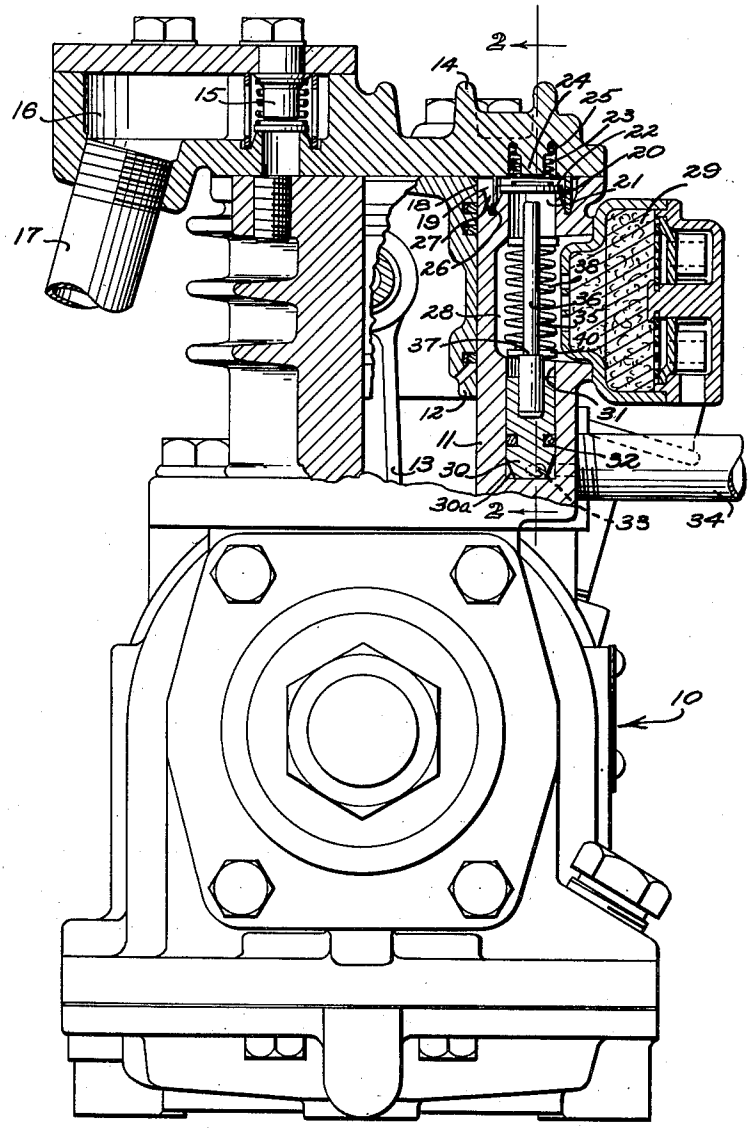
May 14, 1957 H. M. VALENTINE 2,792,169

COMPRESSOR VALVE CONTROL MEANS

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Fig. 1.



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COMPRESSOR VALVE CONTROL MEANS

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Fig. 2.

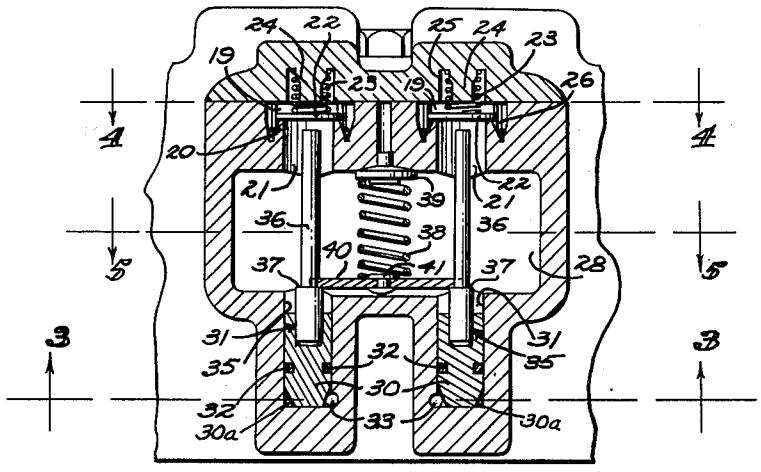
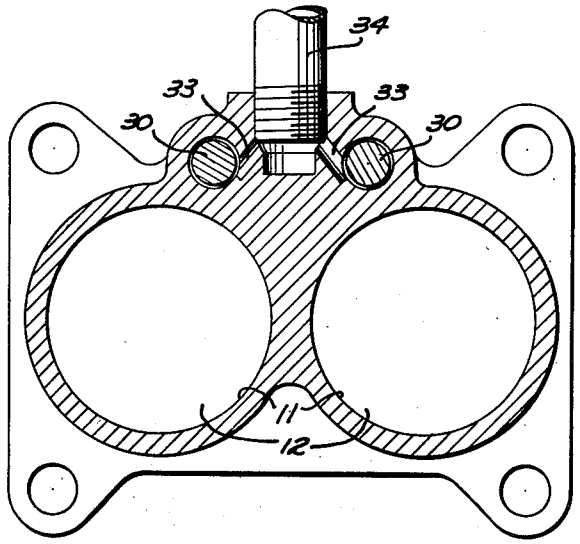


