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C. CUMMINGS.

UNLOADING MEANS FOR AIR COMPRESSORS.

(Application filed Mar. 22, 1899.)

(No Model.)

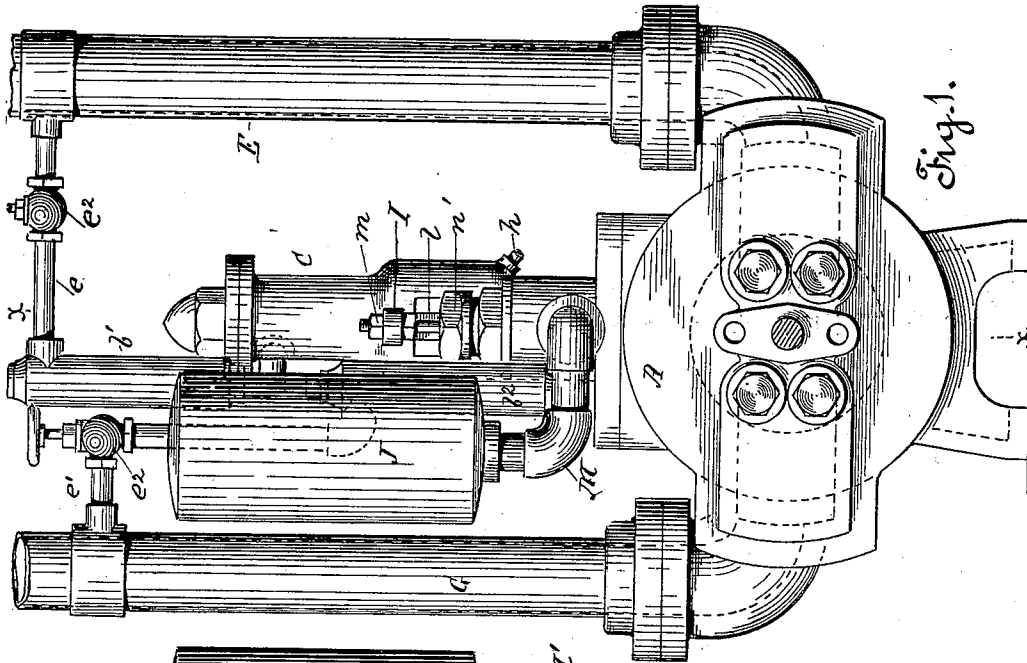


Fig. 1.

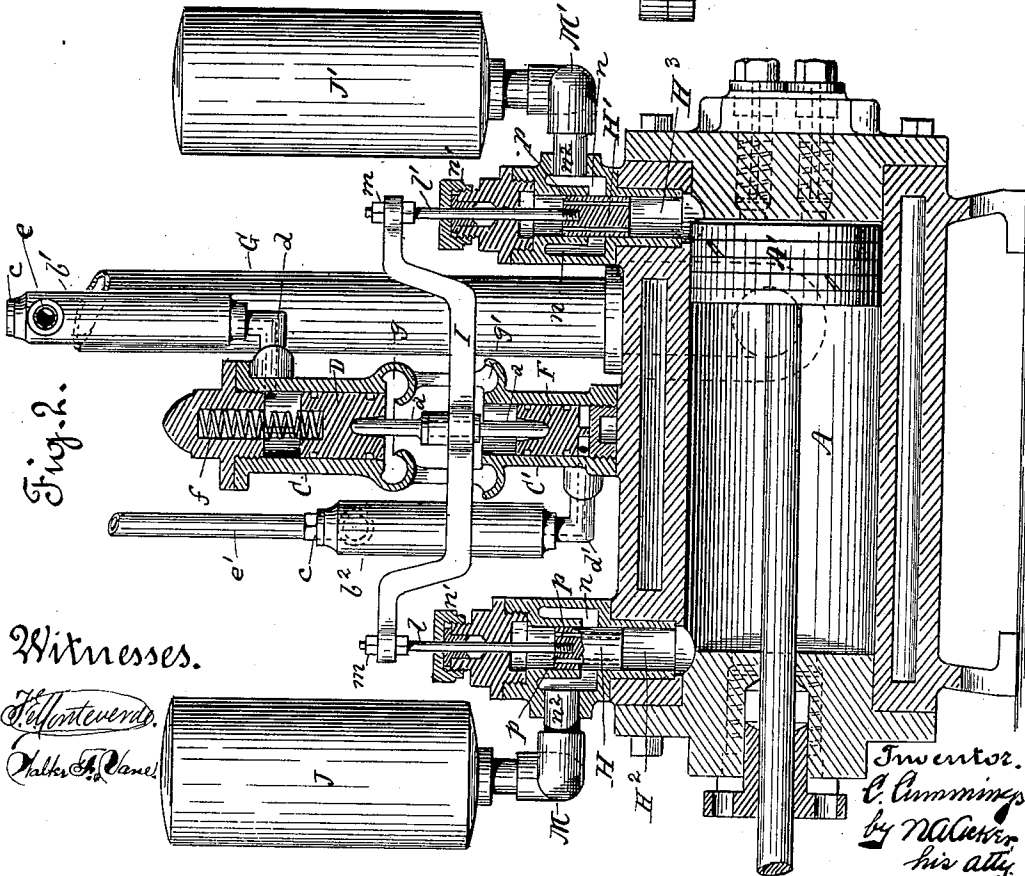


Fig. 2.

