

Oct. 14, 1958

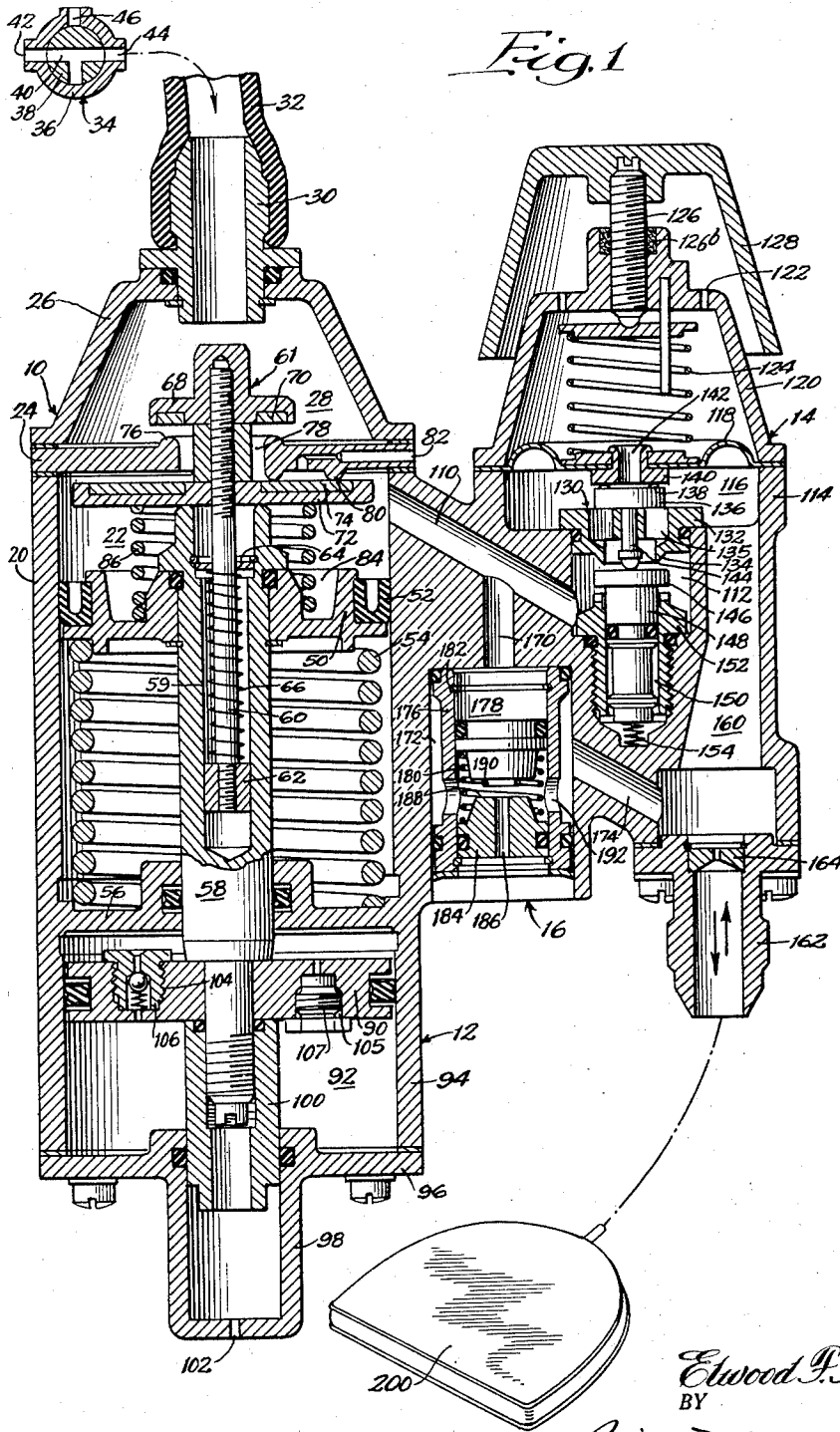
E. F. KNAPP

2,856,147

PULSATING SEAT CUSHION TIMING DEVICE

Filed March 28, 1955

2 Sheets-Sheet 1



INVENTOR:
Elwood F. Knapp
BY
Bair, Freeman & Molinare
ATTORNEYS.

