March 5, 1957 M. W. KISTLER 2,783,936

AIR COMPRESSORS OR THE LIKE

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FIG. 1

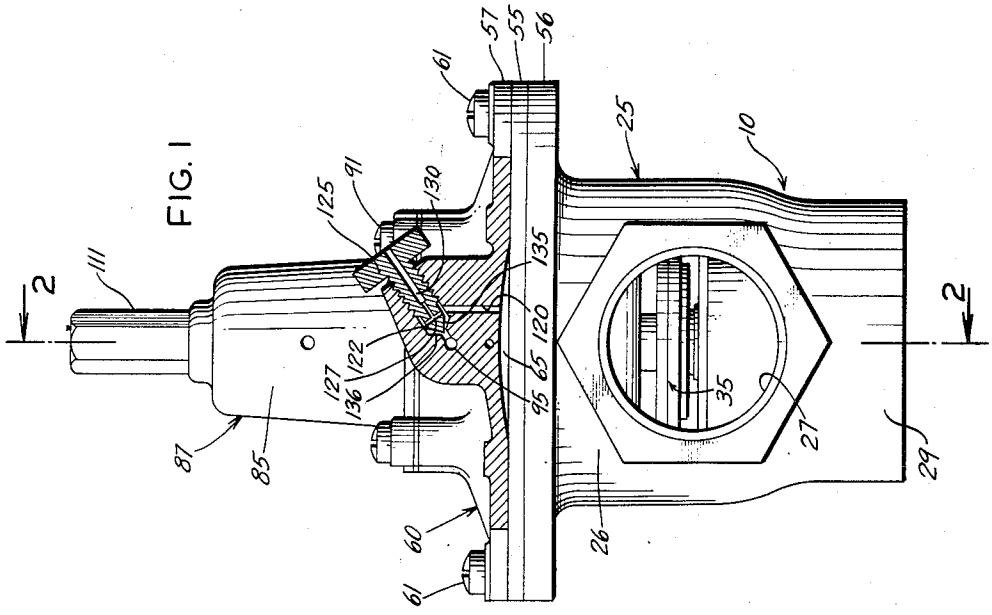
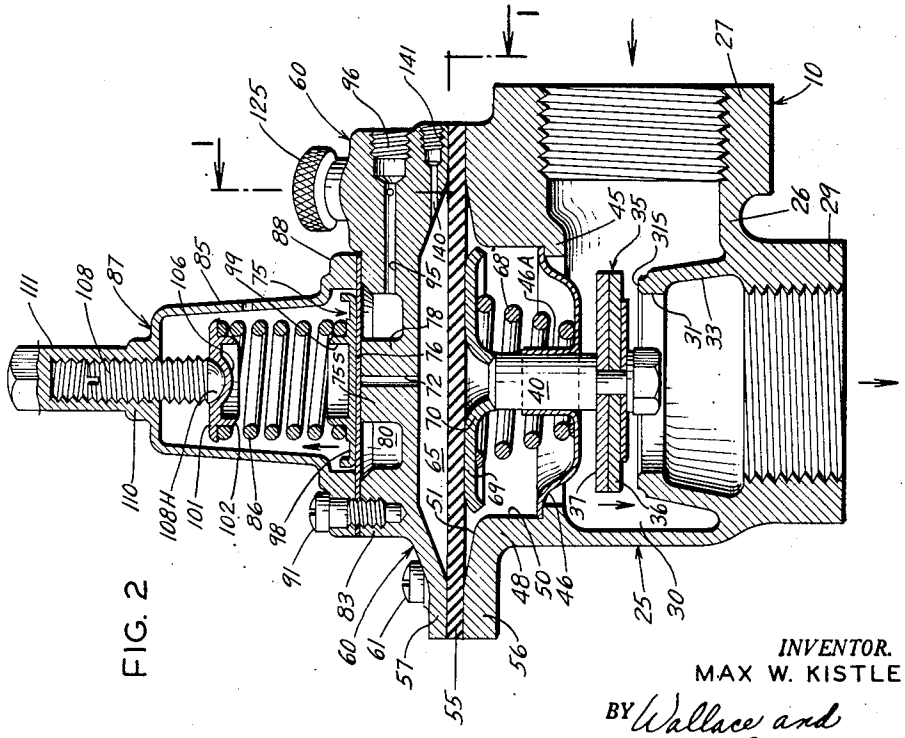


