Jan. 3, 1956 L. A. SAFFORD 2,729,225

COMPRESSOR GOVERNOR

Filed Dec. 29, 1952

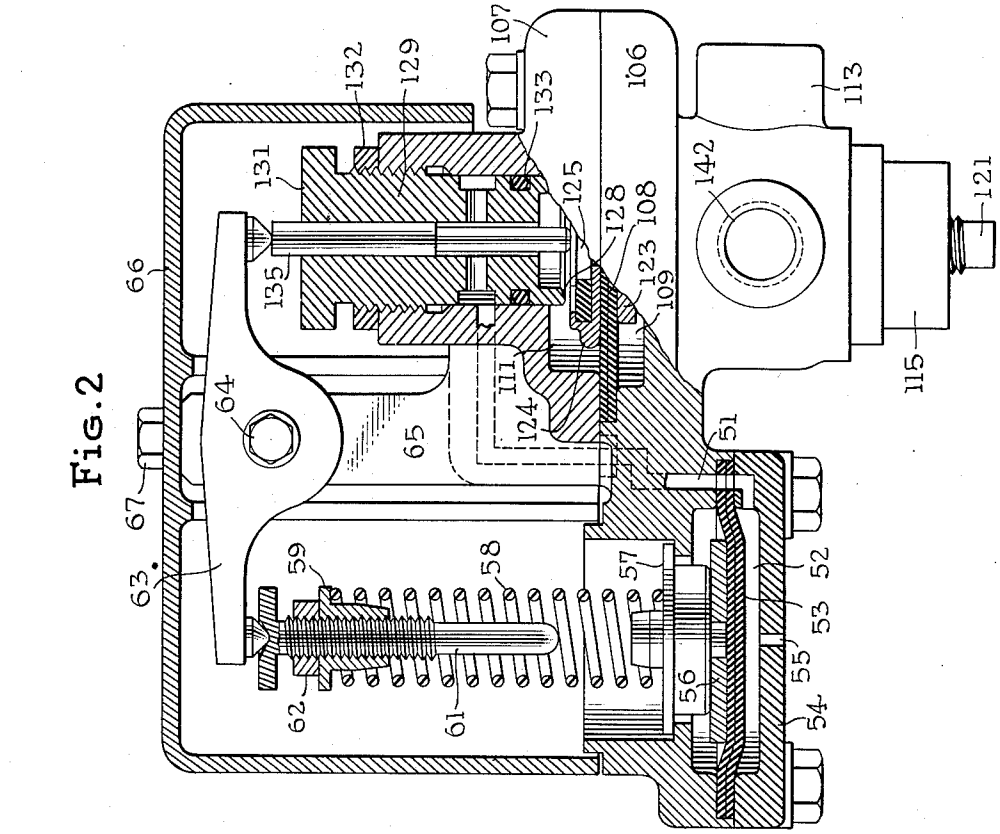


Fig. 2

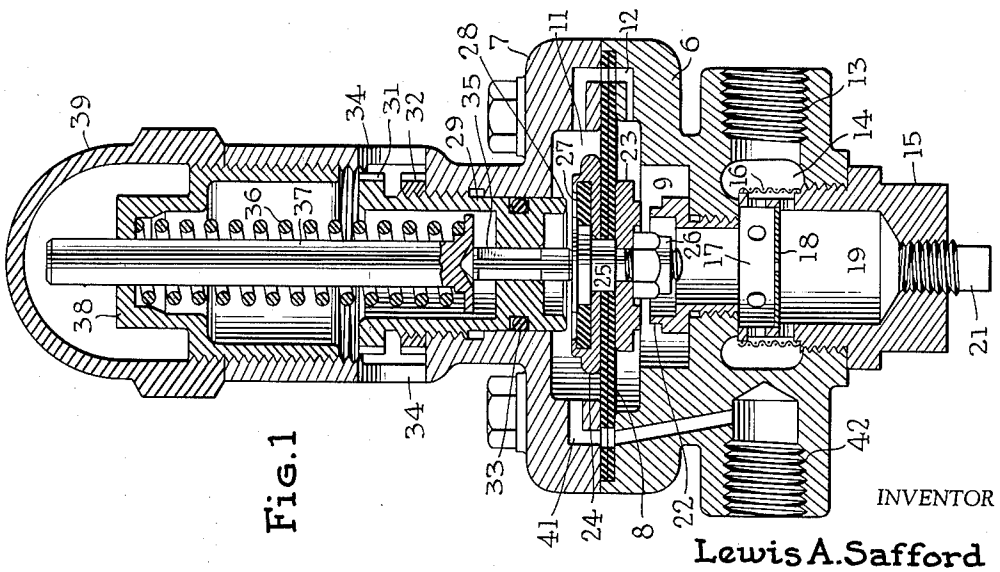


Fig. 1

INVENTOR

Lewis A. Safford

BY Dodge Aud Jones

ATTORNEYS

United States Patent Office 2,729,225 Patented Jan. 3, 1956

2,729,225

COMPRESSOR GOVERNOR

Lewis A. Safford, Watertown, N. Y., assignor to The New York Air Brake Company, a corporation of New Jersey

Application December 29, 1952, Serial No. 328,491

6 Claims. (Cl. 137—107)

The invention to be described and claimed relates to controllers for the unloaders of gas compressors, and will be described as embodied for use in controlling compressors used on electric and diesel-electric locomotives to charge the main reservoirs of the air brake system.

This is a service where close control and infallible operation are of more than ordinary importance, and it is no easy matter to equal the service afforded by the direct-connected steam driven compressors used on steam locomotives, and now obsolescent.

The unloader proper is not involved in the present concept. It is simply a pressure-operated device which, when subjected to pressure unloads, and when vented loads, a compressor, usually a continuously running compressor. The unloader and the compressor each may take different forms, many of which are commercially available. It may be well to mention that the term "load" is here used generically to include any manner of causing a compressor to operate, and "unload" is used similarly to include any manner of terminating or suspending operation.

For railway service the controller should be protected against the entrance of dust, scale or water, and at the same time should not be subject to serious derangement by the occasional entrance thereof. There must be some simple means for adjusting the pressure-setting, which determines the pressure at which the compressor is unloaded. There