Oct. 14, 1958

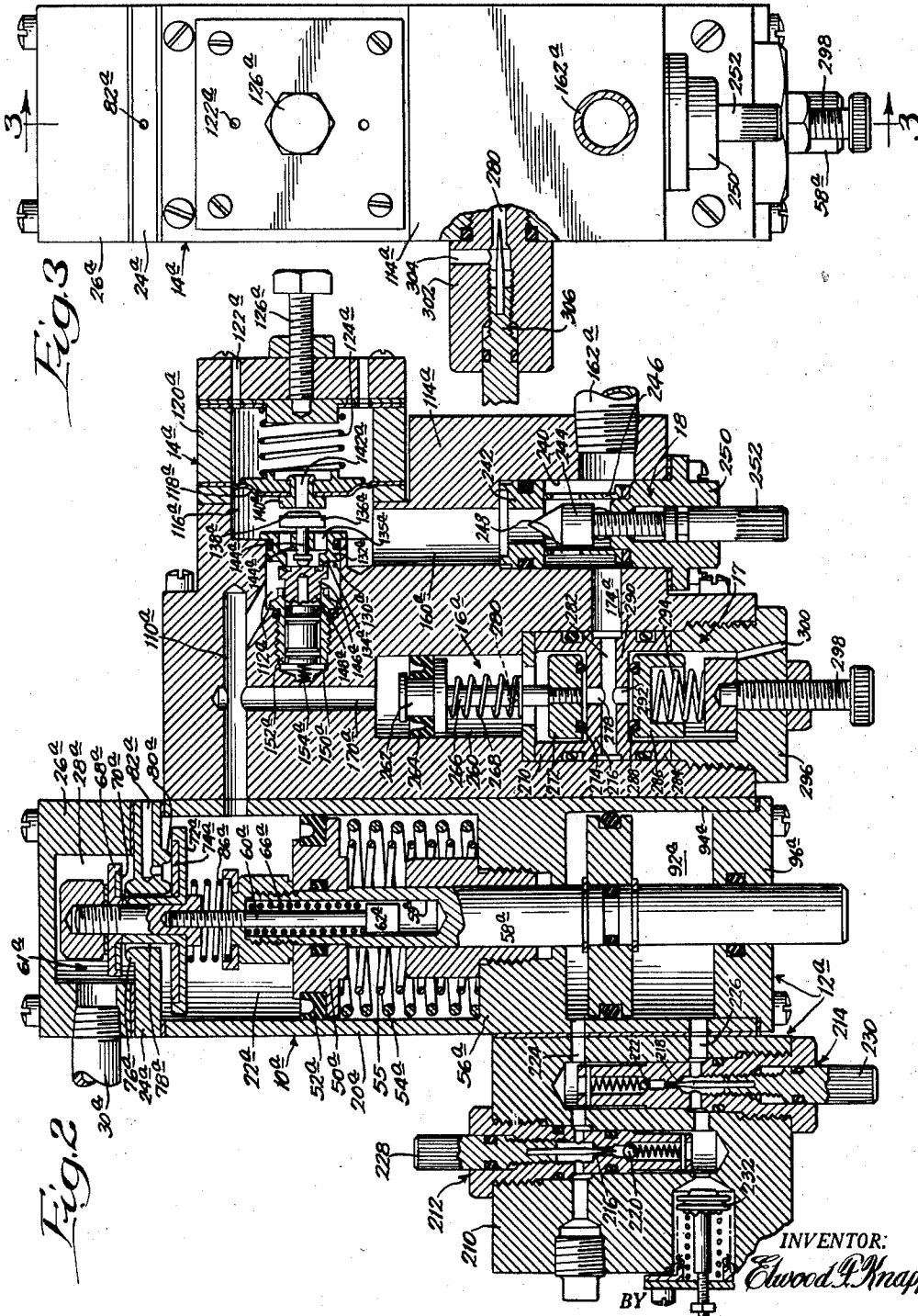
E. F. KNAPP

2,856,147

PULSATING SEAT CUSHION TIMING DEVICE

Filed March 28, 1955

2 Sheets-Sheet 2



INVENTOR:
Elwood F. Knapp,
BY
Bair, Freeman & Molinare
ATTORNEYS.

1

2,856,147

PULSATING SEAT CUSHION TIMING DEVICE

Elwood F. Knapp, Bryan, Ohio, assignor to ARO Equipment Corporation, Bryan, Ohio, a corporation of Ohio

Application March 28, 1955, Serial No. 497,064

14 Claims. (Cl. 251-13)

This invention relates generally to control means for an intermittently inflatable body, and more particularly to a timing device for a pulsating pneumatic seat cushion.

When a person sits or lies in a relatively fixed position for a long period of time, severe discomfort, fatigue, and compression pain are experienced in the gluteal or buttock muscles. Such discomfort is due to the compression effects resulting from the weight of the torso restricting circulation and nerve freedom. In piloted aircraft, for example, the fatigue problem during relatively long flights assumes considerable importance. Also, the comfort of bedridden patients frequently becomes a feature of considerable importance in accelerating recovery after illness. In the case of operations or wounds, for example, the hazard of blood clots is minimized.

It is known that such muscular pains and fatigue may be greatly alleviated through the use of pneumatic cushions or seat pads which serve to provide intermittent pulsations for effecting massage and circulatory stimulation of the pressure loaded body portions. It is a primary object of this invention, therefore, to provide an improved type of intermittently inflatable pneumatic body for alleviating the adverse effects of seated or prone confinement.