FIG. 2



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FIG. 3

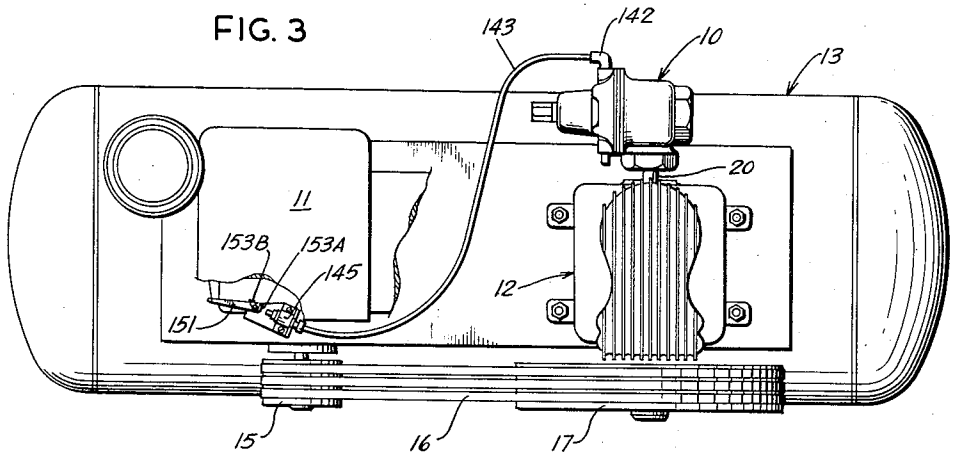
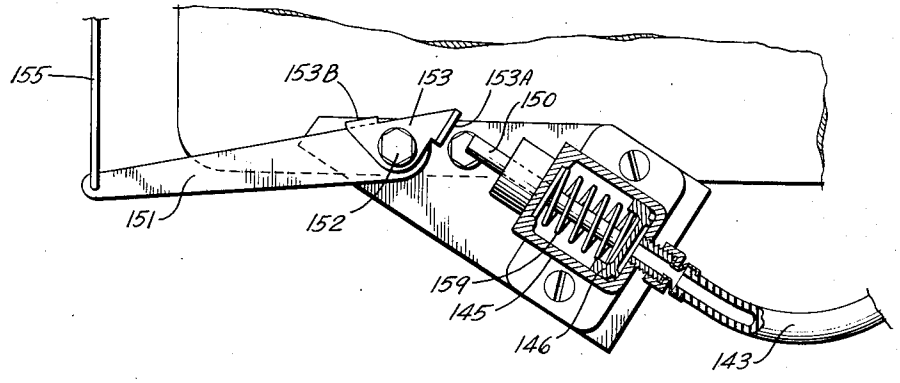


FIG. 4



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United States Patent Office 2,783,936
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2,783,936

AIR COMPRESSORS OR THE LIKE

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Application March 10, 1955, Serial No. 493,530

4 Claims. (Cl. 230—3)

This invention relates to an automatic unloader and speed regulator for use in connection with air compressors and the like.

Air compressors which are adapted to supply air under pressure to a storage tank usually include a so-called unloader attachment adapted to render the compressor ineffective to pump air under pressure to the tank when the pressure of the air in the storage tank is at a predetermined high value. Subsequently, as the tank pressure is gradually reduced by the use of compressed air stored therein, the unloader responds to such reduction at a predetermined low value of tank pressure and the compressor is thereupon reloaded for normal operation.

Unloading of the compressor has been accomplished primarily in two ways. In one instance, the compressor is normally loaded by a normally open valve afforded in the intake line for the compressor so that until unloaded the compressor draws air from the ambient atmosphere to be compressed, and when the compressor is to be unloaded this valve is closed in which case the supply of air to the compressor is interrupted. Unloaders of this kind have been referred to as being of the intake closing type.

