to move towards the outlet of the nozzle 30, the restriction at the outlet causes an increase in the back pressure in the nozzle back pressure line 39 and hence in a nozzle back pressure chamber 40. This causes the relay

centre structure 28 to move upwardly (in accordance with the orientation of the drawings) against the pressure exerted by a supply pressure reference chamber 33 until the vane 22 moves away from the outlet of the nozzle 30. In moving towards a secondary output chamber 42, a secondary chamber valve 44 seats on the relay centre structure 28 and opens in secondary supply chamber 34 in proportion of the motion; a primary chamber valve 43 seats on a primary supply chamber 35 and opens in the centre structure 28 to a relay exhaust 36 in proportion to the motion of the relay centre structure 28. The net result is an increase in the output of the secondary output chamber 42 and a decrease in the output of a primary output chamber 46. A positive force is maintained on the primary chamber valve 43 by a spring 41 and on the second chamber valve 44 by a spring 45. The pressure differential between the primary output chamber 46 and the secondary output chamber 42 is utilised to displace a final control element (not shown). The terms "primary" and "secondary" are used herein solely to distinguish the respective chambers.

The displacement motion of the control element is fed back to the pneumatic positioner 10 through a range spring 50 which, for example, is pivotably interconnected to the rod 13 by a pivot arm 51. Thus, the range spring 50 together with the input or actuating pressure moves the vane 22 as desired. When a force balance is reached between the range spring 50 and the input signal, the relay centre structure 28 returns to a neutral position, closing the primary chamber valve 43 and the secondary chamber valve 44.

The motion of travel of the relay centre structure is dependent upon the position of the nozzle 30.

As described above, an increasing input will move the signal capsule 11 and vane 22 towards the nozzle 30. The resulting increase in the nozzle back pressure chamber 40 moves the relay centre structure 28. The relay centre structure 28 is mechanically linked to the opposite end of the vane 22 from the signal capsule 11. The direction of movement of the relay centre structure 28 provides negative feedback to the vane 22, moving it away from the nozzle. The motion of the relay centre structure 28 will continue until the vane 22 has been moved far enough away from the nozzle 30 to return the nozzle back pressure chamber 40 to its balance level. The actual motion of the relay centre structure 28 is dependent on the position of the nozzle 30 in relation to the signal capsule 11 and relay centre structure pivot points 23, 24. If the nozzle 30 is positioned midway between the two pivot points 23, 24, the motion of the relay centre structure 28 is equal to the motion of the signal capsule 11. If the nozzle 30 is moved closer to the signal capsule pivot 24, the relay centre structure 28 must move farther to restore the nozzle back pressure chamber 40 to its balance level. Locating the nozzle 30 closer to the relay centre structure pivot 23 results in the relay

centre structure 28 having to move less to restore the nozzle back pressure chamber to its balance level. Since the amount which the primary and secondary chamber valves 43, 44 open and close is directly related to the motion of the relay centre structure 28, the position of the nozzle 30 will control the air delivery or gain of the pneumatic positioner 10. In this way the positioner gain can be adjusted over a broad span.

Claims

1. A pneumatic positioner (10) comprising a nozzle (30) connected to a source of air under pressure, a flat vane (22) juxtaposed adjacent to the outlet of the nozzle (30), input means (11) operatively connected to the vane (22) for pivotally moving the vane (22) relative to the outlet to variably restrict the outflow of air from the outlet and vary the backpressure of the nozzle (30), output means (28 etc.) operatively connected to the vane (22) and responsive to the nozzle backpressure to provide negative feedback to the vane, and mounting means (31, 32) mounting the nozzle (30) for movement with respect to the vane (22), characterised in that the output means (28 etc.) is a signal generating means for generating an output signal, the vane (22) comprises an elongate strip having an O-shaped recess disposed between opposed legs of the strip, the input means (11) and the output means (28 etc.) are connected to first and second ends, respectively, of the vane (22), the nozzle (30) is juxtaposed to a portion of the vane (22) intermediate the first and second ends, the mounting means (31, 32) comprises an elongate stem (32) that extends into the O-shaped recess between the legs of the strip and a disc (31) that is mounted on the stem (32) for rotation, and the nozzle (30) is mounted in the disc (31) for movement therewith with the outlet of the nozzle continuously aligned with the vane (22) along a path between the first and second ends.