Fig. 3.



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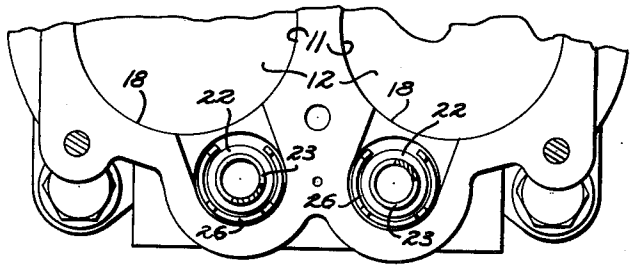


Fig. 4.

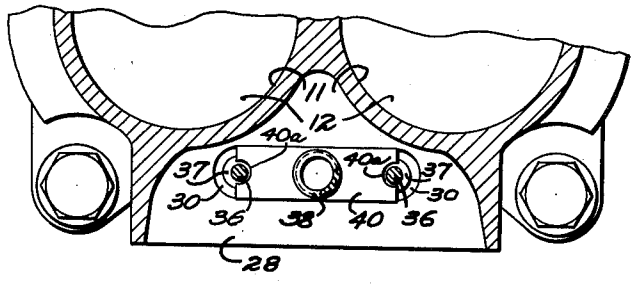


Fig. 5.

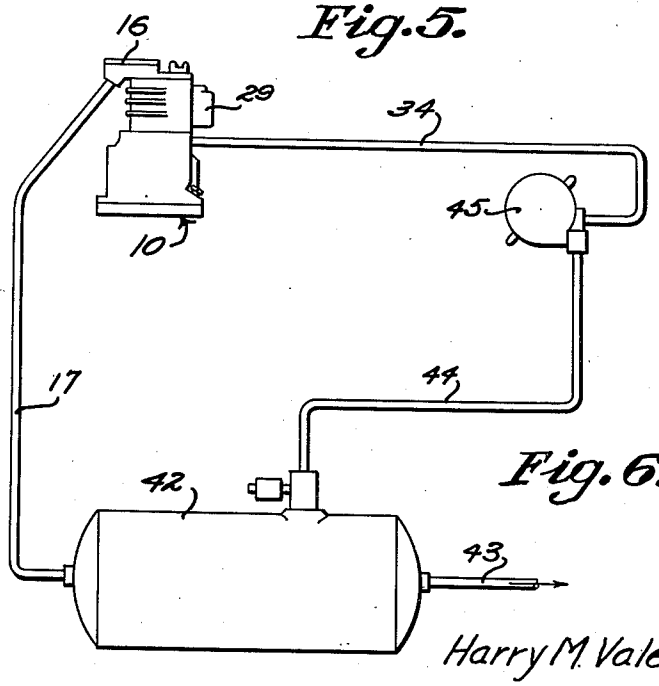


Fig. 6.

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2,792,169

COMPRESSOR VALVE CONTROL MEANS

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Application November 19, 1954, Serial No. 469,923

6 Claims. (Cl. 230—31)

This invention relates to control means and more particularly to means for controlling the flow of fluid pressure supplied by a pump or compressor.

It has previously been customary in connection with pumps and compressors, and particularly in connection with pumps for compressing air, to provide means controlled by pressure in the reservoir for automatically controlling the compressor to prevent further pumping of fluid pressure when the pressure in the reservoir has reached a predetermined value. A frequently used means for accomplishing this has been by use of unloading mechanism which opens the compressor cylinder to the outside atmosphere or to an adjoining cylinder during the reciprocation of the piston or pistons so that no useful work is performed thereby. Commonly, unloading valves, separate from the intake or suction valves, and under the control of a fluid pressure governor responsive to reservoir pressure, are used. The extra costs and complexities involved in providing separate valve mechanisms are undesirable and one of the objects of the present invention is the elimination of extra unloading valves by the provision of actuator means for maintaining the suction valve open so that it functions as an unloader valve whenever a predetermined maximum pressure prevails in the reservoir.