In the second instance, the unloader is used to control the valve which admits air to the cylinder of the compressor on the down stroke of the piston. Thus, when unloading conditions have been reached at the tank, the unloader is operable to hold open the intake valve afforded for the compressor cylinder in which case no air is compressed. Unloaders of this kind have been referred to as being of the compressor valve opening type.

During the time that the compressor is unloaded, it is desirable that the engine or motor used to drive the compressor be idled inasmuch as at this time the compressor in effect is doing no work. Thus in those instances where the compressor has been driven by an electric motor, it has been common practice to use a pressure responsive switch which shuts off the motor when the upper limit of tank pressure has been attained and which restarts the motor automatically after the tank pressure has dropped by a predetermined amount. With engine driven compressors, on the other hand, arrangements for automatic starting and stopping of the engine have been of a complicated nature and have proven unreliable in practice, and for this reason it is common to keep the engine running at full speed during the unloading cycle of the compressor.

It will be appreciated from the foregoing that under many circumstances an engine driven air compressor will run at full speed for prolonged periods when the compressor is not required to pump air, and inasmuch as idling of the engine during the unloading cycle of the compressor would conserve fuel and reduce wear on both the engine and the compressor it is the primary object of the present invention to enable this to be accomplished in an efficient manner. More specifically, it is an object of the present invention to enable the speed of the engine for driving an air compressor to be controlled through

an unloader in such a way that the compressor is unloaded before the engine has been idled, and conversely, to bring the engine up to full speed before the compressor is again to be loaded. In this manner, assurance is had that the speed of the engine is not reduced until after the compressor has been unloaded, and on the other hand that the engine will be running at full speed when the compressor is to be again loaded.

Another object of the present invention is to enable speed regulation of the foregoing kind to be accomplished either with an unloader of the intake closing type or of the compressor valve opening type.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawings which, by way of illustration, show a preferred embodiment of the present invention and the principles thereof and what I now consider to be the best mode in which I have contemplated applying these principles. Other embodiments of the invention embodying the same or equivalent principles may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention and the purview of the appended claims.

In the drawings:

Figure 1 is an elevation of an unloader embodying a speed control, including a part in section taken in the line 1—1 of Figure 2;

Figure 2 is a sectional view taken in the line 2—2, Figure 1;

Figure 3 is a plan view of an air compressor assemblage including the unloader and speed controller of the present invention; and

Figure 4 is a detail view on an enlarged scale, partly in section, of the throttle control shown in Figure 3.

For purposes of disclosure, the unloader and speed regulator of the present invention has been illustrated as embodied in an unloader of the intake closing kind as will be described, and the way in which this may be modified for the valve opening type of unloader will be pointed out herein below.

In Figure 3, the unloader **10** of the present invention is illustrated in a well-known association, including an internal combustion engine **11**, a compressor **12** and a storage tank **13** to which air is pumped by the compressor. The engine **11** drives a pulley **15**, and this pulley in turn is connected by a belt **16** to the pulley **17** used to drive the compressor.

Air to be compressed by the compressor **12** is taken in by the compressor through an air inlet pipe **20**, and this pipe is connected to the unloader as will now be described.

In Figures 1 and 2 the unloader and speed controller **10** of the present invention is illustrated as embodied in an unloader of the intake closing type. The operative parts are housed in a generally cylindrical housing **25**, and the lower portion **26** of this housing in the present instance is of elbow construction affording an air intake in the form of a stub pipe **27** and a compressor inlet likewise in the form of a stub pipe **29**, the latter being adapted to be connected to the compressor by the pipe **20** as described above.

The passages afforded by the pipes **27** and **29** communicate at a chamber **30** disposed within the housing **25** and in the present instance there is associated with the compressor intake passage a valve orifice **31**, afforded by a tapered tubular boss **33** within the chamber **30**. The boss **33** affording the intake valve orifice **31** includes an annular valve seat **31S** about the end thereof which is away from the compressor intake side, and associated with this valve seat is an unloader valve **35** which is normally open, so as to admit of air passing through the valve ori-

fice to the intake of the compressor. This is the condition that prevails when the compressor is loaded; when the compressor is to be unloaded the unloader valve 35 is closed on the valve seat 31S thus disrupting the flow of air through the chamber 30 to the compressor intake.