It is another object to provide control means for an intermittently inflatable body comprising a fluid motor adapted to receive a supply of compressed gas and operative to deliver a cyclically intermittent output pressure for alternately inflating and deflating the pneumatic body, wherein pressure regulatory means are provided for effecting pressure reduction in a controlled manner.

It is a further object to provide control means of the type described wherein hydraulic speed check means is provided to control the speed of cyclical operation of the air motor.

It is still another object to provide a control means of the type described including pressure regulatory means, hydraulic speed check means, inflation valve means, deflation valve means, and safety relief valve means, wherein each of the flow regulating valves may be independently adjusted for predetermining speed of air motor operation and pressure-rate of air flow through the system.

It is still a further object to provide an air motor for use with a control means of the type described, wherein said air motor is of novel construction for providing an efficient, reliable, and controlled cyclical operation.

Further objects and advantages of this invention will become apparent as the following description proceeds and the features of novelty which characterize this invention will be pointed out with particularity in the claims annexed to and forming part of this specification.

A preferred embodiment of the invention is shown in the accompanying drawing, in which:

Figure 1 is a vertical cross-sectional view of a pulsating seat cushion timing device construction in accordance with the present invention;

Figure 2 is a vertical cross-sectional view of a second

2

embodiment of the present invention, wherein adjustment means are provided for variably regulating the various pressure valving devices of the construction; and

Figure 3 is a top plan view, partly broken away and in horizontal section, of the construction shown in Figure 2.

Referring now more particularly to the embodiment illustrated in Figure 1, I have provided a construction comprising essentially a timing section and a control section. The timing section includes a fluid motor, indicated generally at 10, and a hydraulic speed check, indicated generally at 12. The control section includes a pressure regulator 14 and a deflation valve 16.

The motor 10 is preferably air operated for purposes of economy, but may utilize any conveniently available compressed gas, and comprises an air cylinder 20 defining a piston chamber 22 therein. A spacer and partition member 24 is disposed intermediate the air cylinder 20 and an upper cap member 26. The cap member 26 serves to define an upper valve chamber 28 therein. An inlet fitting 30 is carried by the cap member 26 and communicates by means of a flexible conduit 32 with a master control valve 34.

The control valve 34 comprises a housing 36 and a cooperating rotatable valve element 38. The valve element 38 provides a T-passageway 40 which selectively communicates with an inlet 42, an outlet 44, and a side vent 46 of the housing 36. It will be apparent that manual regulation of the master control valve 34 will serve to permit on-off control of a compressed air supply through the conduit 32. The control valve 34 when in its off position also serves to effect venting of the conduit 32 to atmosphere.

An air piston 50 is slidably reciprocable within the air cylinder 20, and provides a resilient wiping seal 52 for cooperation with the cylinder side wall. A piston return spring 54 is disposed with its upper end seated against the lower surface of the piston 50, and its lower end seated against a bottom wall 56 of the housing 20. The spring 54 is biased in compression and tends to urge the piston 50 upwardly toward the partition 24.

The piston 50 provides an elongated piston shaft 58 extending therethrough. The piston shaft 58 is formed with an internal bore 59 to receive the pull rod 60 of a poppet valve assembly 61. The pull rod 60 is provided with an enlarged head 62 at its lower end adapted for sliding engagement with the inner side wall of the bore 59. A retainer ring 64 is provided adjacent the upper end of the bore 59. A lower trip rod spring 66 is positioned between the rod head 62 and the retainer ring 64, and is biased in compression to provide a force tending to urge the pull rod 60 downwardly within the bore 59.

An upper valve plate 68 is carried by the pull rod 60 at its uppermost end, and provides a seal ring 70 at its lower surface. The upper valve plate 68 is disposed above the partition 24 and within the upper valve chamber 28. A lower valve plate 72 is carried by the pull rod 60 and provides a seal ring 74 at its upper surface. The lower valve plate 72 is disposed below the partition 24 and within the piston chamber 22.

The partition 24 is formed at its upper surface with an embossed lip providing a valve seat 76 and defining a main flow passageway 78 therethrough. The lower surface of the partition 24 is formed with an embossed lip providing a lower valve seat 80. The valve seat 80 communicates with an exhaust passageway 82 serving to permit venting of the piston chamber 22 to atmosphere.

The air piston 50 is formed with an annular recess 84 at its upper surface, which is adapted to receive the lower end of an upper trip rod spring 86. The upper end of the spring 86 engages the lower surface of the valve plate

72, and is biased in compression to exert a force tending to separate the lower valve plate 72 from the air piston 50.

