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COMPRESSOR UNLOADING APPARATUS

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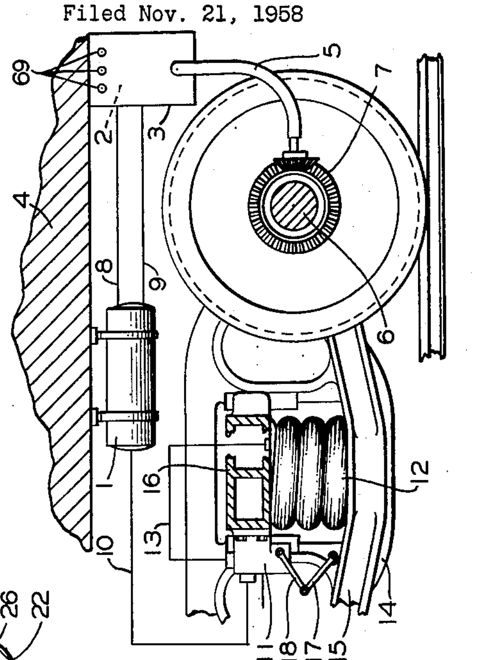

FIG. 1

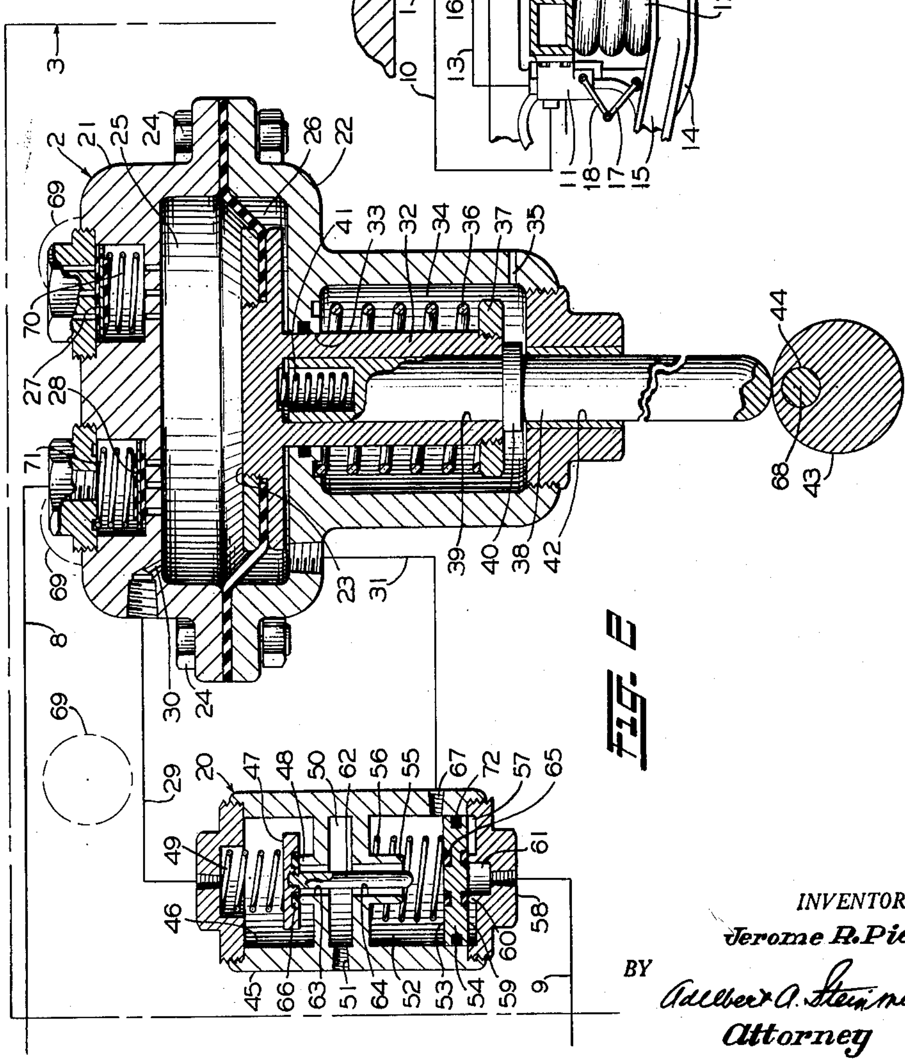

FIG. 2

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COMPRESSOR UNLOADING APPARATUS

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1 Claim. (Cl. 230—14)

This device relates to air compressors and more particularly to a diaphragm type air compressor and a novel means for effecting unloading thereof.