Witnesses.

W. H. H. H. H.
W. H. H. H. H.

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UNITED STATES PATENT OFFICE.

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UNLOADING MEANS FOR AIR-COMPRESSORS.

SPECIFICATION forming part of Letters Patent No. 635,667, dated October 24, 1899.

Application filed March 22, 1899. Serial No. 710,091. (No model.)

To all whom it may concern:

Be it known that I, CHARLES CUMMINGS, a citizen of the United States, residing at the city of Oakland, in the county of Alameda and State of California, have invented certain new and useful Improvements in Unloading Means for Air-Compressors; and I do hereby declare that the following is a full, clear, and exact description thereof.

This invention relates to certain new and useful means for unloading air-compressors designed for use in connection with a double-pipe or pressure system; and it consists in the arrangement of parts and details of construction, as will be hereinafter fully set forth in the drawings and described and pointed out in the specification.

The object of the present invention is to provide against waste of power in air-compressors run at a constant speed used in connection with the double-pipe system, so that in case the use of the compressed air ceases or is cut off for the time being the compression or energy required to compress air during the regular working of the compressor is obviated or dispensed with. This enables me to dispose of safety-valves or similar devices usually employed to release the load and at the same time permits of the compressor running under a constant speed without doing the work of compression, thus, so to speak, allowing of the compressor-piston working idle. Ordinarily if the compressed air is not being utilized or consumed for a time the compressor is still required to compress the air, and this air is forced to escape through a safety-valve or similar device connected therewith for this purpose. While it is true the air escapes from the high-pressure pipe, still certain energy has been expended in order to compress the load, and it is this loss of energy that by the present invention I desire to avoid.

In carrying out my invention I take advantage of the known fact that the greater the clearance-space in any air-compressor the less is its capacity for compression. This being so, it follows that if the clearance-space equals in volume that portion of the compressor-cylinder traversed by the compressing-piston no compressed air would be expelled from the cylinder into the receivers or

compressed-air pipes, provided the pressure within said receiver or air-pipes is greater than the pressure of the air in the cylinder; hence no energy transmitted. If a clearance-space equal in volume to that of the working portion of the compressing-cylinder is provided and connected at each end of the said cylinder—that is, when the compressor is a double-acting one—so that by means of suitable automatically-operated mechanism the said clearance-space may be utilized as a storage reservoir or chamber for the air taken into the cylinder at each stroke of the piston when no compressed air is being used or needed, and, on the other hand, when the compressed air is being used or needed, if said space is “disconnected,” so to speak, or closed from the compressor-cylinder at such times, so as to force the compressed air into the service-pipes, it will be apparent that an air-compressor may be operated in connection with a double-pipe system at a constant speed without loss of energy. Such idea is the basis of the present invention, and the foregoing object is attained by mechanism substantially the same as that illustrated by the accompanying sheet of drawings, forming a part of the present application, wherein—

Figure 1 is a side view in elevation of the compressor used with a double-pipe system, illustrating the receiver and connection between the receiver, high and low pressure pipes, and between the receiver and compressor-cylinder; and Fig. 2 is a longitudinal sectional view in elevation taken on line *xx*, Fig. 1.

In the drawings the letter A is used to indicate the compression-cylinder of an ordinary air-compressor, and A' the piston working freely therein, said cylinder being provided with the usual air-inlet valves, through which air is drawn into the cylinder for compression upon the stroke of the piston during the working of the driving mechanism.

Above the compression-cylinder, preferably, are arranged the connected cylinders C C', within the upper one of which works a piston D. This piston is connected by means of rods *a* to a similar but smaller piston F, working freely within the cylinder C', as shown. The cylinders C and C' are connected, respectively, through the medium of the

hereinafter-described mechanism to the low and high pressure pipes of a double-pipe system for transmitting power. The piston D, working freely in cylinder C, is acted upon by the air contained in the low-pressure pipe E, while the piston F, working freely in lower cylinder C', is acted upon by the air contained in the high-pressure pipe G. Each piston being connected by rods *a*, the movement of one imparts corresponding movement to the other.