Another object of the invention is to provide fluid pressure actuating means comprising an auxiliary piston which is movable to extended position under the control of a fluid pressure governor to unseat the suction valve and maintain it unseated so long as a predetermined pressure prevails in the reservoir.

Another object of the invention is the provision of fluid actuated, suction valve unloading means which is particularly adaptable to use with two-cylinder single-stage compressors.

Still a further object of the invention is the provision of fluid actuated suction valve unloading means for a two-cylinder compressor having an inlet valve for each cylinder which operates to unseat each valve consecutively to expose both cylinders to the outside atmosphere and enables both inlet valves to return simultaneously to their seated positions when pumping is to be resumed.

These and other objects will become apparent as the following detailed description is read in conjunction with the accompanying drawings wherein:

Fig. 1 is a vertical end view partly in elevation and partly in section of a two-cylinder compressor showing the near side cylinder and piston with a portion of the latter broken away and showing the fluid actuated unloader of the present invention;

Fig. 2 is a vertical side sectional view of the unloader mechanism taken substantially on the line 2—2 of Fig. 1;

Fig. 3 is a horizontal sectional view of the fluid pressure inlet to the unloader mechanism taken substantially on a line corresponding to line 3—3 of Fig. 2;

Fig. 4 is a partial horizontal sectional view of the compressor inlet ports and valves taken substantially on a line corresponding to line 4—4 of Fig. 2;

Fig. 5 is a partial horizontal sectional view of the unloader mechanism of the present invention taken substantially on a line corresponding to line 5—5 of Fig. 2;

Fig. 6 is a schematic view of a fluid system employing a compressor utilizing the unloader of the present invention.

Referring now to the drawings and particularly to Fig. 1, there is illustrated a compressor 10 which may be of the two-cylinder single-stage type wherein both pumping chambers are substantially identical, with each comprising a cylinder 11 having a piston 12 slidably mounted therein and driven by a crankshaft (not shown) connected thereto by means of a connecting rod 13 of the conventional type. The upper ends of the cylinders are provided with a unitary cylinder head 14 having a spring pressed discharge valve 15 of conventional construction recessed therein for each of said cylinders. The discharge valves are opened on the compression stroke of the pistons 12 to admit compressed fluid to a discharge manifold 16 having connected thereto a discharge conduit 17 which may lead to a fluid pressure reservoir. The right wall of each cylinder at its upper end is provided with an inlet port 18 and at the right end of this port there is provided an inlet cavity 19 containing a horizontally disposed valve seat 20 having a bore 21 therethrough. An inlet valve 22 of the disc type is normally maintained against the seat by means of a relatively light spring 23 interposed between the upper side of the valve disc 22 and the cylinder head 14 where the spring is retained in position by the depending portion 24 of an annular recess 25 in the head 14. A castellated partially circular valve guide 26 (see Fig. 4) interposed between the head 14 and the bottom of an annular groove 27 surrounding the valve seat 20 is provided for the valve disc 22.

As illustrated in Figs. 1 and 2, the inlet bore 21 of each inlet valve extends downwardly to communicate with an inlet chamber 28 which functions as an inlet manifold for the purpose of supplying fluid to each of the compressor cylinders. Affixed to the right-hand side of the chamber 28 is a conventional filter 29 through which all fluid entering the compressor must first pass. It will now be seen that upon downward movement of either piston 12 the pressure in the cylinder thereof will be less than atmospheric so that the inlet valve 22 will be unseated against the pressure of light spring 23 causing air to flow through the filter 29, into chamber 28, past valve disc 22, through the castellated guide 26 and into the cylinder where, on the following up-stroke of the piston, the fluid is compressed, first causing inlet valve 22 to re-seat and thereafter being discharged to the reservoir when the discharge valves 15 are unseated in the usual fashion.

When a maximum predetermined pressure is received in the reservoir, the compressor or pump 10 must be unloaded and in the present invention relatively simple and inexpensive means are provided for this. With particular reference to Fig. 2, the unloader mechanism of the present invention is illustrated as comprising, for each of the inlet valves, an auxiliary piston 30 slidably contained in auxiliary cylinders 31 which are disposed in axial alignment with the inlet bores 21. The auxiliary pistons are tapered at their lower ends 30*a* and are normally seated on the bottoms of the auxiliary cylinders 31. Seal rings 32 about each auxiliary piston are provided to prevent the escape of actuating fluid which enters the cylinders 31 through drilled passageways 33 shown more particularly in Fig. 3. The drilled passages communicate with an inlet pipe 34 which is intermittently supplied with fluid pressure from governor means as described with more particularity hereinafter. It should be observed that the taper 30*a* at the lower ends of the auxiliary pistons 30 enables the seal rings 32 to be more readily assembled

and also provides a fluid receiving space at the bottoms of the auxiliary cylinders 31.