The lower end of the piston shaft 58 extends downwardly through the bottom wall 56 of the air cylinder 20 into the housing or body portion of the hydraulic speed check 12. An oil piston 90 is carried by the piston shaft 58 and is slidably reciprocable within an oil chamber 92 defined by a housing or body portion 94. An oil chamber cap 96 serves to close the lower end of the housing 94, and provides an extended portion 98 which is adapted to slidably receive a bearing sheath 100 carried by the piston shaft 58 at its lower terminal end. The extended portion 98 is vented to atmosphere at 102, and serves to cooperate with the bottom wall 56 of the air cylinder 20 to guide the piston shaft 58 during reciprocation.

The oil piston 90 is provided with a pair of tapped holes 104 and 105 which provide flow communication from one side of the oil piston to the other. A pair of ball valve assemblies 106 and 107 are mounted within the holes 104 and 105, and are suitably spring biased in opposed directions for restricted oil flow through hole 104 as the oil piston 90 moves upwardly, and through hole 105 as the oil piston 90 moves downwardly.

A flow conduit 110 provides communication from the piston chamber 22 to a lower regulator chamber 112 formed within a pressure regulator housing or body portion 114. An upper regulator chamber 116 is formed within the housing 114 above the lower chamber 112. A fluid pressure responsive diaphragm 118 defines the upper limit of the chamber 116 and is fixedly secured to the housing 114 by means of a retainer cap 120. The volume enclosed by the retainer cap 120 is vented to atmosphere by a plurality of vent ports 122. A loading spring 124 is provided for determining the response of the diaphragm 118. An adjustment screw 126 is operatively connected to the loading spring 124, and serves to vary the spring compression to predetermine the loading force upon the diaphragm, as desired. A manual control knob 128 is provided for facilitating adjusting rotation of the screw 126. The knob 128 may be suitably calibrated to indicate the adjusting force of the spring 124 in terms of reduced pressure output of the regulator 14.

A regulator valve and seat assembly 130 is provided intermediate the chambers 112 and 116, and includes a valve support and seat member 132. A valve seat 134 is provided between member 132 within the lower chamber 112, defining a flow passageway 135 therethrough. A pressure relief valve 136 is slidably carried by the support member 132 for vertical reciprocatory movement. A half cross section O-ring seal 138 is carried by the top surface of the valve 136 for sealing cooperation with a valve seat 140 carried by the diaphragm 118. The valve seat 140 defines an exhaust passageway 142 therethrough.

The valve 136 provides a stem 144 which extends downwardly through the flow passageway 135 for cooperation with the head portion 146 of a regulator valve plunger 148. The plunger 148 is mounted for vertical reciprocation within the bore 150 of a plunger support member 152 which is fixedly screw-threaded within a recess underlying the lower regulator chamber 112. A loading spring 154, biased in compression, serves to urge the valve plunger 148 in an upward direction, tending to effect seating engagement of the head portion 146 with the valve seat 134.

An outlet passageway 160 is formed within the regulator housing 114 in communication with the upper regulator chamber 116, and leads to an outlet fitting 162. An orifice plate 164 is fixedly positioned within the passageway defined by the outlet fitting 162 to regulate the rate of flow therethrough.

A by-pass conduit 170 leads from the flow conduit 110 to a bore 172 within the body portion constituting the deflation valve section 16 of the construction shown. A conduit 174 provides flow communication from the bore

172 to the outlet passageway 160 of the pressure regulator. A piston cylinder 176 is fixedly positioned within the bore 172 in spaced relation to the side walls thereof. A piston 178 is slidably reciprocable within the cylinder 176, and is suitably loaded by means of a spring 180 which is biased in compression between the piston 178 and an orifice member 184 fixedly carried by the piston cylinder 176. An exhaust port 186 provides flow communication through the orifice member 184, and a valve seat surface 188 is defined by the upper end of the orifice member. A sealing ring 190 is carried by the piston 178 at its lower face for cooperative engagement with the valve seat 188 to effect closure of the port 186. A plurality of side ports 192 extend through the piston cylinder 176 to permit flow communication between the conduit 174 and the exhaust port 186.

A suitable flexible conduit, such as the element 32, may be secured to the outlet fitting 162 to provide flow communication with an inflatable seat cushion shown in perspective at 200.

The function and operation of the device shown in Figure 1 is substantially as follows: The master control valve 34 is manually turned to the open position, as shown in Figure 1, to supply a source of compressed air through the conduit 32 and inlet fitting 30 to the upper valve chamber 28. The poppet valve 61 is normally in its up or "air-in" position, as shown in Figure 1, and permits air to flow from the chamber 28 through the main flow passageway 78 into the piston chamber 22. The air piston 50 will be moved downwardly by the incoming air pressure, against the bias of the spring 54. The piston shaft 58 will also move downwardly, compressing the lower trip rod spring 66. When the trip spring has been sufficiently compressed to build up a predetermined force, the pull rod 60 will be drawn downwardly within the bore 59 to effect a closure of the upper valve elements 70 and 76. At the same time, the lower valve elements 74 and 80 will be moved apart to a valve-open position, permitting a venting of the air pressure within the piston chamber 22 through the exhaust passageway 82 to atmosphere.

