May 23, 1933. J. LE VALLEY 1,909,972

START STOP UNLOADER FOR MULTIPLE STAGE COMPRESSORS

Filed April 19, 1932

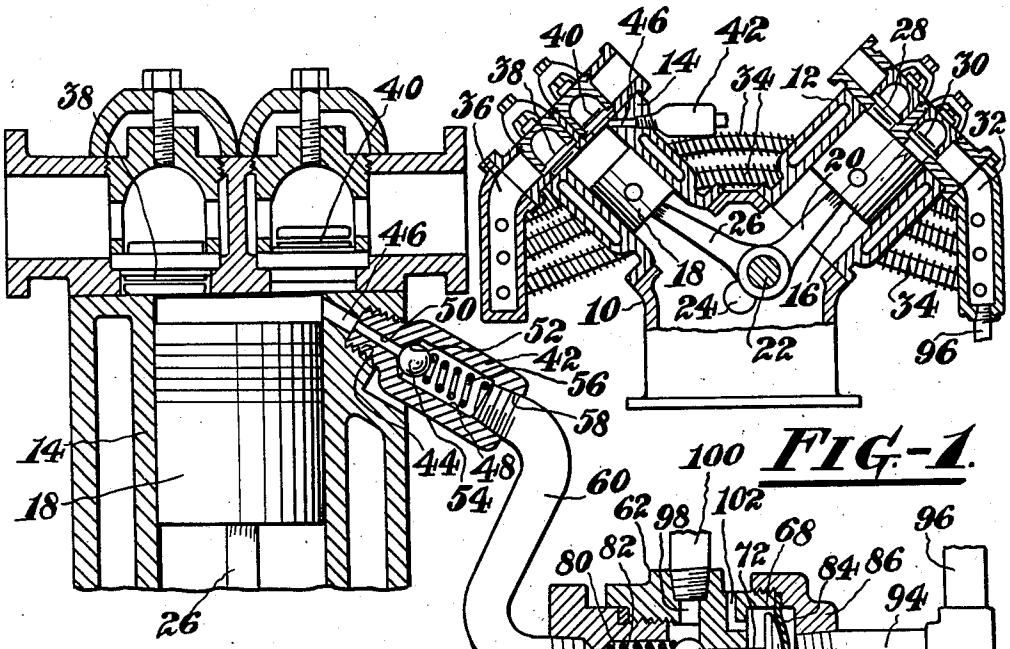


FIG.-1.