The upper ends of the auxiliary pistons 30 are axially drilled to receive the lower ends of elongated plungers 35 having reduced upper ends 36 forming shoulders 37 which are disposed on the plungers 35 so as to be slightly above the auxiliary cylinder bores 31 when the auxiliary pistons 30 are in their normal seated position of Fig. 2. The upper ends 36 of the plungers 35 extend upwardly into the inlet bores 21 with their upper termini spaced a slight distance below the centers of the valve discs 22 when the auxiliary pistons 30 are in their normal position.

The auxiliary pistons are yieldingly retained in the normal position of Fig. 2 by means of a single compression spring 38 which is interposed between an upper spring seat 39 affixed centrally in the upper wall of chamber 28 and a transverse bridge member 40 having a centrally disposed spring guide 41. As shown in Fig. 5, the bridge member 40 comprises a rectangular member whose ends are adapted to be seated on the shoulders 37 of the plungers 35 with the ends of the bridge members having semicircular bifurcated ends 40*a* which embrace the reduced upper ends 36 of the plungers to prevent any relative lateral movement of the bridge member with respect to the plungers.

It should now be apparent from the described arrangement of the unloader means of the present invention that when fluid pressure is admitted to the auxiliary cylinders 31 the auxiliary pistons 30 move upwardly causing the reduced ends 36 of plungers 35 to strike valve discs 22 to unseat them and expose the compressor cylinders 11 to the outside atmosphere so that further compression ceases and the compressor is thus unloaded. As the auxiliary pistons 30 continue to move upwardly with the valves 22 the plunger ends 36 move the valves into engagement with the cylinder head 14 which forms a stop for the discs with the upper termini of the plunger ends 36 abutting the disc valves in their stopped position on their under sides opposite the point where their upper sides engage the depending portions 24 of the annular recesses 25 so that the valves are not subjected to any distorting forces resulting from plunger pressure. During the unloading operation, it will also be apparent that when the auxiliary pistons 30 move upwardly to bring the plunger ends 36 into engagement with the inlet valves, one inlet valve or the other will be subjected to compressor cylinder pressure depending on which of the compressor pistons 12 is on the up-stroke, while the other inlet valve will be partially opened in the normal manner as its compressor piston is on the down-stroke. Under these conditions, the inlet valve under compression cannot be opened until its compressor piston has started its down-stroke and hence the plunger 36 engaging the valve has its further movement delayed until this down-stroke occurs, whereas the other already-opened inlet valve will be maintained open through the continued upward movement of its plunger 36. The bridge member 40 permits this consecutive opening of the inlet valves by rocking slightly at its ends on the shoulders 37 of the plungers 35 as one plunger precedes the other in its respective valve opening movement. When fluid pressure is exhausted from the auxiliary cylinders, the single compression spring 38 acting on the bridge member 40 serves to return both of the auxiliary pistons 30 simultaneously to their normal seated position of Fig. 2.

Referring now to Fig. 6, a fluid compression system is illustrated which employs a compressor utilizing an unloader mechanism of the present invention. The compressor 10 draws air from the atmosphere through the filter 29 and discharges the compressed fluid through the discharge conduit 17 to a reservoir 42 from whence the compressed fluid is drawn via a conduit 43 to its place of use. A third conduit 44 leads from the reservoir to a fluid governor 45 of the type well known in the art which includes a normally closed valve means which prevents the flow of fluid pressure through the conduit 44 until a predetermined maximum pressure is reached in the reservoir at which time pressure responsive means in the governor causes the normally closed valve of the governor to be opened to admit fluid pressure to the conduit 34 leading to the drilled passageways 33 (Fig. 3) communicating with the auxiliary cylinders 31, whereupon the auxiliary pistons 30 are raised to unseat the inlet valves and unload the compressor as previously described. When the fluid pressure in the reservoir 42 falls to a predetermined low pressure the fluid pressure responsive device in the governor closes the aforementioned valve therein while simultaneously exhausting the fluid pressure in the conduit 34 so that the auxiliary pistons 30 again return to their normal position thus allowing the inlet valves to re-seat and compression to recommence.