In railway service many uses have been found for a separate air compressor on each car to supply fluid under pressure to auxiliary devices other than the brake devices, which are supplied with fluid under pressure by the main compressor on the locomotive. An example of this is the provision of a separate compressor to provide an auxiliary supply of fluid under pressure to air spring devices on each car, in the event that it is desired to supplement or supplant the supply of fluid under pressure from other sources such as the auxiliary reservoirs of the air brake system on the cars.

According to the invention, there is provided a novel air compressor of the diaphragm type having a novel unloading means. More specifically, the diaphragm compressor shown is of the cam-driven type wherein the compression stroke is effected by force movement of a cam-driven push rod, and the intake stroke is by a return spring action. Unloading of the compressor is accomplished by an unloading valve responsive to a selected maximum pressure in the reservoir charged by the compressor to effect venting of the compression chamber of the compressor and delivery of fluid under pressure to the non-pressure side of the said diaphragm, in opposition to the return spring, to thereby maintain the diaphragm in a compression position. When the pressure of fluid in the reservoir decreases to a selected minimum pressure, at which time the unloading valve operates to vent the non-pressure side of the diaphragm and to cut off the venting of the compression chamber, the diaphragm is again freed for oscillatory motion responsive to the driving cam operation to cause compression of fluid under pressure and delivery thereof to the reservoir.

In the accompanying drawings, Fig. 1 shows, partly in section and partly in outline, a novel compressor and unloading arrangement for supplying compressed fluid to the air spring of an air spring system of a railway car; and Fig. 2 shows an enlarged sectional view of the compressor and unloading arrangement of the system shown in Fig. 1.

Description

Referring to Fig. 1, there is shown an air spring suspension system for a railway car, said system comprising a reservoir 1 charged with fluid under pressure by a compressor 2 (detailed in Fig. 2) contained in a protective casing 3. The reservoir 1 and the compressor 2 and casing 3 are all suitably mounted on a sprung portion 4 of the vehicle, such as the car body. A flexible shaft 5 driven by any suitable gear system on the car axle 6, shown herein as a bevel gear arrangement 7, serves to transmit the driving force to the compressor as described hereinafter. The compressor 2 is connected to the reservoir by a delivery pipe 8 and an operating pipe 9. A pipe 10 serves to supply fluid under pressure from the reservoir to a leveling valve device 11 of a typical air spring suspension arrangement in which the leveling valve device 11 controls the pressure of fluid supplied to an air spring 12 through a pipe 13. The air spring 12 rests on a spring pad 14 carried by a wheel-truck side frame 15 of the railway car, said side frame constituting an unsprung portion of the car while a bolster 16 which supports the center sill (not shown) rests on said air spring and constitutes a sprung portion of the car to which the leveling valve device 11 is suitably attached. Relative movement between the sprung portion, such as the bolster 16, and the unsprung portion, such as the side frame 15, is reflected through a pair of pivotally connected levers 17 and 18, the lever 17 being pivotally secured to the side frame 15 and the lever 18 being operatively connected to a rotary operating shaft (not shown) of the leveling valve device 11.