must be some simple means for adjusting the pressure interval, i. e. the amount pressure may fall after unloading occurs and before loading occurs. The range of each adjustment should be substantial, and the adjustments should be independent, so that either can be made without changing the other, and without materially modifying the effect of the other. The controller must be stable.

Devices affording the above and other advantageous features have been constructed and successfully operated and are illustrated in the accompanying drawing, in which—

Fig. 1 is an axial section of a controller embodying the invention.

Fig. 2 is a similar view showing the addition to the controller of Fig. 1 of spring-loading means designed to accelerate valve-shifting, so that the pressure tolerances will be closer.

Statements of direction refer to the controller positioned as drawn.

The embodiment of Fig. 1

In this figure conventions commonly used in the air brake art are adopted. All ports are drawn as if they lay at the plane of section even though other locations may be commercially preferable. This permits flows to be traced in a single section. The diaphragm is shown in its mid position (a position in which it never stops while in service) so that the two valves which it carries are away from their respective seats and can be more clearly portrayed.

The housing of the controller comprises a lower section 6 and an upper section 7 whose mating faces are formed to afford an edge-confining seat for a diaphragm 8 which separates two chambers 9 and 11 which are in restricted communication through the choked passage 12. The diaphragm is shown as two-ply, but may be made of any suitable material and construction affording the necessary strength and flexibility. The chamber 11 is smaller in diameter than the chamber 9 and these diameters control the exposed upper and lower areas of diaphragm 8 within the peripheral portion thereof.