While the present invention has been described in its application as an unloading means for a two-cylinder compressor it should be apparent that the teaching of the present invention could as readily be applied to a single cylinder compressor or to a multi-cylinder compressor. Furthermore, where the mechanism of the present invention has been described in its application to complete unloading of the compressor it could as readily be applied to partial unloading of a compressor by merely moving the inlet port to a lower position in the cylinder wall so that the port is cut off by the compressor piston prior to completion of its up-stroke. Other modifications and changes may also be incorporated in the structure shown and described herein and such modifications are intended to be included in the invention without departing from the scope of the appended claims.

What is claimed is:

1. In a two-cylinder compressor of the type having an inlet port in the wall of each of the cylinders, a pair of inlet cavities communicating with each of said ports, an inlet chamber, a pair of parallel inlet bores communicating said chamber with each of said cavities, and inlet valves in said cavities normally closing each of said bores, the improvement which comprises unloader means for said compressor including a pair of auxiliary pistons and cylinders disposed in said chamber in axial alignment with said inlet bores, a plunger on each of said pistons extending into said bores and being movable in a valve opening direction to open said valves upon admission of fluid pressure to said auxiliary cylinders, a shoulder on each of said plungers, a bridge member extending between said plungers and having its opposed ends seated on said shoulders, spring means acting on said bridge member to maintain said plungers normally out of engagement with said valves and normally opposing movement of said pistons in a valve opening direction.

2. In a two-cylinder compressor of the type having an inlet port in the wall of each of the cylinders and a valve for normally closing each of said ports, the improvement which comprises unloader means for said compressor including a pair of plungers each operable to move one of said valves to open position, means for operating said plungers including a pair of auxiliary pistons integral with one end of said plungers, means including a bridge member engaging said pistons for maintaining said plungers out of engagement with said valves, and an auxiliary cylinder for each of said pistons adapted to receive fluid pressure to move said pistons in a valve opening direction.

3. In a two-cylinder compressor of the type having an inlet port in the wall of each of the cylinders, a common inlet chamber for supplying fluid to each of said ports, and valves for normally closing each of said ports, the improvement which comprises unloader means for said compressor disposed in said chamber and including a pair of plungers each operable to move one of said valves to open position, means for operating said plungers

including a pair of auxiliary pistons and cylinders in said inlet chambers, each of said pistons being affixed to one end of each of said plungers, and means for normally maintaining said plungers out of engagement with said valves including shoulders on said plungers, a bridge member engaging said shoulders, and spring means acting on said bridge member to oppose movement of said pistons and plungers in a valve opening direction.

4. In a compressor having a cylinder, an inlet port in the wall of said cylinder, an inlet cavity in communication with said port, an inlet bore through a wall of said cavity, a disc type inlet valve for closing said bore, a cylindrical valve guide surrounding said valve and being interposed between opposed walls of said cavity, the wall at the end of said guide opposite said bore providing a stop for said valve when moved to open position, a depending portion of said opposite wall being in axial alignment with said bore, said portion being defined by an annular recess in said wall and surrounding said portion, a spring interposed between the bottom of said recess and said valve for normally maintaining said valve closed, unloading means for said compressor including a fluid operated plunger movable to open said valve upon admission of fluid to a pressure receiving surface of said plunger, said plunger being axially aligned with said depending portion so that upon movement thereof, the plunger engages said valve disc opposite the depending portion in said cavity whereby said portion provides a stop for said plunger upon contact of said valve therewith to prevent any distortion of said valve, and resilient means normally maintaining said plunger out of engagement with said valve.

5. In a two-cylinder compressor of the type having an inlet port in the wall of each of the cylinders, a pair of inlet cavities communicating with each of said ports, an inlet chamber, a pair of parallel inlet bores communicating said chamber with said cavities, and disc valves in said cavities for closing said bores, the improvement which comprises unloader means for said compressor including

a pair of auxiliary plungers and cylinders disposed in said chamber in axial alignment with said bores, said plungers being movable in a valve opening direction to open said valves upon admission of fluid pressure to said auxiliary cylinders, a shoulder on each of said plungers, a bridge member extending between said plungers and having its opposed ends rockingly seated on said shoulders, the ends of said member being bifurcated to embrace said plungers, and a single compression spring having one end engaging a wall of said chamber and its other end engaging said bridge member intermediate the plungers for normally maintaining said plungers out of engagement with said valves.

6. In a compressor of the type having at least a pair of cylinders and pistons therein, each of said cylinders provided with an inlet port, and a valve for each of said inlet ports for normally closing the same, the improvement which comprises unloader mechanism for said compressor comprising a plunger for each of said valves and operable to consecutively move the valves to open position, a bridge member extending between said plungers and having its opposite ends rockably engaging said plungers, and a single spring engaging the bridge member intermediate its ends for normally maintaining said member and plungers in inoperative position.

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