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The air spring 12 and leveling valve device 11, details of which are not deemed necessary to be shown for purposes of the present invention, are of the usual type and operate in a well-known manner to maintain the bolster 16 and therefore the sprung portion 4 of the car at a preselected height relative to the axle 6 on which the car wheel is mounted. It will be understood that for a predetermined degree of fluid pressure in the air spring 12, said spring supports a given load at a predetermined normal level. An increase in the load over said given load causes the air spring 12 to be compressed, thereby causing relative movement of the levers 17 and 18. Relative movement of levers 17 and 18 effects operation of the leveling valve device 11 to cause delivery of fluid under pressure from the reservoir 1 via pipe 10 through the valve device 11 to pipe 13 and thence to the air spring 12 to increase the degree of pressure therein over said predetermined degree and expand the spring and thereby raise the bolster 16 and other sprung portions to its predetermined normal level previously mentioned. When the bolster 16 attains its said normal level, the relative movement of the lever arms 17 and 18 effected by said raising causes the leveling valve device 11 to operate into a lap position and maintain the bolster 16 at its normal level. If the load on the vehicle is decreased, fluid pressure in the air spring 12 will expand the spring to raise the bolster 16 above its normal level, thereby causing relative movement of the lever arms 17 and 18 which in turn effects operation of the leveling valve device 11 to release fluid under pressure from the air spring 11 to lower the bolster 16. When the bolster 16 has been lowered to its normal position, the relative movement of lever arms 17 and 18 during said lowering causes the leveling valve device to operate into a lap position and maintain the bolster 16 at its normal level until further load changes occur to cause further raising or lowering as is necessary.

As shown in Fig. 2, the compressor 2 and an unloading valve 20 are enclosed in the protective casing 3. The compressor 2 itself is illustrated as including two cooperating body portions 21 and 22 having therein a movable abutment shown as a diaphragm piston 23, the periphery of the diaphragm of which is held in clamped relation between the body portions 21 and 22 as by a plurality of bolts 24. Formed between the diaphragm piston 23 and the body portion 21 is a compression chamber 25. Also formed between the diaphragm piston and body portion 22 is a chamber 26, hereinafter called the control chamber.

An inlet valve 27 provides an intake communication to the compression chamber 25. A discharge valve 28 and pipe 8 provide a discharge communication from the compression chamber 25 to the reservoir 1. A pipe 29 and a passage 30 establish communication between said compression chamber 25 and the unloading valve 20 for reasons hereinafter explained. A pipe 31 establishes communication between the control chamber 26 and the unloading valve 20 for reasons hereinafter explained. The diaphragm piston has a suitable piston stem, hereinafter referred to as the piston follower 32, extending through the chamber 26 and through a sealed bore 33 in a partition of the body portion 22 to a chamber 34 which is connected to atmosphere by a port 35. A spring 36 interposed between the body portion 22 and a nut 37 screwed on the end of the follower 32 biases the diaphragm piston toward the lower position in which it is shown in the drawing.

A cam follower rod 38 is slidably mounted in a bore 39 within the piston follower 32, said cam follower rod 38 having a shoulder 40 engaging the piston follower 32 in such a manner that any upward movement of the cam follower rod 38 will cause similar movement in the piston follower and thus the diaphragm piston. A guide bore 42 within a detachable portion of the body portion 22 is adapted to guide the cam follower rod 38. The free end of cam follower rod 38 is positioned to ride on a cam 43 fixed on a cam shaft 44 connected to and driven by the previously-mentioned flexible shaft 5 by rotation of the car axle 6.

A spring 41 is suitably carried in a recess in the upper end of the cam follower rod 38 in interposed relation between the piston follower 33 and the cam follower rod 38 to reduce shock and bias the cam follower rod 38 into constant contact with the cam 43.

The unloading valve 20 comprises a body structure 45 having formed therein a plurality of separate chambers, as follows: a chamber 46 housing a valve 47, an annular valve seat 48 and valve spring 49, said chamber being in constant communication with the compression chamber 25 of the compressor by way of pipe 29; an exhaust chamber 50 in constant communication with atmosphere through a port 51; a chamber 52 formed by the body structure 45 and the upper face 53 of a sliding piston valve 54, said chamber housing an annular valve seat 55 and a valve spring 56 biasing said piston valve 54 downwardly; a pressure chamber 57 formed by a threaded cap 58 and the lower face 59 of said sliding piston valve 54. It should be noted that the piston valve 54 is of the snap-action-type due to restricted initial effective area of the lower face 59 of said valve as herein explained. An annular seating rib 60 on the threaded cap 58 defines a pressure build-up chamber 61 open to a relatively small area of the lower face 59 of the piston valve 54 and connected by pipe 9 to reservoir 1 such that when the valve lifts against the force of spring 56 due to a predetermined pressure buildup in chamber 61, the chamber 61 opens into the larger pressure chamber 57 with the result that the entire area of lower face of the piston valve 54 is suddenly subjected to the pressure in line 9 to give a fast snapping action upward to the said valve.