The unloader valve comprises a pair of valve discs 36 and 37 of the usual kind, and these are carried at the end of a stem 40 which is under the control of a pressure-responsive diaphragm as will be described. The valve discs are assembled on a reduced portion of the stem 40 and may be conveniently clamped in position by a nut at the end of the valve stem 40 as shown in Figure 2.

The interior of the housing section 26 which is spaced above the boss 33 as viewed in Figure 2 includes an annular shoulder 45 serving to support the annular edge of a circular guide plate 46 for the valve stem 40, and this plate is formed in the medial portion thereof with a bearing sleeve 46A in which the enlarged portion of the valve stem above the valve discs is positioned for sliding movement. The housing section 26 includes an extension 48 beyond the annual shoulder 45 on which the guide plate for the valve stem is positioned, and this extension affords a chamber 50 of relatively large dimensions as can be seen in Figure 2.

The end of the chamber 50 away from the shoulder 45 is tapered upwardly in a radial outward direction as viewed in Figure 2 to afford a sloped surface 51 for accommodating downward flecture of a control diaphragm 55 used to control the unloader valve as will be described. Outwardly of the sloped surface 51, the housing section 26 includes a clamping flange 56 for the outer marginal portion of the control diaphragm, and corresponding to this flange is a like annular flange 57 formed about the base of an upper housing section 60.

The housing section 60 is clamped to the housing section 26 by cap screws as 61 which are tightened to hold the two flanges 56 and 57 tightly on the opposed faces of the outer marginal portions of the control diaphragm 55 for the unloader valve. The interior of the upper housing section 60 is arched over the control diaphragm for the unloader valve so as to afford a pressure chamber 65 on the side of the diaphragm 55 away from the unloader valve 35 and it is within the pressure chamber 65 that air under pressure is adapted to impinge upon and control the diaphragm 55.

The unloader valve 35, as noted above, is normally open with respect to the valve seat afforded therefor, and this condition is normally maintained by a coil spring 68 within the chamber 50 acting at one end against a pressure plate 69 on the side of the diaphragm away from the pressure chamber 65, and the opposite end of the control spring reacts against the guide plate 46 for the valve stem 40. The pressure plate 69 in the medial portion thereof is formed with a hub 70 configured to engage a taper on the end of the valve stem 40 that is disposed toward the control diaphragm and preferably the hub is welded thereto.

Air under pressure in the tank 13 is adapted to be admitted to the pressure chamber 65 through an inlet orifice 72 formed in the housing section 60 and the end of this orifice away from the pressure chamber 65 is normally closed by a pilot valve 75 which in the present instance is in the form of a diaphragm 76. The inlet orifice 72 for the pressure chamber 65 is formed centrally in a boss 78 which extends in the direction away from the pressure chamber 65, and surrounding this boss is an annular chamber 80. Confining the chamber 80 on the side thereof away from the boss 78 is a flange 83 serving in part as a clamp for the pilot valve diaphragm 76 as will be described.

The end of the boss 78 away from the pressure chamber 65 affords a valve seat 75S where the orifice 72 opens into the chamber 80, and the pilot valve 75 is baised to a normally closed position with respect to the valve seat 75S by a coil spring 86 which will be described in more detail below. The coil spring 86 is arranged within a tapered cap 87 which includes at the base thereof an annular flange 88 complementary to the flange 83 so that the cap 85 may be held to the housing section 60 by cap screws as 91 with the outer marginal portion of the pilot valve diaphragm 76 clamped tightly between the complementary flanges 83 and 88.

