S. B. REDFIELD.

COMPRESSOR UNLOADER.

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1,428,981. Patented Sept. 12, 1922.

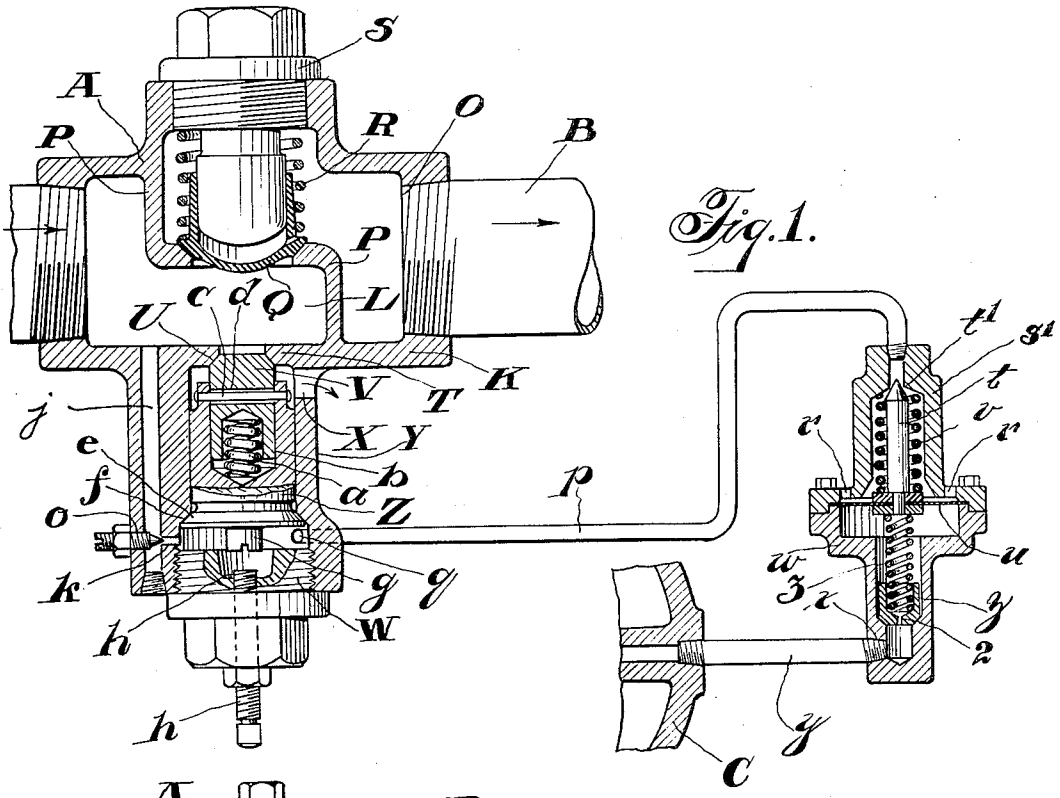


Fig. 1.

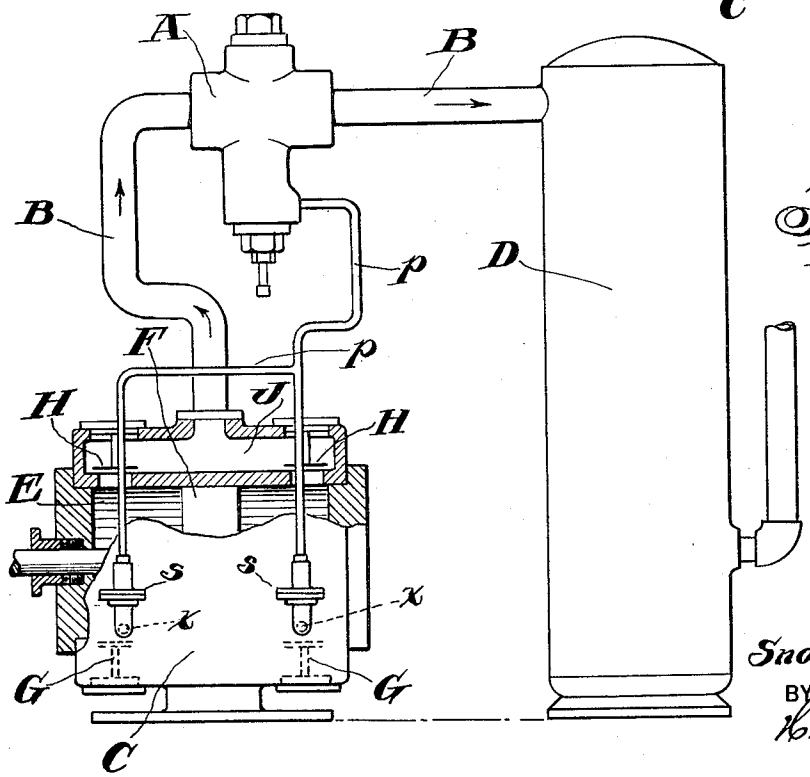


Fig. 2.