The piston return spring 54, having been compressed during the downward stroke of the piston 50, is now free because of the release of air pressure from the piston chamber 22 to cause the piston 50 to move upwardly. When the piston 50 approaches the upper limit of its travel, the upper trip rod spring 86 will have been compressed so as to provide a sufficient force to move the pull rod 60 upwardly relative to the piston 50 to its former "air-in" position, thereby effecting closure of the lower or exhaust valve and opening of the upper or main flow valve. The reciprocatory cycle will then be repeated.

When the master control valve 34 is turned to its off position, air line supply pressure will be prevented from reaching the air motor 10, and at the same time residual air within the air motor will be vented through the control valve vent port 46 to atmosphere. In this way, the piston return spring 54 will always serve to drive the piston 50 to its uppermost position when the unit is turned off. This is necessary in order to prevent the air motor from being stalled in an intermediate position, resulting in a pressure load tending to prevent deflation of the seat cushion 200 when the device is turned off.

The oil chamber 92 of the hydraulic speed check 12 is filled with a suitable hydraulic fluid. Since the air piston 50 is directly connected to the oil piston 90 by means of the common piston shaft 58, the speed of reciprocating travel of the air motor is controllably restricted by the flow of hydraulic fluid through the ball valves 106 and 107. The valve 106 serves to control the upward speed of movement during the deflation portion of the motor cycle, and the valve 107 serves to control the downward speed of movement during the inflation portion of the motor cycle. The pressure regulator 14 is substantially conventional in operation and serves to reduce the supply pressure received from the air motor 10

through the flow conduit 110 to a suitable operating level. In practice, a pressure of about 20 p. s. i. from the air motor 10 will be reduced to a preselected pressure within the range of from about 1 to 5 p. s. i., adjustment being made by means of the screw 126 and loading spring 124.

The deflation valve 16 is actuated by the air supply from the air motor 10 through the flow conduits 110 and 170. When compressed air is actuating the air motor 10, air will also be supplied to the deflation valve piston 178, causing downward movement thereof to effect seating of the valve elements 188 and 190, thereby closing the exhaust port 186. In this way, the output air supply from the pressure regulator will not be permitted to vent through the deflation valve 16. During upward travel of the air motor piston 50, however, the pressure within the air motor piston chamber 22 will be vented to atmosphere, and at the same time the input air pressure to the pressure regulator 14 and to the deflation valve 16 will also be vented. The spring 180 will then serve to move the deflation valve piston 178 upwardly, thereby providing flow communication from the conduit 174, through the cylinder side port 192, and the exhaust port 186, to atmosphere. In this way, air within the seat cushion 200 will be permitted to escape to atmosphere, permitting deflation of the cushion.

The fixed orifice plate 164 serves as an inflation control means to restrict the air flow going from the pressure regulator 14 to the seat cushion 200. The orifice also serves to restrict return flow in the opposite direction from the seat cushion 200. It should be noted that a sudden over-load on the seat cushion will serve to transmit an excess pressure back through the outlet passageway 160 to the pressure regulator chamber 116. Such a back pressure will serve to deflect the diaphragm 118 upwardly, separating the pressure relief valve elements 136 and 138-140, and permitting a venting of the excess pressure to atmosphere. In this way, an immediate pressure relief may be effected without risk of injury to any of the working parts of the construction.

It will be apparent that the construction of the present invention serves to provide a cyclical operation of intermittent inflating and deflating of a pneumatic seat cushion. Operation is effected at a constant predetermined inflating pressure, in a constant timed cycle of alternate inflation and deflation. Provision is made for venting any excessive pressures due to sudden over-load on the seat cushion.

In Figures 2 and 3 of the drawing I have illustrated a second embodiment of this invention which includes all of the operating features shown in the construction of Figure 1 of the drawing, and incorporates additional pressure adjusting and regulating means for permitting a variety of pressure and operating adjustments, as desired.

The various structural elements of the embodiment of Figures 2 and 3 which are similar in purpose and function to corresponding parts of the arrangement shown in Figure 1, have been designated with the same numerals with the added letter designation "a," and will not be described in detail. The embodiment of Figures 2 and 3 includes a timing section, having an air motor 10a, and a hydraulic speed check 12a, and an air control section, having a pressure regulator 14a, a deflation valve 16a, and further providing a safety relief valve 17 and an inflate control valve 18. The essential differences of this embodiment from the construction of Figure 1 lie in the provision of valving adjustments for the hydraulic speed check 12a, the deflation valve 16a and the outlet orifice, together with the added feature of a safety relief valve.

The construction of the air motor 10a is substantially identical with the air motor 10 of Figure 1, two piston return springs 54a being employed in place of the single return spring 54 shown in Figure 1.