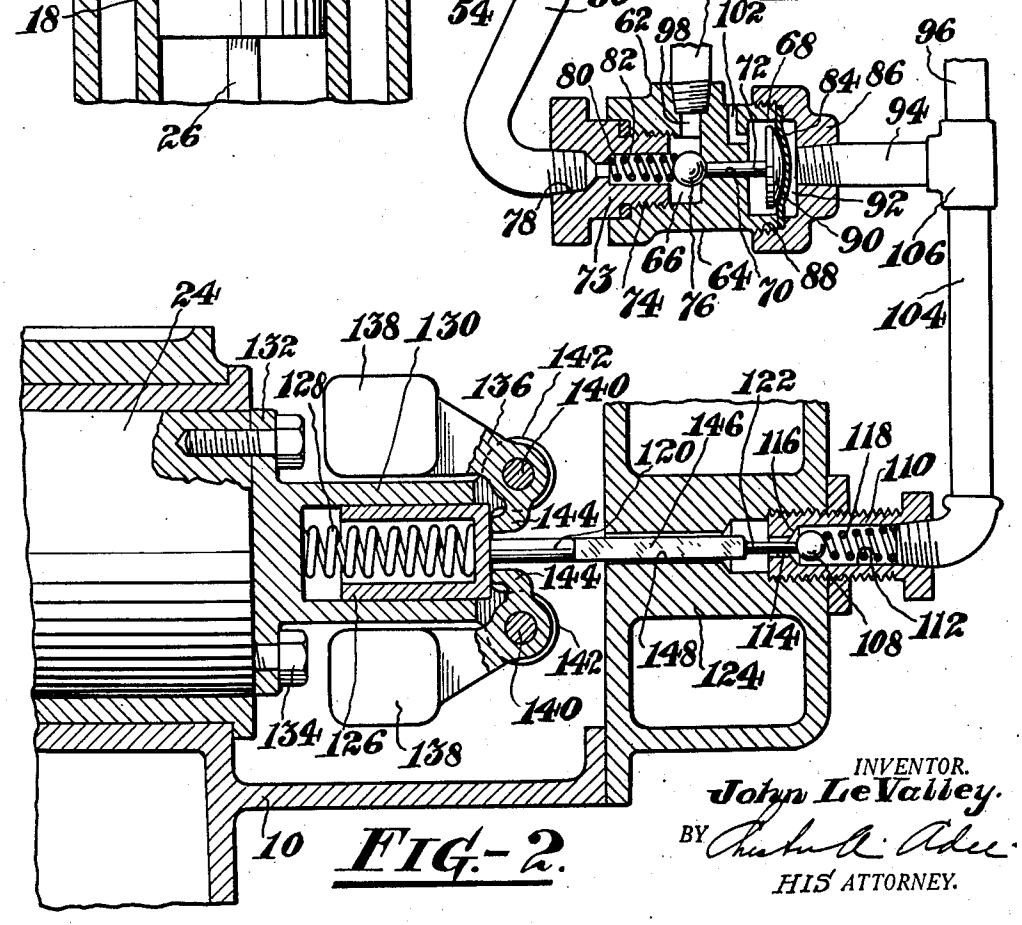


FIG.-2.

INVENTOR.
John LeValley.
BY Chester A. Adee
HIS ATTORNEY.

Patented May 23, 1933 1,909,972

UNITED STATES PATENT OFFICE

JOHN LE VALLEY, OF PAINTED POST, NEW YORK, ASSIGNOR TO INGERSOLL-RAND COMPANY, OF JERSEY CITY, NEW JERSEY, A CORPORATION OF NEW JERSEY

START STOP UNLOADER FOR MULTIPLE STAGE COMPRESSORS

Application filed April 19, 1932. Serial No. 606,109.

This invention relates to compressors, but more particularly to an unloader for compressors.

One object of the invention is to reduce the load on the prime motor of the compressor during the starting period of the compressor.

Another object is to produce an inexpensive and simple unloader which may be cheaply maintained and which will be positive in operation.

Other objects will be in part obvious and in part pointed out hereinafter.

In the drawing accompanying the specification and in which similar reference characters refer to similar parts,

Fig. 1 is a section through a compressor of a type adapted to be fitted with an unloader as contemplated by the invention, and

Fig. 2 is a longitudinal section through the cylinder of the compressor and the unloading means constructed in accordance with the practice of the invention together with associated parts of the compressor mechanism also shown in section.

Referring to the drawing and more particularly to Fig. 1 the compressor includes a base 10 upon which are suitably mounted a low pressure cylinder 12 and a high pressure cylinder 14 provided with pistons 16 and 18 respectively. The piston 16 is adapted to be reciprocated by a connecting rod 20 mounted on the crank pin 22 of the crank shaft 24. Likewise the piston 18 is provided with a connecting rod 26 journalled on the crank pin 22. The low pressure cylinder 12 is provided with a suitable inlet valve 28 and a discharge valve 30 controlling the flow of compressed fluid to a manifold 32. Suitable cooling conduits 34 connect the manifold 32 to an inlet manifold 36 suitably attached to the high pressure cylinder 14 which is provided with suitable inlet and discharge valves 38 and 40 respectively.

The compressor above described is quite similar to that disclosed in my co-pending application No. 510,140 filed January 21, 1931 and as in the case of that compressor, it is highly desirable that the load be removed during the starting period of the compressor and particularly would be driven by a motor having relatively low starting torque.