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COMPRESSOR UNLOADER.

Application filed August 15, 1921. Serial No. 492,568.

To all whom it may concern:

Be it known that I, SNOWDEN B. REDFIELD, a citizen of the United States, and a resident of Easton, Northampton County, State of Pennsylvania, have invented a certain Compressor Unloader, of which the following is a specification, accompanied by drawings.

This invention relates to compressor unloaders but more particularly to an unloader for relieving the fluid compression load during the period of starting. The compressor may be operated for instance by an electric motor automatically started and stopped by means of an automatic pressure controlled electric switch, while my unloader has no connection with the control switch and the unloading and loading operations are performed only by the action of the compressor itself.

The invention is in some respects an improvement upon the unloader disclosed in my former patent No. 1,421,309 granted June 27, 1922, and the objects of the invention are to simplify the apparatus and obtain quicker unloading, even before complete stoppage of the machine.

Further objects of the invention will hereinafter appear and to all of these ends the invention is shown in the accompanying drawings in which

Figure 1 is a longitudinal sectional elevation of the unloader, and

Figure 2 is a diagrammatic elevation partly in vertical section of the unloader applied to a compressor unit.

Referring to the drawings and at first to Figure 2, the unloader A is connected in the discharge line B of a compressor C between the compressor and the usual receiver D. The compressor, shown diagrammatically for simplicity, comprises the cylinder E having the reciprocating piston F adapted to be driven from any suitable source of power as an electric motor (not shown). The compressor is provided with the inlet valves G and discharge valves H, and the discharge chamber J is connected to the discharge line B.

The unloader shown in detail in Figure 1 comprises the valve casing K having the main valve chamber L separated from the outlet O by a partition P on which the main check valve Q is adapted to be seated for controlling the discharge from the casing. The check valve Q is provided with a spring R bearing on the valve and held by the cap S, which cap also forms a valve guide. The pressure in the receiver tank D normally holds the main check valve Q to its seat.

The wall T of the casing K is provided with a valve seat U on which a relief valve V is adapted to be seated, for controlling communication between the main valve chamber L and an atmospheric relief port X conveniently located in the side of the extension Y of the main casing K in which the relief valve V operates. The relief valve V is preferably carried by a piston Z and has limited longitudinal movement relatively to the piston, being urged inwardly by a comparatively heavy coiled spring *a* in the valve socket *b*, of sufficient strength to resist the full line pressure in the main valve chamber L and prevent the relief valve from opening against the spring due to said pressure when the valve is held to its seat by the combined spring pressure and fluid pressure beneath the piston Z. The movement of the relief valve is limited by the pin *c* passing through the transverse aperture *d* in the valve and secured at each end in the valve piston Z.

The piston Z is of the differential type and is provided with an enlarged head *e* forming a pressure area materially greater than the opposing pressure area on the face of the relief valve V, and pressure behind the piston head *e* will force the relief valve V to its seat U with sufficient force to compress the strong spring *a* and also hold the piston head *e* firmly against the seat *f* in the casing extension Y, so that leakage of fluid past the piston from behind the piston head is shut off and prevented. The relative longitudinal movement or lost motion connection provided between the relief valve V and the piston Z enables both the valve and the piston to be tightly seated on their seats U and *f* respectively.

A projection or stop *g* on the piston Z is adapted to bear upon an adjusting screw *h* in the cap W, by means of which the initial starting position of the piston Z and relief valve V may be adjusted. A by-pass *j* leads from the main valve chamber L and communicates with a port *k* opening behind the piston Z and controlled by a set-screw *o* forming a choking needle valve.

The unloader so far described prevents the fluid compressing load from coming upon the machine until the motor is up to full speed. Fluid, as air, enters the main valve casing K at the inlet side and leaves at the discharge outlet O, and the main check valve Q holds back the air in the receiver D and pipe lines while the compressor is idle. When the compressor is started, any slight pressure built up in the main valve chamber L will force both the relief valve V and the piston Z rearwardly and substantially all the air being pumped will pass out through the port X to atmosphere. It is to be assumed that the adjusting screw *h* has been set at such a point that the relief valve and piston move rearwardly and open the relief valve the required amount, so that when the compressor is up to full speed, there will be a throttling pressure of a few pounds as the air passes the relief valve. This low pressure is transmitted slowly through the by-pass connection *j* and port *k* controlled by the choking needle valve *o*, behind the differential piston head *e*, and finally forces the piston Z and the relief valve V to their seats by the time full compressor speed is reached. After this point is reached, all the air passes the main check valve Q to the system.