Lower section 6 has a pipe threaded passage 13 for the main reservoir connection. This is shown centered on the plane of section but actually should be located back of the plane of section so as to enter the annular chamber 14 tangentially. A closure plug 15 of cup-shaped configuration is screwed into a central opening in the bottom of portion 6 and carries an annular screen 16 and a perforated sustaining sleeve 17 which form the inner wall of chamber 14. A horizontal baffle 18 with central equalizing port partly isolates a water-collecting space 19.

Air entering through connection 13 induces a whirling flow in chamber 14. Water and oil are separated from the air and collect in space 19. A removable drain plug 21 is provided for clean-out purposes.

Screwed into an opening above the plug 15 and fixed in position is an annular fitting carrying valve seat 22. This seat and valve 23 mounted on the lower side of the diaphragm 8 control flow to space 9 via connection 13. The valve 23 and a somewhat larger valve 24 are mounted back to back at the center of diaphragm 8 and on opposite faces thereof by means of a shouldered bolt 25 and nut 26. The shouldering of the bolt limits the compression of the center of the diaphragm between the two valves and also provides means to confine the center of the rubber (or similar) facing 27 on valve 24. A marginal flange on the valve confines the peripheral portion of the facing.

Valve 24 coacts with an annular seat 28 formed on the lower end of a fitting 29 adjustably threaded into upper housing portion 7. It may be turned by a dentated flange 31 and locked by a dentated ring nut 32. It is sealed by a groove-mounted O-ring 33.

The upper housing portion 7 has a generally tubular upward extension in the bore of which the fitting 29 is threaded. This extension is apertured at 34 for venting purposes and to give access to the flange 31 and locking nut 32. The fitting 29 has an axial guideway for a fluted thrust pin 35 which reacts downward on valve 24 and is loaded by spring 36 through the flanged stem 37 which engages the upper end of the pin 35.

A threaded cup-shaped plug 38 is adjustably threaded in the upper end of the tubular extension of housing portion 7 and serves as a guide for stem 37, and as an adjustable seat for the upper end of spring 36. Plug 38 is locked in its adjusted positions by threaded cap 39 of familiar form.

The chamber 11 is connected by passage 41 with the pipe threaded passage 42. This affords connection for the pipe leading to the motor of the unloader. This is commonly a single acting expansible chamber motor of some description. So far as is here material, venting of connection 42 loads the compressor, whereas development of pressure in connection 42 unloads it.

It is important to observe that the effective area of seat 28 is greater than the effective area of seat 22 and the amount of such differential is such as approximately to neutralize the effect of the increase in the stress of spring 36 which occurs as the dual valves shift upward between their alternate seated positions. Thus, in the design, the valve area differential should be chosen on the basis of the mean adjusted stress in spring 36 and

the spring's scale. The unloading pressure can be changed within reasonable limits by adjusting spring seat 38.

To recapitulate, the differential seat area is primarily intended to prevent "short cycling." The diaphragm moves full stroke so that one valve or the other is closed. When valve 23 is closed against seat 22 main reservoir pressure acts on the area within seat 22 and chambers 9 and 11 are at atmospheric pressure. When valve 24 is closed against seat 28 the whole lower face of diaphragm 8 is subject to main reservoir pressure, and so is the upper face outside seat 28, the space within the seat being at atmospheric pressure. Since seat 28 is the larger, main reservoir pressure acts on an increased effective area. Hence the diaphragm stays up until main reservoir pressure has fallen a substantial amount.

What this fall in main reservoir pressure shall be is determined by adjusting the position of seat 28, and thus changing the lift of valve 24. A governor proportioned about as shown in the accompanying drawing and designed to maintain main reservoir pressures of about 140 pounds' gage has been used in determining operative characteristics. An ⅛ inch lift gives about a 10 p. s. i. interval.

Obviously adjustment of spring stress when made within ordinary limits affects the pressure interval in a very minor degree, and adjustment of valve lift can have only a similarly minor effect on spring action.

Thus, for all practical purposes the adjustments are independent in their effects. Mechanically the adjusting means are strictly independent.