The ball valve assemblies 106 and 107 of Figure 1 are omitted from the oil piston 90a of Figure 2, and an adjustable flow valving means is provided in place

thereof. A supplemental valve housing or body portion 210 is disposed adjacent the oil chamber 92a. A needle valve assembly 212 for deflation timing during up stroke movement of the oil piston 90a, and a needle valve assembly 214 for inflation timing during down stroke movement of the oil piston 90a, are provided within the valve housing 210. The needle valves provide control orifices 216 and 218 respectively, and include spring loaded ball checks 220 and 222. Flow passages 224 and 226 communicate the opposite ends of the oil chamber 92a with the needle valves 212 and 214. Adjusting valve stems 228 and 230 permit the flow area of the control orifices 216 and 218 to be varied as desired.

It will be apparent that as the oil piston 90a moves downwardly through the oil chamber 92a during an inflation stroke of the air motor 10a, oil will be by-passed through the flow passage 226, control orifice 218, and flow passage 224 resulting in displacement from the lower side of the oil piston 90a to the upper side thereof. By regulating the area of the control orifice 218, the speed of the downward air motor stroke may be regulated. Similarly, during upward movement of the oil piston 90a, oil will flow through the flow passage 224, control orifice 216, and flow passage 226, resulting in displacement from the upper side of the oil piston 90a to the lower side thereof. Again, by varying the area of the control orifice 216, the upward speed of movement of the air motor 10a may be regulated. In this way, the speed and timing of the inflation and deflation portions of the air motor cycle may be independently and variably regulated.

A spring-loaded expansion bellows 232 is provided within the valve housing 210 in oil flow communication with the hydraulic circuit of the speed check 12a. The bellows 232 serves to accommodate fluid expansion and contraction which may occur within the hydraulic circuit due to variations in surrounding temperature.

The regulator 14a receives the air pressure output of the air motor 10a, and is substantially identical in structure and operation to the regulator 14 in Figure 1. The regulator 14a serves to provide a cyclically intermittent output pressure at a reduced pressure level, which may be variably regulated within a predetermined operating range. Exhaust valve means are also provided by the regulator to accommodate excessive back pressures which may occur during operation.

An outlet passageway 160a transmits flow from the regulator 14a to an outlet fitting 162a, in the manner of the structure of Figure 1. The fixed orifice plate 164 of Figure 1 is replaced, however, by an inflate control valve 18.

An enlarged bore 240 is formed within the housing 114a intermediate the flow means 160a and 162a. A metering plug 242 is fixedly positioned within the bore 240 and provides a passageway and valve seat. A metering valve 244 cooperates with the metering plug 242 to vary the orifice size and regulate pressure flow. A sleeve member 246 having side ports 248 surrounds the metering valve 244. A valve retainer plug 250 serves to maintain the various parts of the inflate control valve 18 in adjusted relation. An adjusting valve stem 252 cooperates with the valve retainer 250 to permit control movement of the metering valve 244 as desired. In this way, the rate of flow between the timing device and the pneumatic seat cushion may be further regulated independently of the pressure regulator 14a and the deflation valve 16a.

The exhaust or deflation valve assembly 16a is essentially identical in function, although somewhat different in construction and arrangement, as the valve 16 of Figure 1. A bore 260 is formed in the body portion which constitutes the deflation valve section 16a. The bore 260 communicates with the flow conduit 110a by means of a by-pass conduit 170a. A conduit 174a provides flow communication from the bore 260 through

the inflate control valve 18 to the outlet 162a. A piston 262 having a sliding seal 264 is vertically reciprocable within a relatively small diameter upper portion of the bore 260. A stem 266 extends downwardly from the piston 262. A spring 268 provides a biasing force tending to move the piston 262 in an upward direction.

A valve cylinder insert 270 is positioned in an enlarged diameter portion of the bore 260, and slidably receives an exhaust valve member 272 in loose relation therein. The valve member 272 is fixedly carried by the stem 266. A seal ring 274 is provided at the lower face of the exhaust valve member 272 and is adapted to cooperate with a valve seat 276 formed by the cylinder insert 270. A flow passageway 278 extends through the valve member 272 with the upper small diameter portion of the bore 260 when the seal ring 274 is unseated from the valve seat 276. A vent port 280 serves to communicate the upper bore with the atmosphere.

A flow space 282 underlies the valve seat 276 and provides communication between the flow passageway 278 and the flow passageway 174a. The deflation valve 16a is actuated by air pressure received directly from the air motor 10a. When pressure is exerted against the deflation valve piston 262, the valve member 272 is caused to seat, thereby closing the flow passageway 278 and preventing deflation or exhaust flow through the vent port 280.