The housing section 60 is formed with an inlet passage or orifice 95 communicating at the inner end thereof with the chamber 80 that surrounds the pilot valve 75. The outer end of this inlet passage is enlarged and tapped at 96 to accommodate a conduit (not shown) connected at the opposite end to the tank 13 so that there will be air in the chamber 80 having a pressure corresponding to that of the compressed air in the tank tending to lift the normally closed pilot valve diaphragm 76 away from the valve seat 75S about the inlet orifice 72 to the pressure chamber 65. Such tendency of air under pressure within the chamber 80 to lift the pilot valve diaphragm is normally resisted by the return action of the pilot valve control coil spring 86 acting at one end against a pressure plate 98 disposed on the side of the pilot diaphragm 76 away from the chamber 80. This pressure plate is formed in the medial portion thereof with a hub 99 serving as a socket for the corresponding end of the coil spring 86.

The end of the coil spring 86 away from the pressure plate 98 carries another pressure plate 101 including a socket 102 for the corresponding end of the pilot valve control spring. The pressure plate 101 includes a depression 106 in the medial portion thereof, and this depression is adapted to receive the rounded head 108H of an adjusting screw 108 adapted to regulate the tension of the pilot valve control spring. This may be accomplished by threading the screw into a nut element 110 formed in the end of the cap 85 away from the flanged portion thereof, and capping the exposed end of the adjusting screw with an exposed lock nut 111.

The return spring 86 that controls the pilot valve is set as described above so that the pilot valve 75 will be opened or retracted relative to the valve seat 75S when air under pressure in the chamber 80 attains the maximum desired value, and when this occurs air under predetermined high pressure flows through the orifice 72 and impinges upon the control diaphragm 55 for the unloader valve. The tension of the return spring 68 for the unloader valve control diaphragm 55 is such that the diaphragm 55, being of relatively large diameter, is flexed at a pressure in the chamber 65 of about 15 p. s. i. in the direction of the valve seat 31S for the unloader valve 35, thus driving the stem 40 in a compressor unloading direction. In this manner, the unloader valve 35 is closed on the seat 31S thereby interrupting the supply of air to the compressor.

It may here be pointed out that once the pilot valve 75 is opened to unload the compressor, an additional area of the diaphragm 76 is exposed to air under pressure, namely, the medial portion of the diaphragm 76 that is normally closed on the valve seat 75S. Hence, the pilot valve control spring 86 is more than over-balanced when the pilot valve is opened, thereby assuring that the pilot valve remains open until pressure in the tank 13 has been reduced to a value appreciably below that at which the pilot valve is first opened during the unloading cycle.

When the predetermined value of low pressure of air in the tank 13 has been attained, the pilot valve 75 is closed on the valve seat 75S by the return spring 86 and this disrupts the supply of air under pressure through the orifice 72 to the pressure chamber 65. To enable air under pressure to be bled from the pressure chamber 65 so that the unloader valve will return to the normally open position when the pilot valve 75 closes as aforesaid, a bleed orifice 120, Figure 1, is afforded in the housing section 60 in communication with the pressure chamber 65. At the end opposite the pressure chamber 65, the bleed orifice 120 opens into an air chamber 122 of relatively small

diameter, and this air chamber is tapped so as to receive an adjustable set screw 125 which will be described in more detail below. The end of the set screw 125 that is disposed in the air chamber 122 is formed with a transverse aperture 127, and the shank and cap of the set screw 125 are bored with an axial bleed aperture 130 which at one end communicates with the transverse aperture 127 and which at the other end opens to atmosphere. In this manner, irrespective of the setting of the set screw 125, air under pressure in the pressure chamber 65 is enabled to bleed to the atmosphere. This of course is a bleed of relatively small rate which does not interfere with unloading operation of the control diaphragm 55. However, when the pilot valve 75 closes as aforesaid to enable the compressor to be again loaded, air will gradually bleed from the pressure chamber 65 until the pressure chamber 65 has been exhausted to such an extent that the return spring 68 relieves the unloader valve 35 relative to the valve seat 31S whereupon the compressor is again effective to pump air.