2. A pneumatic positioner according to claim 1, comprising a flexible membrane (23) interconnected between the input means (11) and the first end of the vane (22).

3. A pneumatic positioner according to claim 1 or claim 2, comprising a flexible membrane (24) interconnected between the second end of the vane (22) and the signal generating means (28 etc.).

4. A pneumatic positioner according to claim 3, wherein the signal generating means (28 etc.) comprises a cylindrical relay housing (12), a relay centre structure (28) slidably received in the housing, and a link (27) mechanically interconnected between the relay centre structure (28) and the flexible membrane (24) that is interconnected between the second end of the vane and the signal generating means (28 etc.).

Patentansprüche

1. Pneumatische Positioniereinrichtung (10) mit

einer Düse (30), welche an eine Quelle von unter Druck stehender Luft angeschlossen ist, einem flachen Blatt (22), welches unmittelbar an dem Ausgang der Düse (30) angeordnet ist, einer Eingabeeinrichtung (11), welche im Betrieb mit dem Blatt (22) verbunden ist, um dieses relativ zu dem Auslaß schwenkbar zu bewegen, um das Ausströmen von Luft aus dem Auslaß variabel einzuschränken und um den Rückstaudruck der Düse (30) zu verändern, einer Ausgabeeinrichtung (28 etc.), welche im Betrieb mit dem Blatt (22) verbunden ist und auf den Düsenrückstaudruck anspricht, um eine negative Rückkopplung für das Blatt bereitzustellen, und Festigungsmitteln (31, 32) zum Befestigen in der Düse (30), für eine Bewegung bezüglich des Blattes (22), dadurch gekennzeichnet, daß die Ausgabeeinrichtung (28 etc.) eine Signalerzeugungseinrichtung ist zum Erzeugen eines Ausgangssignales, daß das Blatt (22) einen länglichen Streifen aufweist, der eine O-förmige Aussparung hat, welche zwischen gegenüberliegenden Schenkeln des Streifens angeordnet ist, daß die Eingabeeinrichtung (11) und die Ausgabeeinrichtung (28 etc.) mit ersten bzw. zweiten Enden des Blattes (22) verbunden sind, daß die Düse (30) an einem Abschnitt des Blattes (22) angeordnet ist, welcher zwischen dem ersten und dem zweiten Ende liegt, daß die Befestigungseinrichtung (31, 32) einen länglichen Schaft (32) aufweist, welcher sich in die O-förmige Aussparung zwischen die Schenkel des Streifens erstreckt, sowie eine Scheibe (31) aufweist, welche auf dem Schaft (32) drehbar montiert ist, und daß die Düse (30) in der Scheibe (31) so montiert ist, daß sie sich mit dieser bewegt, wobei der Auslaß der Düse durchgehend mit dem Blatt (22) entlang einer Strecke zwischen dem ersten und dem zweiten Ende ausgerichtet sind.

2. Pneumatische Positioniereinrichtung nach Anspruch 1, mit einer flexiblen Membran (23), welche zwischen der Eingabeeinrichtung (11) und dem ersten Ende des Blattes (22) angeschlossen ist.

3. Pneumatische Positioniereinrichtung nach Anspruch 1 oder 2, welche eine flexible Membran (24) aufweist, die zwischen dem zweiten Ende des Blattes (22) und der Signalerzeugungseinrichtung (28 etc.) angeschlossen ist.

4. Pneumatische Positioniereinrichtung nach Anspruch 3, wobei die Signalerzeugungseinrichtung (28 etc.) ein zylindrisches Relaisgehäuse (12), einen zentralen Relaisaufbau (28), welcher gleitbar in dem Gehäuse aufgenommen ist, und ein Verbindungsglied (27) aufweist, welches mechanisch zwischen dem zentralen Relaisaufbau (28) und der flexiblen Membran (24) angeschlossen ist, welche zwischen dem zweiten Ende des Blattes und der Signalerzeugungseinrichtung (28 etc.) angeschlossen ist.