It will be apparent that during upward travel of the air motor piston 58a, following exhaust of the pressure within the piston chamber 22a, air pressure against the piston 262 will also be vented. The spring 268 will then serve to unseat the valve member 272, allowing air within a seat cushion to pass along a return flow path inwardly through the outlet fitting 162a, past the inflate control valve 18, through the passages 174a, 282, 278, and 260, to the vent port 280. In this way, the seat cushion will be allowed to deflate.

A safety relief valve assembly 17 is additionally provided in the construction of Figures 2 and 3. The assembly 17 is structurally arranged in a convenient manner within the enlarged diameter portion of the bore 260 immediately below the deflation valve assembly 16a. A lower portion 284 of the deflation valve cylinder insert 270 defines a flow space 282 thereabove.

A safety valve member 286 is slidably received in loose relation within the insert 284, and carries a seal ring 288 for seating cooperation with a valve seat 290 formed by the insert 284. A flow passageway 292 extends through the valve seat 290 to the flow space 282. A loading spring 294 serves to bias the valve member 286 toward sealing engagement with the valve seat 290. A retainer plug 296 serves to maintain the various parts in assembled relation. An adjustment screw 298 is mounted within the retainer plug 296 and serves to vary the loading force of the spring 294, thereby permitting selective variation of the maximum pressure at which the valve member 286 will be forced to unseat. A vent passageway 300 extends through the retainer plug 296 to permit flow communication from the passageway 292 around the valve member 286 to atmosphere when the safety valve is unseated.

In practice, the safety valve 17 is set to relieve seat cushion pressure at about 2 to 3 pounds in excess of maximum operating pressure. The provision of the safety valve 17 in addition to the regulator exhaust valve 136a-140a is of particular importance in aircraft applications where pressure regulator failure may occur.

The deflation vent port 280 is adjustably regulated to permit control of the rate of deflation of the seat cushion. As best seen in Figure 3 of the drawing, a valve housing or body portion 302 provides an exhaust port 304 in flow communication with the outermost end of the vent port 280. A needle valve assembly 306 is mounted within the valve body 302, and serves to permit variable

adjustment of the escape orifice area between the ports 280 and 304. In this way, the deflation rate may be selectively controlled as desired.

The construction of Figures 2 and 3 operates in a substantially identical functional manner as the construction of Figure 1. Additional structural means comprising an inflation control valve 18 and a safety relief valve 17 are provided. Further, the hydraulic speed check 12a permits variable regulation of the downward and return strokes of the air motor 10a by means of needle valves permitting selective control of oil by-pass orifices. Still further, the deflation valve 16a is provided with a co-operating needle valve adjustment to permit regulation of the deflation rate.

Changes may be made in the construction and arrangement of the parts of my Pulsating Seat Cushion Timing Device without departing from the real spirit and purpose of my invention, and it is my intention to cover by the claims any modified forms of structure or use of mechanical improvements which may be reasonably included within their scope.

What I claim as new and desire to obtain by Letters Patent of the United States is:

1. Control means for an intermittently inflatable body comprising fluid motor means, pressure regulator means, and deflating valve means; said fluid motor having an inlet adapted to receive a supply of compressed gas and an outlet communicating with said pressure regulator means, said fluid motor means being automatically operative in response to a substantially constant inlet pressure to deliver a cyclically intermittent output pressure through its outlet to said pressure regulator, said pressure regulator means having an outlet and being operative to reduce said cyclically intermittent output pressure to a predetermined reduced cyclical pressure level and discharge a periodic inflating pressure through its outlet, and deflating valve means communicating with said fluid motor means outlet and with said pressure regulator means outlet.

2. Control means for an intermittently inflatable body comprising fluid motor means, pressure regulator means, and deflating valve means; said fluid motor having an inlet adapted to receive a supply of compressed gas and an outlet communicating with said pressure regulator means, said fluid motor means being automatically operative in response to a substantially constant inlet pressure to deliver a cyclically intermittent output pressure through its outlet to said pressure regulator, said pressure regulator means having an outlet and being operative to reduce said cyclically intermittent output pressure to a predetermined reduced cyclical pressure level and discharge a periodic inflating pressure through its outlet, and deflating valve means communicating with said fluid motor means outlet and with said pressure regulator means outlet, said deflating valve means being normally closed when said fluid motor means delivers an output pressure and opening when said fluid motor is not delivering an output pressure.

3. Control means for an intermittently inflatable body comprising fluid motor means, pressure regulator means, and deflating valve means; said fluid motor having an inlet adapted to receive a supply of compressed gas and an outlet communicating with said pressure regulator means, said fluid motor means being automatically operative in response to a substantially constant inlet pressure to deliver a cyclically intermittent output pressure through its outlet to said pressure regulator, said pressure regulator means having an outlet and being operative to reduce said cyclically intermittent output pressure to a predetermined reduced cyclical pressure level and discharge a periodic inflating pressure through its outlet, deflating valve means communicating with said fluid motor means outlet and with said pressure regulator means outlet, and safety relief valve means in flow com-

fluid motor is not delivering an output pressure, and said deflating valve means being adjustable to vary the rate of venting flow therethrough.