The invention herein to be described is an improvement over the unloader described in the above mentioned application in that it provides a means for utilizing a relatively small centrifugal mechanism for unloading the high pressure cylinder 14 when the compressor is operated at relatively high discharge pressures. To this end the unloader is provided with relief devices which are adapted to be operated by fluid pressure below that of the discharge of the high pressure cylinder. In this instance the pressure utilized is that which obtains in the intercooler conduits 34. The unloading mechanism includes a plug 42 fitted into an aperture 44 of the high pressure cylinder 14 terminating in a passageway 46 leading to the interior of the cylinder 14. The plug 42 is hollow, being provided with two concentric bores 48 and 50, the former bore being of larger diameter than the latter and both bores being connected by a valve seat 52 upon which a ball check valve 54 is adapted to rest, being resiliently held in this position by means of a spring 56. An aperture 58 in the plug 42 is adapted to receive a threaded tube 60 which leads to a pilot valve 62. The pilot valve 62 consists of a body 64 having opposed apertures 66 and 68 connected by a bore 70 into which is slidably fitted a plunger rod 72. The aperture 68 is closed by means of a valve seat plug 73 provided with a valve seat 74 for a ball valve 76 which is adapted to be pressed onto the seat 74 by means of the plunger rod 72. The plug 73 is provided with a threaded aperture 78 to receive the threaded tube 60 which communicates with a bore 80 to receive a valve spring 82 normally tending to maintain the ball valve 76 off its seat.

The aperture 68 is closed by a diaphragm 84 held in place by a suitable cap 86 threaded onto the end of the valve body 64 as at 88. The diaphragm 84 is arranged to actuate the plunger rod 72 through the medium of the plunger head 90 integrally formed with the rod and bearing against the diaphragm 84 due to the pressure of the spring 82.

The interior of the cap 86 and the diaphragm 84 form a chamber 92 into which pressure fluid is admitted by means of a pipe 94 connected by means of a pipe 96 to the discharge manifold 32 of the low pressure cylinder 12. The chamber or aperture 66 is maintained at atmospheric pressure by means of a vent 98 and vent pipe 100 leading to atmosphere. Similarly the chamber 68 is maintained at atmospheric pressure by a suitable vent 102 also leading to atmosphere.

The pipe 96 is also adapted to act as a vent for unloading the low pressure cylinder by reducing the pressure in the discharge manifold 32 to atmosphere and to this end a branch pipe 104 is provided connecting with the pipe 96 at a T 106. The venting of pipe 104 is controlled by a ball valve 108 contained in a plug 110 to which the pipe 104 is connected. The plug 110 is provided with a large concentric bore 112 and a smaller bore 114 joined by a conical valve seat 116 for the ball valve 108. Normally the ball valve 108 is held upon its seat 116 by means of a spring 118 within the bore 112. When the compressor is at rest or when operating at slow speed the ball valve 108 is centrifugally operated by a plunger rod 120, having a reduced end 122 adapted to pass through the small bore 114 of the plug 110. Preferably the plug 110 is fitted into a portion 124 forming part of the compressor base 10 and its bore 114 is coaxial with the crank shaft 24. In order that the rod 120 may hold the ball valve 108 off its seat when the compressor is not running, a cup-shaped end 126 is provided within which a spring 128 is inserted normally tending to push the rod 120 in the direction of the ball valve.

Centrifugal means are provided to depress the spring 128 and withdraw the rod 120 when the compressor has reached a predetermined speed of operation. To this end the shaft 24 is provided with a cylindrical extension 130 bolted to the shaft at flanges 132 by means of bolts 134 and is adapted to receive the cup-shaped end 126 of the rod 120.