Greater closing of the choking set screw or needle valve *o* delays the loading point but this choking valve should preferably be as nearly closed as will allow the device to operate for loading. Adjustment of the screw *h* behind the piston Z determines the pressure to which the side discharge to atmosphere through port Z will be built up by relief valve V, by the time the compressor has reached full speed. This adjusting screw *h* should preferably be set at a point to produce just enough throttling at the relief valve V to move the piston Z inwardly and close the relief valve V when the choking needle valve *o* is set well towards its seat in the port *k*. The throttling due to the slightly open relief valve V need not be considerable, but should be at least a pound or two, in order to start building up an initial pressure in the receiver tank D, when starting with the said tank entirely empty.

Loading should be delayed until substantially full compressor speed is reached, and unloading should occur automatically just as, or before, the compressor stops entirely. In order to accomplish unloading on stopping the compressor, means are provided for quickly reducing the pressure behind the head *e* of the piston Z, which causes the piston to be instantaneously driven rearwardly by the pressure in front of the relief valve V. For this purpose I prefer to connect one or more bleeder valves, substantially like the valve disclosed, in my aforesaid Patent No. 1,421,309, between the port *q* of the unloader and the compressor cylinder C, in this instance two such bleeder valves *s* being so connected to the indicator taps *x* at each end of the compressor as by means of the pipes *p* and *y*. The pipe *p* leads to one end of one portion *s'* of the bleeder valve casing, while the other pipe *y* connects to the opposite end of the other portion *w* of the bleeder valve casing. A diaphragm *u* is held between the casing portions *s'* and *w*, and carries a needle valve *t* controlling the port *t'*, which vents the pipe *p* and the space behind the relief valve piston Z to atmosphere through the bleeder valve atmospheric ports *r* when pressure beneath the diaphragm *u* is relieved as the compressor stops. A check valve *z* in the casing portion *w* having a minute hole 2 is held to its seat by a spring 3, and the diaphragm *u* is subject to the pressure in the compressor, which holds the needle valve *t* to its seat against the pressure of a light spring *v* during the running period. When the compressor stops, the air under the diaphragm *u* passes through the small hole 2 back into the compressor cylinder, and the needle valve *t* then opens, thus venting the space back of the relief valve piston Z to atmosphere through the ports *r*, and permitting the relief valve V and piston Z to be forced rearwardly to open the relief valve V. All the air then in the compressor cylinder and discharge pipe up to the check valve Q is at once relieved to atmosphere through the atmospheric port X, and the compressor is unloaded, ready to start.

The unloader should be adjusted to unload as promptly as possible on stopping. The more nearly closed the choking valve *o* is set, the more prompt will be the unloading, and the setting may be such that the compressor will be completely unloaded during the last few strokes of the piston.

The light spring *v* is for the purpose of positively assisting the opening of the bleeder valve *t*, but is preferably omitted entirely, since the valve will be opened automatically due to the full pressure in the pipe *p* on the valve and the suction produced in the compressor cylinder C at each suction stroke, which at slow speed, just before stopping, is sufficient to drop the valve *t*. Without the spring *v*, a very slight pressure in the compressor cylinder C, sufficient for instance to open its discharge valves, will be enough to close the bleeder valve *t* immediately after starting the compressor, thus closing any communication between the pipe *p* and the atmosphere.

By using two bleeder valves for the compressor cylinder, the last few suction strokes at either end of the air compressing cylinder cause the needle valves *t* to open during each suction stroke, when the speed is sufficiently low and the unloading takes place. By this means the operation of the unloader

is entirely independent of leakage through the discharge valves of the compressor. By connecting bleeder valves to operate on the slow suction strokes just before stopping, reduced cylinder pressure is always assured, and the unloader has been found to operate satisfactorily and well in actual practice.

I claim:

1. A compressor unloader comprising a valve casing having a main valve chamber adapted to be connected in the discharge line of the compressor, a main discharge valve controlling the outlet from said chamber to the discharge line, a vent to atmosphere from said chamber, and an automatic differential relief valve controlling said vent to atmosphere and subjected on opposed differential pressure surfaces to the pressure in the main valve chamber, whereby a delayed time element is produced between the starting of the compressor and the opening of said main discharge valve.

2. A compressor unloader comprising a valve casing having a main valve chamber adapted to be connected in the discharge line of the compressor, a main discharge valve controlling the outlet from said chamber to the discharge line, a vent to atmosphere from said chamber, and an automatic differential relief device controlling said vent to atmosphere, consisting of a piston having an enlarged head and a spring pressed relief valve movable on said piston, both the spring pressed relief valve and the piston head being subjected to fluid pressure from the main valve chamber for actuating the piston and valve together and thereby preventing the loading of the compressor until an element of time has elapsed after starting.