Assume that valve 23 is seated and that main reservoir pressure attains the value for which spring 36 is set. The diaphragm lifts full stroke and valve 24 closes against seat 28. This puts the unloader under pressure and the pump ceases to operate. Since the area within seat 28 is larger than that within seat 22 the diaphragm is held up until main reservoir pressure has been reduced materially. When it has been so reduced valve 24 moves from seat 28, the whole diaphragm area becomes temporarily subject to main-reservoir pressure acting downward, and the diaphragm snaps down closing valve 23. Port 42 and chamber 11 then vent to atmosphere via the flutes on stem 35. The unloader resets and the compressor again becomes active.

Modified embodiment, Figure 2

The right hand portion of Fig. 2 is simply a restatement of Fig. 1 omitting the loading spring and its adjusting means. Parts essentially the same as parts in Fig. 1 are given the same reference numerals as are used in Fig. 1 but increased by 100.

Thus in Fig. 2 there are parts corresponding to parts 6 to 33 and those which are visible are numbered 106 to 133. There is no atmospheric port corresponding directly to 34 and push stem 135 is not fluted.

Instead its upper portion makes a good sliding fit in fitting 129 (which differs in form from 29) and its lower portion is reduced to afford an exhaust path to port 51 which leads to the chamber 52 below a second diaphragm 53. This second diaphragm is marginally clamped by a cap 54 bolted to the lower housing member 106. The chamber 52 is vented to atmosphere by a small port 55 which performs the ultimate venting functions of apertures 34 in Fig. 1.

Diaphragm 53 sustains a thrust plate 56 which may react upward against a marginally flanged spring seat 57. The marginal flange on the spring seat engages a shoulder on housing 106 to limit downward motion of spring seat 57.

A spring 58 sustained at its lower end by seat 57 reacts at its upper end against seat 59 adjustably threaded on stem 61 and locked by nut 62. The thrust of spring 58 is transferred to stem 135 by stem 61 through a first-class lever 63 fulcrumed at 64 on an upstanding bracket 65 carried by body portion 107.

Thus the spring 58 is the direct analog of spring 36 and is adjustable to vary its stress. Functionally, the only significant difference is that when valve 124 opens, the air which exhausts past it, charges chamber 52, forcing diaphragm 53 upward and increasing the loading of spring 58. This extra loading is temporary, for chamber 52 is vented through port 55.

A cap 66 held by bolt 67 to bracket 65 overhangs the spring and lever mechanism to protect them from mechanical injury.

The two embodiments described are illustrative of the inventive principle, and no limitation as to specific form is implied.

What is claimed is:

1. A pressure responsive controller for pressure operated motors, comprising in combination, a housing and a diaphragm marginally supported thereby, the housing and diaphragm defining on opposite sides of the diaphragm two working spaces which are in continuous restricted communication with each other; means affording a connection between a space whose pressure is to exercise control to the first of said working spaces, and including a relatively smaller valve seat presented toward the diaphragm; a valve carried by the diaphragm and capable of closing against said seat; a connection with atmosphere to the second of said working spaces and including a relatively larger valve seat presented toward the diaphragm; a second valve carried by the diaphragm and capable of closing against the second named seat; yielding means biasing the diaphragm toward the first named seat; and means affording a connection between the second working space and a motor to be controlled.

2. A pressure responsive controller for pressure operated motors, comprising in combination, a housing and a diaphragm marginally supported thereby, the housing and diaphragm defining on opposite sides of the diaphragm two working spaces which are in continuous restricted communication with each other; means affording a connection between a space whose pressure is to exercise control to the first of said working spaces, and including a relatively smaller valve seat presented toward the diaphragm; a valve carried by the diaphragm and capable of closing against said seat; a connection with atmosphere to the second of said working spaces and including a relatively larger valve seat presented toward the diaphragm; means for adjusting the second named seat toward and from the diaphragm; a second valve carried by the diaphragm and capable of closing against the second named seat; yielding means biasing the diaphragm toward the first named seat; and means affording a connection between the second working space and a motor to be controlled.