A valve stem 62 is attached to the valve 47 in chamber 46 and extends downwardly therefrom through an exhaust bore 63, exhaust chamber 50, and exhaust bore 64 into chamber 52. The valve stem 62 is of such length that when the piston valve 54 is moved upward against the spring 56 the piston valve 54 engages said lower end of the stem and moves said stem 62 and the valve 47 upward until a seating ring 65 in the face of said piston valve 54 seats on the valve seat 55 and a seating ring 66 in the valve 47 is at the same time unseated from the valve seat 48.

A port 67 to which pipe 31 is connected establishes communication between the chamber 26 of the compressor and either chamber 52 or the pressure chamber 57 of the unloading valve 20 dependent upon the position of the piston valve 54 to one or the other side of port 67 as explained hereinafter.

Operation

In operation, rotation of the car axle 6 incident to travel of the car along the track causes operation of the bevel gear arrangement to rotate the flexible shaft 5 and consequently the cam shaft 44 is rotated about an axis 68. The cam follower rod 38 rides on the rotating cam 43 such that when the cam follower rod 38 engages the low side of the cam 43 (as shown), the connected diaphragm piston is permitted to be moved to its lowermost position (as shown) by the biasing force of the spring 36. During the just described downward motion of the diaphragm piston 23, a partial vacuum or suction is created in compression chamber 25 such that the atmospheric pressure within the protective casing 3 (as permitted by vents 69) will force the inlet valve 27 open against the action of a spring 70 and permit fluid at atmospheric pressure to flow into the compression chamber 25. As the cam 43 continues to rotate, the high side thereof begins to move the cam follower rod 38 and connected diaphragm piston upward to an uppermost position when the high point on the cam 43 is engaging the cam follower rod 38. During the just described upward movement of the diaphragm piston 23, the fluid in compression chamber 25 is compressed to cause the inlet valve 27 to close and the discharge valve 28 to open against the forces of a spring 71, thereby permitting the fluid under pressure to flow past the discharge valve 28 through the pipe 8 to the reservoir 1. Continued rotation of the cam 43 causes continued reciprocating upward and downward motion of the cam follower rod 38 such that the upward motion effected by the cam follower rod 38 on the cam 43 is the compression stroke and the downward motion effected by the action of spring 36 is the intake stroke.

The just described delivery of fluid under pressure continues from the compression chamber 25 to the reservoir and similarly to chamber 61 of the unloading valve 20, connected by pipe 9, to the reservoir, until a predetermined pressure is attained in the reservoir 1 and chamber 61 at which the fluid pressure in chamber 61 of the unloading valve 20 is sufficient to overcome the force of the spring 56 and thereby move the sliding piston valve 54 upward to open chamber 61 into chamber 57 and snap the valve 54 to an uppermost position. During the upward movement of the piston valve 54 a plurality of results occur as follows: first, a passage for venting the chamber 26 of the compressor is cut off at the port 67 in the unloading valve; second, fluid under pressure from the reservoir 1 is supplied via pipe 9, chambers 61 and 57, port 67 and pipe 31 to the underside of the diaphragm piston 23 in chamber 26; thirdly, the piston valve 54 engages the valve stem 61 moving said stem and connected valve 47 upward until valve 47 is unseated from the valve seat 48 thereby venting the compression chamber 25 of the compressor to atmosphere via passage 30, pipe 29, chamber 46, past the valve seat 48, through the exhaust bore 69 to the exhaust chamber 49 and thence to atmosphere via port 51; and fourth, the piston valve 54 comes to rest on the valve seat 55 to prevent leakage of any fluid under pressure that may get by the piston ring 22 on said valve.