3. A compressor unloader comprising a valve casing having a main valve chamber adapted to be connected in the discharge line of the compressor, a main discharge valve controlling the outlet from said chamber to the discharge line, a vent to atmosphere from said chamber, a relief valve controlling said vent to atmosphere, a piston on which said relief valve has limited longitudinal movement, a spring between the valve and piston, the piston being subject to the pressure existing in the main valve chamber tending to move the relief valve to closed position and hold the valve closed, whereby the load is not thrown on the compressor until the compressor has reached a speed sufficient to build up enough pressure in the said main valve chamber to actuate the piston in a direction to close the said relief valve.

4. A compressor unloader comprising a valve casing having a main valve chamber adapted to be connected to the discharge line of the compressor, a main discharge valve controlling the outlet from said chamber to the discharge line, a vent to atmosphere from said chamber, an automatic relief valve controlling said vent to atmosphere and actuated both to open and close by fluid pressure, thereby preventing the opening of the main discharge valve until the compressor has attained sufficient speed to permit the load to be safely thrown on the compressor, and means for automatically relieving the pressure holding the relief valve closed as the compressor stops, in order to vent the main valve chamber to atmosphere and unload the compressor on stopping.

5. A compressor unloader comprising a valve casing having a main valve chamber adapted to be connected in the discharge line of the compressor, a main discharge valve controlling the outlet from said chamber to the discharge line, a vent to atmosphere from said chamber, an automatic differential relief valve controlling said vent to atmosphere and subjected on opposed differential pressure surfaces to the pressure in the main valve chamber, whereby a delayed time element is produced between the starting of the compressor and the opening of said main discharge valve, and an automatic bleeder valve controlled by the pressure in the compressor, for automatically relieving the pressure holding the relief valve closed as the compressor stops, in order to vent the main valve chamber to atmosphere and unload the compressor on stopping.

6. A compressor unloader comprising a valve casing having a main valve chamber adapted to be connected in the discharge line of the compressor, a main discharge valve controlling the outlet from said chamber to the discharge line, a vent to atmosphere from said chamber, an automatic differential relief device controlling said unit to atmosphere, consisting of a piston having an enlarged head and a spring pressed relief valve movable on said piston, both the spring pressed relief valve and the piston head being subjected to fluid pressure from the main valve chamber for actuating the piston and valve together and thereby preventing the loading of the compressor until an element of time has elapsed after starting, and an automatic bleeder valve controlled by the pressure in the compressor, for automatically relieving the pressure on the enlarged piston head holding the relief valve closed as the compressor stops, in order to vent the main valve chamber to atmosphere and unload the compressor on stopping.

7. A compressor unloader comprising a valve casing having a main valve chamber adapted to be connected in the discharge line of the compressor, a main discharge valve controlling the outlet from said chamber to the discharge line, a vent to atmosphere from said chamber, a relief valve controlling said vent to atmosphere, a piston on which said relief valve has limited longitudinal movement, a spring between the valve and piston,

the piston being subject to the pressure existing in the main valve chamber tending to move the relief valve to closed position and hold the valve closed, whereby the load is not thrown on the compressor until the compressor has reached a speed sufficient to build up enough pressure in the said main valve chamber to actuate the piston in a direction to close the said relief valve, and an automatic bleeder valve controlled by the pressure in the compressor for automatically relieving the pressure rearwardly of the piston holding the relief valve closed as the compressor stops, in order to vent the main valve chamber to atmosphere and unload the compressor on stopping.

8. A compressor unloader comprising a valve casing having a main valve chamber adapted to be connected in the discharge line of the compressor, a main discharge valve controlling the outlet from said chamber to the discharge line, a vent to atmosphere from said chamber, and an automatic differential relief device controlling said vent to atmosphere, consisting of a piston having an enlarged head and a spring pressed relief valve movable on said piston, both the spring pressed relief valve and the piston head being subjected to fluid pressure from the main valve chamber for actuating the piston and valve together and thereby preventing the loading of the compressor until an element of time has elapsed after starting, and means for throttling the supply of fluid pressure from the main valve chamber to actuate the piston in a direction to close the relief valve.

9. A compressor unloader comprising a valve casing having a main valve chamber adapted to be connected in the discharge line of the compressor, a main discharge valve controlling the outlet from said chamber to the discharge line, a vent to atmosphere from said chamber, a relief valve controlling said vent to atmosphere, a piston on which said relief valve has limited longitudinal movement, a spring between the valve and piston, the piston being subject to the pressure existing in the main valve chamber tending to move the relief valve to closed position and hold the valve closed, whereby the load is not thrown on the compressor until the compressor has reached a speed sufficient to build up enough pressure in the said main valve chamber to actuate the piston in a direction to close the said relief valve, and means for throttling the supply of fluid pressure from the main valve chamber to actuate the piston in a direction to close the relief valve.

In testimony whereof I have signed this specification.

SNOWDEN B. REDFIELD.