The set screw 125 enables the compressor to be manually unloaded when desired. Thus referring to Figure 1, it will be noted that the set screw 125 includes a tapered end portion 135 which when the set screw 125 is turned fully in is adapted to close off one end of an orifice 136. The opposite end of the orifice 136 communicates with the air passage 95, which, it will be recalled, is adapted to be connected with the tank 13 as described above. Normally, the set screw 125 is positioned so that the tapered end 135 thereof closes off the orifice 136 with respect to the air chamber 122, but if it be desired to manually unload the compressor the set screw 125 is backed off several turns and thereupon air under pressure flows into the air chamber 122 about the tapered end of the set screw 125 and from the chamber 122 to the pressure chamber 65 through the air passages 127 and 120.

Under and in accordance with the present invention, the unloader 10 is used to control the throttle setting of the internal combustion engine 11 shown in Figure 3. To enable this to be achieved in a way to be described, an air outlet 140 is formed in the housing section 60 in communication with the pressure chamber 65, and the end of the outlet 140 opposite the end that opens into the pressure chamber 65 is tapped as at 141 to receive an elbow 142, Figure 3. The opposite end of elbow 142 receives a conduit 143, and as shown in Figure 4 this conduit leads to an inlet opening afforded in the wall of the cylinder 145 of an air operated piston 146 which is mounted at the side of the internal combustion engine 11 as shown in Figure 3.

The piston 146 is normally in the unactuated position shown in Figure 4 with the rod 150 of the piston retracted relative to a throttle control lever 151. The throttle control lever is pivoted on a pin 152, and a shoe 153 for the lever 151 is also arranged on the pin 152. The shoe 153 includes a right-angled cleat 153A adapted to be engaged by the piston rod 150, and an oppositely directed right-angled cleat 153B on the shoe 153 engages the edge of the lever 151 forwardly of the pin 152 to rock the lever 151 counterclockwise as viewed in Figure 4 when the piston 146 is actuated. The end of the lever 151 opposite the end associated with the piston rod 150 has attached thereto a cable 155 which in turn is used to set the throttle of the engine 11 from full speed to idle position.

The engine throttle is normally biased in full speed position conforming to the normally loaded condition for the compressor, and a return spring 159 yieldably holds piston 146 so that the piston rod 150 is retracted relative to the control lever 151.

When air under pressure is admitted to the pressure chamber 65 upon opening of the pilot valve 75, air under pressure is simultaneously furnished to the outlet passage 140, and through the conduit 143 to the cylinder 145 in which the throttle control piston 146 is arranged to reciprocate. Under and in accordance with the present invention, the return spring 68 for the diaphragm 55 and the return spring 159 for the air operated piston 146 are selected so that the unloader valve 35 closes to unload the compressor prior to the piston 146 and the piston rod 150 being effective on the shoe 153 to pivot the lever 151 counterclockwise as viewed in Figure 4 to set the throttle of the engine 11 in idling position. Preferably, the tension of spring 68 is selected to permit closing of the unloader valve 35 when the air pressure in chamber 65 attains approximately 15 p. s. i., while the tension of the return spring 159 for the piston 146 is such that a pressure of approximately 50 p. s. i. is required to advance the piston rod 150 against the cleat 153A of the lever control shoe 153. In this way, a differential is assured between unloading of the compressor and idling of the engine so that the compressor is unloaded in advance of engine idling.

When the pilot valve closes to commence a reloading cycle, air bleeds from the conduit 143 simultaneously with air in the pressure chamber 65 through the bleed passage 120, and in view of the foregoing the piston rod 150 will be retracted from the control lever 151 as soon as the pressure in the conduit 143 drops to about 50 p. s. i., whereas on the other hand the unloader valve is not opened until the pressure in pressure chamber 65 drops to approximately 15 p. s. i. Hence, under compressor reloading conditions, the engine is brought up to full speed before the unloader valve 35 is opened.

It will be appreciated from the foregoing while the present invention has been described in connection with an unloader of the intake closing type, the invention is also applicable to unloaders of the compressor intake valve opening type. In connection with the latter application of the invention, it is merely necessarly to omit the unloader valve 35 and extend the stem 40 as an air-operated piston to the intake valve of the compressor as will be apparent for instance from U. S. Patent No. 2,275,303 of Burr W. Mantle.