A pair of arms 136 weighted as at 138 are pivotally mounted as at 140 upon lugs 142 integrally formed with the cylindrical extension 130 and are provided with ends 144 bearing against the cup-shaped end 126 of the rod 120. Upon rotation of the shaft 24 the weighted ends 138 of the arms are adapted to overcome the tension in the spring 128 and to depress the cup-shaped member 126 thereby withdrawing the rod 120 and releasing the ball valve 108.

In order to permit the escape of air or gas under pressure the rod 120 is provided with flat sides as at 146 and additionally the aperture 148 in the portion 124 of the base is of slightly larger diameter than the rod 120.

In the operation of the device, while the compressor is not running the spring 128 forces the rod 120 to unseat the ball valve 108 thereby permitting the escape of any gas under pressure which may exist in the manifold 32 or the intercooler tubes 34 by way of the tubes 96 and 104. In this position also the spring 82 forces the ball valve 76 from its seat 74 thereby permitting the escape of any fluid compressed in the high pressure cylinder 14 by way of the plug 42 and the pipe 60, the bore 80 and bore 98 of the pilot valve and thence by way of the pipe 100 to any suitable receptacle or to atmosphere.

Upon speeding up of the compressor centrifugal force acting upon the weights 138 causes the ends 144 of the arms 136 to depress the plunger rod 120 thereby releasing the ball valve 108 which is forced to unseat by the spring 118.

Since the air being compressed in the low pressure cylinder 12 and discharged into the manifold 32 can no longer escape pressure will then build up in the chamber 92 of the pilot valve until the pressure upon the diaphragm 84 is sufficient to overcome the pressure of the spring 82 and the pressure of the air being discharged through the bore 80 of the pilot valve. The plunger rod 70 is thereupon moved by the pressure from the diaphragm 84 to force the ball valve 76 to its seat 74 holding it tightly thereagainst.

Being closed to the escape of gas under pressure the volume within the pipe 60 will act as a clearance for the cylinder 10 until completely filled with gas under the maximum pressure obtainable in the cylinder 14 whereupon the check valve 54 remains upon its seat 52 due to the biasing tension of the coil spring 56.

It will be seen therefore that during the starting period of the compressor the cylinders are unloaded until the speed is such that the centrifugal force of the weight 138 is sufficient to overcome the tension of the spring 128 and that the high and low pressure cylinders load successively, the low pressure cylinder being loaded first and arranged to control the loading of the high pressure cylinder. It will be seen that the low pressure cylinder will load slowly due to the fact that the intercooler tubes 34 and the manifolds 32 and 36 have considerable storage capacity. The high pressure cylinder is loaded only upon the building up of the pressure in the manifold 32 and the load is thrown onto the high pressure cylinder 14 relatively slowly due to the relatively slow closing of the ball valve 76.

Thus by the above construction are accomplished, among others, the objects hereinbefore referred to.

I claim:

1. A start stop unloader for multiple stage compressors comprising means to control the escape of the discharge of one stage to atmosphere for unloading and loading that stage

of the compressor upon stopping and starting respectively of the compressor, and means operable by said loading means for loading another stage of said compressor.

2. A start stop unloader for multiple stage compressors comprising means associated with the discharge of one stage of said compressor to permit the escape of fluid therefrom upon stopping of the compressor, means for unloading the second stage of said compressor, and means controlled by the discharge pressure of the first stage to control said unloading means for the other stage.

3. A start stop unloader for multiple stage compressors comprising a centrifugally operated means for reducing the discharge pressure of one stage of the compressor when the compressor comes to rest, and fluid operated means for controlling another stage of the compressor operated by the discharge pressure of the first said stage.

4. A start stop unloader for a compressor having a pair of compression chambers and a discharge chamber for one of said chambers leading to the inlet of the second compression chamber, a centrifugally operated escape valve to reduce the pressure in said discharge chamber when the compressor comes to rest, a conduit leading from one of said compression chambers to atmosphere, and a valve controlled by the pressure in the said discharge chamber for controlling the escape of fluid from said conduit to atmosphere.

In testimony whereof I have signed this specification.

JOHN LE VALLEY.