Revendications

1. Positionneur pneumatique (10) comprenant une buse (30) reliée à une source d'air sous

centre structure 28 having to move less to restore the nozzle back pressure chamber to its balance level. Since the amount which the primary and secondary chamber valves 43, 44 open and close is directly related to the motion of the relay centre structure 28, the position of the nozzle 30 will control the air delivery or gain of the pneumatic positioner 10. In this way the positioner gain can be adjusted over a broad span.

Claims

1. A pneumatic positioner (10) comprising a nozzle (30) connected to a source of air under pressure, a flat vane (22) juxtaposed adjacent to the outlet of the nozzle (30), input means (11) operatively connected to the vane (22) for pivotally moving the vane (22) relative to the outlet to restrict the outflow of air from the outlet and vary the backpressure of the nozzle (30), output means (28 etc.) operatively connected to the vane (22) and responsive to the nozzle backpressure to provide negative feedback to the vane, and mounting means (31, 32) mounting the nozzle (30) for movement with respect to the vane (22), characterised in that the output means (28 etc.) is a signal generating means for generating an output signal, the vane (22) comprises an elongate strip having an O-shaped recess disposed between opposed legs of the strip, the input means (11) and the output means (28 etc.) are connected to first and second ends, respectively, of the vane (22), the nozzle (30) is juxtaposed to a portion of the vane (22) intermediate the first and second ends, the mounting means (31, 32) comprises an elongate stem (32) that extends into the O-shaped recess between the legs of the strip and a disc (31) that is mounted on the stem (32) for rotation, and the nozzle (30) is mounted in the disc (31) for movement therewith with the outlet of the nozzle continuously aligned with the vane (22) along a path between the first and second ends.

2. A pneumatic positioner according to claim 1, comprising a flexible membrane (23) interconnected between the input means (11) and the first end of the vane (22).

3. A pneumatic positioner according to claim 1 or claim 2, comprising a flexible membrane (24) interconnected between the second end of the vane (22) and the signal generating means (28 etc.).

4. A pneumatic positioner according to claim 3, wherein the signal generating means (28 etc.) comprises a cylindrical relay housing (12), a relay centre structure (28) slidably received in the housing, and a link (27) mechanically interconnected between the relay centre structure (28) and the flexible membrane (24) that is interconnected between the second end of the vane and the signal generating means (28 etc.).

Patentansprüche

1. Pneumatische Positioniereinrichtung (10) mit

einer Düse (30), welche an eine Quelle von unter Druck stehender Luft angeschlossen ist, einem flachen Blatt (22), welches unmittelbar an dem Ausgang der Düse (30) angeordnet ist, einer Eingabeeinrichtung (11), welche im Betrieb mit dem Blatt (22) verbunden ist, um dieses relativ zu dem Auslaß schwenkbar zu bewegen, um das Ausströmen von Luft aus dem Auslaß variabel einzuschränken und um den Rückstaudruck der Düse (30) zu verändern, einer Ausgabeeinrichtung (28 etc.), welche im Betrieb mit dem Blatt (22) verbunden ist und auf den Düsenrückstaudruck anspricht, um eine negative Rückkopplung für das Blatt bereitzustellen, und Festigungsmitteln (31, 32) zum Befestigen in der Düse (30), für eine Bewegung bezüglich des Blattes (22), dadurch gekennzeichnet, daß die Ausgabeeinrichtung (28 etc.) eine Signalerzeugungseinrichtung ist zum Erzeugen eines Ausgangssignales, daß das Blatt (22) einen länglichen Streifen aufweist, der eine O-förmige Aussparung hat, welche zwischen gegenüberliegenden Schenkeln des Streifens angeordnet ist, daß die Eingabeeinrichtung (11) und die Ausgabeeinrichtung (28 etc.) mit ersten bzw. zweiten Enden des Blattes (22) verbunden sind, daß die Düse (30) an einem Abschnitt des Blattes (22) angeordnet ist, welcher zwischen dem ersten und dem zweiten Ende liegt, daß die Befestigungseinrichtung (31, 32) einen länglichen Schaft (32) aufweist, welcher sich in die O-förmige Aussparung zwischen die Schenkel des Streifens erstreckt, sowie eine Scheibe (31) aufweist, welche auf dem Schaft (32) drehbar montiert ist, und daß die Düse (30) in der Scheibe (31) so montiert ist, daß sie sich mit dieser bewegt, wobei der Auslaß der Düse durchgehend mit dem Blatt (22) entlang einer Strecke zwischen dem ersten und dem zweiten Ende ausgerichtet sind.