From the foregoing it will be seen that the present invention enables the compressor to be unloaded before the engine is idled, and conversely, the engine to be brought up to full speed before the compressor is again loaded, and this is attained through an unloader having a pressure chamber used to control pneumatically from a common source of air under pressure both an unloader valve and an air-operated piston for controlling the throttle of the gas engine used to drive the compressor.

Hence, while I have illustrated and described the preferred embodiments of my invention, it is to be understood that these are capable of variation and modification, and I therefore do not wish to be limited to the precise details set forth, but desire to avail myself of such changes and alterations as fall within the purview of the following claims.

I claim:

1. An unloader and speed control device for an engine-driven air compressor or the like including an engine coupled in mechanical driving relationship to a compressor, a fluid storage device coupled to the outlet of said compressor, an intake valve for said compressor actuatable between two different operating positions to load and unload said compressor, and a throttle for said engine, said device comprising: a housing structure defining first and second pressure chambers, and inlet ports for said two chambers; a diaphragm mounted within said housing structure and constituting at least a portion of one wall of said first pressure chamber, said diaphragm being actuatable between two given operating positions in response to predetermined changes in fluid pressure within said first pressure chamber; means mechanically connecting said diaphragm to said intake control valve to actuate said valve to its unloading position in response to actuation of said diaphragm to one of said two operating positions and for actuating said valve to its loading

position in response to actuation of said diaphragm to the other of its two operating positions; conduit means interconnecting said fluid storage device and said inlet port of said second chamber; a pilot valve comprising a second diaphragm mounted within said housing and constituting at least a portion of one wall of said second pressure chamber, said second diaphragm being interposed in the inlet port of said first pressure chamber to admit fluid under pressure to said first chamber in response to an increase in fluid pressure within said second chamber above a predetermined threshold value; biasing means for closing said pilot valve in response to a decrease in pressure in said second chamber to a value substantially lower than said threshold pressure; a pressure-responsive piston adapted to engage said engine throttle; and a conduit interconnecting said piston with said first pressure chamber to actuate said piston between a full speed position in which said piston is disengaged from said throttle and an idle position in which said piston is in engagement with said throttle in predetermined time relationship with respect to actuation of said intake control valve between said loading and unloading positions.

2. An unloader and speed control device for an engine-driven air compressor or the like including an engine coupled in mechanical driving relationship to a compressor, a fluid storage device coupled to the outlet of said compressor, an intake valve for said compressor actuatable between two different operating positions to load and unload said compressor, and a throttle for said engine, said device comprising: a housing structure defining first and second pressure chambers, an inlet port for said first chamber interconnecting said two chambers, and an inlet port for said second chamber; a diaphragm mounted within said housing structure and constituting at least a portion of one wall of said first pressure chamber, said diaphragm being actuatable between two given operating positions in response to predetermined changes in fluid pressure within said first pressure chamber; means mechanically connecting said diaphragm to said intake control valve to actuate said valve to its unloading position in response to actuation of said diaphragm to one of said two operating positions and for actuating said valve to its loading position in response to actuation of said diaphragm to the other of its two operating positions; conduit means interconnecting said fluid storage device and said inlet port of said second chamber; a second diaphragm mounted within said housing and constituting at least a portion of one wall of said second chamber; a valve seat, having a substantial surface area relative to the surface area of said second diaphragm, encompassing the opening of said first chamber inlet port into said second chamber; biasing means, normally urging said second diaphragm into engagement with said valve seat to close said first chamber inlet port, for establishing a first threshold pressure which must be exceeded within said second chamber before fluid under pressure may be admitted to said first chamber from said second chamber and for establishing a second threshold pressure, substantially lower than said first threshold pressure, below which the pressure in said second chamber must drop to re-seat said diaphragm; a pressure-responsive piston adapted to engage said engine throttle; and a conduit interconnecting said piston with said first pressure chamber to actuate said piston between a full speed position in which said piston is disengaged from said throttle and an idle position in which said piston is in engagement with said throttle in predetermined time relationship with respect to actuation of said intake control valve between said loading and unloading positions.