With the piston valve 54 in its uppermost position, the compressor is in an unloaded condition, that is the compression chamber 25 is vented to atmosphere and the diaphragm piston 23 is maintained in its uppermost position by the fluid under pressure in chamber 26 opposing and overcoming any downward forces effected by the spring 36. In the unloaded condition of the compressor, continued rotation of the cam 43 merely causes an up and down reciprocating motion of the cam follower rod 38 within the bores 39 and 42 and no movement of the diaphragm piston 23 is effected.

The compressor remains in the described unloaded condition until the fluid pressure in the reservoir 1 and similarly in chamber 57 of the unloading valve 20 is reduced to a selected minimum pressure sufficient to allow the spring 56 to return the piston valve 54 to an operating position of rest against the annular rib 60 on the threaded cap 58. When the piston valve 54 returns to the operating position, the spring 49 in chamber 46 seats the valve 47 on the valve seat 48 thereby stopping the venting of the compression chamber 25 of the compressor to atmosphere. Simultaneously with the sealing off of the compression chamber 25, the chamber 26 at the underside of the diaphragm piston 23 is vented to atmosphere via pipe 31, port 67, chamber 52, exhaust bore 64, exhaust chamber 50 and port 51, thus permitting the spring 36 to return the diaphragm piston 23 to its lower position when the cam 43 rotates such that the lower side thereof engages the cam follower rod 38 and thereby restarts the reciprocating up and down compression and intake strokes of the diaphragm piston 23.

It can thus be seen that when the compressor is in an operating condition with chamber 26 vented to atmosphere, the cam follower rod 38 and diaphragm piston 23 are in constant reciprocating motion with the cam 43 effecting upward motion and the spring 36 effecting downward motion, the spring 41 acting as a buffer between the follower rod and the diaphragm piston and maintaining the follower rod in contact with the cam 43 to prevent any bouncing action. When the compressor is in an unloaded position with fluid under pressure supplied via the reservoir and the unloading valve 20 to the chamber 26, the diaphragm piston is maintained in its uppermost position while the cam 43 continues to effect upward motion of the cam follower rod 38 within the bores 42 and 39, the spring 41 effecting downward motion thereof to maintain the follower in contact with the cam shaft to prevent any damage thereto.

It should be noted that although the compressor shown herein is the diaphragm type, the invention may be similarly employed with a ring-packed piston type compressor.

Having now described the invention, what I claim as new and desire to secure by Letters Patent, is:

A compressor operated by driving means for supplying fluid under pressure to a reservoir means, said compressor comprising a casing having a piston bore containing a piston means, said piston means having a piston stem, said piston stem having a guide bore for receiving a push rod, eccentric means rotated by the driving means and engaging said push rod to produce oscillatory movement of said push rod, biasing spring means within said guide bore effective to maintain said push rod in constant engagement with said eccentric means, said piston means being moved into a first position within said piston bore as effected by said push rod engaging said piston stem responsively to operation of said eccentric means, spring means interposed between said piston stem and said casing and encircling said piston stem in a manner to effect movement of said piston means into a second position within said bore, means providing a first chamber on one side of said piston means, inlet valve means operable responsively to movement of said piston means to said second position as effected by said spring means to cause supply of fluid to said first chamber, discharge valve means operable responsively to movement of said piston means to said first position within said bore as effected by said eccentric means and said push rod means to cause supply of fluid under pressure from said first chamber to the reservoir means, means providing a second chamber on the opposite side of said piston means and through which said piston stem and said spring extend, and valve means operable responsively to a predetermined pressure of fluid in the reservoir to effect venting of said first chamber to atmosphere and to concurrently supply fluid under pressure to said second chamber to effect immobilization of said piston means and said piston stem in a position in which said piston stem is operatively disengaged from the push rod in opposition to the force of said second-named spring means, thereby causing unloading of said compressor irrespective of the operation of said eccentric means and corresponding move- of said push rod within said guide bore.

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