2. Pneumatische Positioniereinrichtung nach Anspruch 1, mit einer flexiblen Membran (23), welche zwischen der Eingabeeinrichtung (11) und dem ersten Ende des Blattes (22) angeschlossen ist.

3. Pneumatische Positioniereinrichtung nach Anspruch 1 oder 2, welche eine flexible Membran (24) aufweist, die zwischen dem zweiten Ende des Blattes (22) und der Signalerzeugungseinrichtung (28 etc.) angeschlossen ist.

4. Pneumatische Positioniereinrichtung nach Anspruch 3, wobei die Signalerzeugungseinrichtung (28 etc.) ein zylindrisches Relaisgehäuse (12), einen zentralen Relaisaufbau (28), welcher gleitbar in dem Gehäuse aufgenommen ist, und ein Verbindungsglied (27) aufweist, welches mechanisch zwischen dem zentralen Relaisaufbau (28) und der flexiblen Membran (24) angeschlossen ist, welche zwischen dem zweiten Ende des Blattes und der Signalerzeugungseinrichtung (28 etc.) angeschlossen ist.

Revendications

1. Positionneur pneumatique (10) comprenant une buse (30) reliée à une source d'air sous



pression, une palette plate (22) juxtaposée adjacente à la sortie de la buse (30), un moyen d'entrée (11) reliée de manière opérante à la palette (22) pour déplacer par pivotement la palette (22) relativement à la sortie afin de restreindre de façon variable l'échappement d'air de la sortie et modifier la contrepression de la buse (30), un moyen de sortie (28 etc) relié de manière opérante à la palette (22) et réagissant à la contrepression de la buse (30) pour fournir une réaction négative à la palette, et un moyen d'assemblage (31, 32) montant la buse (30) pour qu'elle se déplace relativement à la palette (22), caractérisé en ce que le moyen de sortie (28 etc) comprend une bande allongée comportant un évidement en O disposé entre les pattes opposées de la bande, le moyen d'entrée (11) et le moyen de sortie (28 etc) sont reliés aux première et seconde extrémités, respectivement, de la palette (22), la buse (30) est juxtaposée à une portion de la palette (22) entre les première et seconde extrémités, le moyen d'assemblage (31, 32) comprend une tige allongée (32) qui s'étend dans l'évidement en O entre les pattes de la bande et un disque (31) qui est monté sur la tige afin de tourner, et la buse

(30) est montée dans le disque (31) pour se déplacer avec ce dernier avec la sortie de la buse alignée continuellement avec la palette (22) le long d'un trajet entre les première et seconde extrémités.

2. Positionneur pneumatique selon la revendication 1, comprenant une membrane flexible (23) interconnectée entre le moyen d'entrée (11) et la première extrémité de la palette (22).

3. Positionneur pneumatique selon la revendication 1 ou 2, comprenant une membrane flexible (24) interconnectée entre la seconde extrémité de la palette (22) et le moyen de production de signal (28 etc).

4. Positionneur pneumatique selon la revendication 3, dans lequel le moyen de production de signal (28 etc) comprend un boîtier de relais cylindrique (12), une structure centrale de relais (28) reçue de manière à coulisser dans le boîtier, et une liaison (27) interconnectée mécaniquement entre la structure centrale de relais (28) et la membrane flexible (24) qui est interconnectée entre la seconde extrémité de la palette et le moyen de production de signal (28 etc).

30

35

40

45

50

55

60

65

5



* C L M S *