3. An unloader and speed control device for an engine-driven air compressor or the like including an engine coupled in mechanical driving relationship to a compressor, a fluid storage device coupled to the outlet of said compressor, and a throttle for said engine, said device comprising: a housing structure defining first and second pressure chambers, an inlet port for said first chamber interconnecting said two chambers, an inlet port for said second chamber, and an intake conduit adapted to be connected to the intake port of said compressor; an unloader valve mounted within said intake conduit in said housing and actuatable between two different operating positions to load and unload said compressor; a diaphragm mounted within said housing structure and constituting at least a portion of one wall of said first pressure chamber, said diaphragm being actuatable between two given operating positions in response to predetermined changes in fluid pressure within said first pressure chamber; a valve stem mechanically interconnecting said diaphragm and said unloader valve to actuate said valve to its unloading position in response to actuation of said diaphragm to one of said two operating positions and for actuating said valve to its loading position in response to actuation of said diaphragm to the other of its two operating positions; conduit means interconnecting said fluid storage device and said inlet port of said second chamber; a pilot valve comprising a second diaphragm mounted within said housing and constituting at least a portion of one wall of said second pressure chamber, said second diaphragm being interposed between said second pressure chamber and the inlet port of said first pressure chamber to admit fluid under pressure to said first chamber in response to an increase in fluid pressure within said second chamber above a predetermined threshold value; biasing means for closing said pilot valve in response to a decrease in pressure in said second chamber to a value substantially lower than said threshold pressure; a pressure-responsive piston adapted to engage said engine throttle; and a conduit interconnecting said piston with said first pressure chamber to actuate said piston between a full speed position in which said piston is disengaged from said throttle and an idle position in which said piston is in engagement with said throttle in predetermined time relationship with respect to actuation of said intake control valve between said loading and unloading positions.

4. An unloader and speed control device for an engine-driven air compressor or the like including an engine coupled in mechanical driving relationship to a compressor, a fluid storage device coupled to the outlet of said compressor, an intake valve for said compressor actuatable between two different operating positions to load and unload said compressor, and a throttle for said engine, said device comprising: a housing structure defining first and second pressure chambers, an inlet port for said first chamber interconnecting said two chambers, and an inlet port for said second chamber; a diaphragm mounted within said housing structure and constituting at least a portion of one wall of said first pressure chamber, said diaphragm being actuatable between two given operating positions in response to predetermined changes in fluid pressure within said first pressure chamber; means mechanically connecting said diaphragm to said intake control valve to actuate said valve to its unloading position in response to actuation of said diaphragm to one of said two operating positions and for actuating said valve to its loading position in response to actuation of said diaphragm to the other of its two operating positions; means for biasing said diaphragm toward said other position to establish a predetermined minimum valve actuation pressure for said intake valve; conduit means interconnecting said fluid storage device and said inlet port of said second chamber; a pilot valve comprising a second diaphragm mounted within said housing and constituting at least a portion of one wall of said second pressure chamber, said second diaphragm being interposed between said second pressure chamber and the inlet port of said first pressure chamber to admit fluid under pressure to said first chamber in response to an increase in fluid pressure within said second chamber

above a predetermined threshold value; biasing means for closing said pilot valve in response to a decrease in pressure in said second chamber to a value substantially lower than said threshold pressure; a pressure-responsive piston adapted to engage said engine throttle; a conduit interconnecting said piston with said first pressure chamber to actuate said piston between a full speed position in which said piston is disengaged from said throttle and an idle position in which said piston is in engagement with said throttle; and means biasing said piston toward its disengaged position to establish a predetermined minimum piston actuation pressure substantially greater than said minimum valve actuation pressure whereby said piston is actuated to its full speed position before said compressor is loaded and to its idle position after said compressor is unloaded.

References Cited in the file of this patent

UNITED STATES PATENTS

1,081,175	Wainwright	Dec. 9, 1913
2,661,893	Le Valley	Dec. 8, 1953