3. A pressure responsive controller for pressure operated motors, comprising in combination, a housing and a diaphragm marginally supported thereby, the housing and diaphragm defining on opposite sides of the diaphragm two working spaces which are in continuous restricted communication with each other; means affording a connection between a space whose pressure is to exercise control to the first of said working spaces, and including a relatively smaller valve seat presented toward the diaphragm; a valve carried by the diaphragm and capable of closing against said seat; a connection with atmosphere to the second of said working spaces and including a relatively larger valve seat presented toward the diaphragm; means for adjusting the second named seat toward and from the diaphragm; a second valve carried by the diaphragm and capable of closing against the second named seat; yielding means biasing the diaphragm toward the first named seat; means for adjusting said yielding means to vary the bias afforded thereby; and means affording a connection between the second working space and a motor to be controlled.

4. A pressure responsive controller for pressure operated motors, comprising in combination, a housing and

a diaphragm marginally supported thereby, the housing and diaphragm defining on opposite sides of the diaphragm two working spaces which are in continuous restricted communication with each other; means affording a connection between a space whose pressure is to exercise control to the first of said working spaces, and including a relatively smaller valve seat presented toward the diaphragm; a valve carried by the diaphragm and capable of closing against said seat; a connection with atmosphere to the second of said working spaces and including a relatively larger valve seat presented toward the diaphragm; a second valve carried by the diaphragm and capable of closing against the second named seat; yielding means biasing the diaphragm toward the first named seat; means affording a connection between the second working space and a motor to be controlled; and pressure responsive means interposed in said connection with atmosphere and reacting on said yielding means to increase the bias afforded thereby when the second working space discharges through said connection.

5. A pressure responsive controller for pressure operated motors, comprising in combination, a housing and a diaphragm marginally supported thereby, the housing and diaphragm defining on opposite sides of the diaphragm two working spaces which are in continuous restricted communication with each other; means affording a connection between a space whose pressure is to exercise control to the first of said working spaces, and including a relatively smaller valve seat presented toward the diaphragm; a valve carried by the diaphragm and capable of closing against said seat; a connection with atmosphere to the second of said working spaces and including a relatively larger valve seat presented toward the diaphragm; means for adjusting the second named seat toward and from the diaphragm; a second valve carried by the diaphragm and capable of closing against the second named seat; yielding means biasing the diaphragm toward the first named seat; means for adjusting said yielding means to vary the bias afforded thereby; means affording a connection between the second working space and a motor to be controlled; and pressure responsive means interposed in said connection with atmosphere and reacting on said yielding means to increase the bias afforded thereby when the second working space discharges through said connection.

6. A pressure responsive controller for pressure operated motors, comprising in combination a divided housing; a diaphragm marginally clamped between the parts of the housing on the plane of division, said housing and diaphragm defining on opposite sides of the diaphragm two working spaces which are in continuous restricted communication with each other, the inner margin of the diaphragm-clamping area being of larger diameter in the first than in the second working spaces, whereby the diaphragm has a larger effective area when pressure in the second working space predominates than it has when pressure in the first predominates; means affording connection between a space whose pressure is to exercise control to the first of said working spaces, and including a relatively smaller valve seat presented toward the diaphragm; a valve carried by the diaphragm and capable of closing against said seat; a connection with atmosphere to the second of said working spaces and including a relatively larger valve seat presented toward the diaphragm; a second valve carried by the diaphragm and capable of closing against the second named seat; yielding means biasing the diaphragm toward the first named seat; and means affording a connection between the second working space and a motor to be controlled.

References Cited in the file of this patent

UNITED STATES PATENTS

2,395,941	Rockwell	Mar. 5, 1946
2,412,428	Rockwell et al	Dec. 10, 1946
2,429,489	Roth	Oct. 21, 1947
2,508,344	Fitch	May 16, 1950
2,670,751	Wilson	Mar. 2, 1954

FOREIGN PATENTS

566,205	France	Feb. 11, 1924