11. A fluid motor adapted to receive a supply of compressed gas and operative to deliver a cyclically intermittent output pressure, said motor comprising a piston cylinder defining a chamber therein, a piston reciprocally movable within said chamber, poppet valve means carried by said piston, partition means at one end of said cylinder defining a first valve seat and flow opening therethrough and a second valve seat and flow opening therethrough, said valve seats being spaced apart a fixed distance, said first flow opening being adapted to conduct a supply of compressed gas to said chamber and said second flow opening being adapted to communicate said chamber with the atmosphere, said poppet valve providing a pair of fixedly spaced valve heads adapted to cooperate with said first and second valve seats for alternatively closing one flow opening while opening the other, said piston chamber being adapted to communicate with an inflatable body, whereby when said first flow opening is open compressed gas will be transmitted through said chamber, and when said second flow opening is open said chamber will be vented and said first flow opening will be closed for discontinuing the gas supply through said chamber.

12. The combination of claim 1, wherein said fluid motor comprises a piston cylinder defining a chamber therein, a piston reciprocally movable within said chamber, poppet valve means carried by said piston, partition means at one end of said cylinder defining a first valve seat and flow opening therethrough and a second valve seat and flow opening therethrough, said valve seats being spaced apart a fixed distance, said first flow opening being adapted to conduct a supply of compressed gas to said chamber and said second flow opening being adapted to communicate said chamber with the atmosphere, said poppet valve providing a pair of fixedly spaced valve heads adapted to cooperate with said first and second valve seats for alternatively closing one flow opening while opening the other, said piston chamber being adapted to communicate with an inflatable body, whereby when said first flow opening is open compressed gas will be transmitted through said chamber, and when said second flow opening is open said chamber will be vented and said first flow opening will be closed for discontinuing the gas supply through said chamber.

13. A fluid motor adapted to receive a supply of compressed gas and operative to deliver a cyclically intermittent output pressure, said motor comprising a piston cylinder defining a chamber therein, a piston reciprocally movable within said chamber, poppet valve means operatively connected to said piston, partition means at one end of said cylinder defining a first valve seat and flow opening therethrough and a second valve seat and flow opening therethrough, said valve seats being spaced apart a fixed distance, said first flow opening being adapted to conduct a supply of compressed gas to said chamber and said second flow opening being adapted to communicate said chamber with the atmosphere, said poppet valve pro-

viding a pair of fixedly spaced valve heads adapted to cooperate with said first and second valve seats for alternatively closing one flow opening while opening the other, said piston chamber being adapted to communicate with an inflatable body, whereby when said first flow opening is open compressed gas will be transmitted through said chamber and when said second flow opening is open said chamber will be vented and said first flow opening will be closed for discontinuing the gas supply through said chamber, first resilient means biasing said piston toward said partition means to open said first flow opening and close said second flow opening, and second resilient means actuated by piston movement away from said partition means in response to gas pressure within said chamber for moving said poppet valve to close said first flow opening and open said second flow opening, thereby venting said chamber and allowing said first resilient means to return said piston to its initial position.

14. A fluid motor adapted to receive a supply of compressed gas and operative to deliver a cyclically intermittent output pressure, said motor comprising a piston cylinder defining a chamber therein, a piston reciprocally movable within said chamber, poppet valve means operatively connected to said piston, partition means at one end of said cylinder defining a first valve seat and flow opening therethrough and a second valve seat and flow opening therethrough, said valve seats being spaced apart a fixed distance, said first flow opening being adapted to conduct a supply of compressed gas to said chamber and said second flow opening being adapted to communicate said chamber with the atmosphere, said poppet valve providing a pair of fixedly spaced valve heads adapted to cooperate with said first and second valve seats for alternatively closing one flow opening while opening the other, said piston chamber being adapted to communicate with an inflatable body, whereby when said first flow opening is open compressed gas will be transmitted through said chamber and when said second flow opening is open said chamber will be vented and said first flow opening will be closed for discontinuing the gas supply through said chamber, first resilient means biasing said piston toward said partition means to open said first flow opening and close said second flow opening, second resilient means actuated by piston movement away from said partition means in response to gas pressure within said chamber for moving said poppet valve to close said first flow opening and open said second flow opening, thereby venting said chamber and allowing said first resilient means to return said piston to its initial position, and hydraulic speed check means mechanically connected to said piston for controlling the speed of cyclical reciprocation thereof.

References Cited in the file of this patent

UNITED STATES PATENTS

772,115	Thompson	Oct. 11, 1904
2,213,789	Wilkins	Sept. 3, 1940
2,338,760	Deming	Jan. 11, 1944
2,684,672	Summerville	July 27, 1954
2,720,887	Safford	Oct. 18, 1955