It will be observed that the cylinder C and piston D are considerably larger than cylinder C' and piston F. In fact, the areas of pistons D and F have the same ratio to each other that the pressures of air contained in the high and low pressure pipes E and G have to each other. Such being the case, if the piston D has twice the area of piston F and the pressure of compressed air in the high-pressure pipe G is double that of the air contained in the low-pressure pipe E, then the pressure of air in cylinders C and C' will be such as to hold or maintain the pistons D and F in equilibrium when the pressures are in normal condition.

The lower end of piston D and the upper end of piston F are exposed to the atmosphere, and the pressure from the supply or pressure pipes E and G acts upon the said pistons, preferably, through the medium of a body of oil located in oil-wells *b'* *b*². Each well is supplied with a removable screw-cap *c*, which when removed permits of oil being fed to the wells in order to resupply the same. Oil-well *b'* is connected to cylinder C by means of the pipe *d*, so as to supply oil under pressure to the cylinder above or back of the piston D, while the well *b*² is connected to cylinder C' by pipe *d'*, so as to supply oil under pressure below the piston F, Fig. 2. The oil-well *b'* is also connected to the low-pressure supply E by pipe *e* and the oil-well *b*² to the high-pressure supply G by the pipe *e'*, each pipe connection being supplied with a globe-valve *e*², by means of which the air-supply to either well may be cut off while the same is being supplied with oil or filled.

The upper cylinder C is provided at its lower end with the drip-receptacle *g*, which receives such oil as may escape or leak through the piston D, and a similar receptacle *g'* is arranged around the upper end of cylinder C', so as to receive such oil as escapes from the piston F. The oil caught in drip-receptacle *g* escapes through outlet-openings drilled therethrough into drip-receptacle *g'*, and the same is drawn therefrom by means of the escape-pipe *h*.

In order to prevent sudden movement of the pistons D and F from one extreme to the other of their range of action, a spring *f* is interposed within the cylinder C, so as to maintain a downward pressure upon the piston D, Fig. 2.

The pistons D and F are connected by the rods *a* to the yoke I, which yoke at its ends carries the stems *l l'*, which are provided with

the adjusting-nuts *m*. These stems *l l'* pass through stuffing-boxes *n' n'* and are connected to pistons H H', which pistons work freely through the chambers H² H³, communicating with the compressing-cylinder at each end thereof. In the wall of these chambers H² H³ are formed the ports *n*, which communicate with the outlet-openings *n*² of the chambers. When the piston-valves H H' stand in the position indicated by Fig. 2 of the drawings, these ports are closed. At any suitable distance from the chambers H² H³ are arranged the receivers or air-reservoirs J J', which connect, respectively, to the outlet *n*² of the chambers H² H³ by means of the pipe connections M M'. These receivers or air-reservoirs are each of such size as to have a capacity for air equal to the volume of the compression-cylinder less that occupied by the compressor-piston, or, in other words, the volume of each receiver is equal to the air-space of the compressing-cylinder with its piston. When the piston-valves H H' are raised to clear the ports *n*, an uninterrupted communication is established between the compressing-cylinder and each receiver. In order to balance the piston-valves H H', so as to equalize the air-pressure thereon, each valve is provided with a series of vertical openings or holes *p*, drilled there-through or otherwise formed.

The operation of the foregoing mechanism may be briefly and clearly described in the following manner: We must presume that the high and low pressure supply-pipes which connect the compressor with a distant motor or motors to be driven are charged with air—for instance, the low-pressure supply-pipe at a pressure of one hundred (100) pounds and the high-pressure supply-pipe at a pressure of two hundred (200) pounds. Now if the various parts of the apparatus stand relatively the same as illustrated by Fig. 2 of the drawings and the distant driven motor consumes or uses the air as rapidly as it is compressed and delivered then the difference in pressure between the high and low pressure supply-pipes will remain unaltered, and the pressure upon the pistons D and F being equal the same will be held in equilibrium. As the compressor is presumed to be running at a constant speed, it is obvious that if for any reason a part or the entire consumption of the compressed air by the driven motor is cut off the pressure in the high-pressure supply-pipe will increase and that of the low-pressure supply-pipe decrease or fall, and thus destroy the fixed ratio of pressures between the supply-pipes. This variation will give a back or increased pressure from the high-pressure pipe to the piston F through the described connections and a decreased pressure from the piston D to the low-pressure supply-pipe, and thus break or destroy the equilibrium of the said pistons D and F. The moment this variance in pressures takes place the increased pressure brought to bear against the piston F serves to raise or force the same upward with-

in its cylinder and carry the piston D therewith, owing to the connecting-rods interposed therebetween. As these pistons rise the yoke I is carried therewith, the movement of which lifts the stems l' and raises the piston-valves H H' within the chambers $H^2 H^3$, so as to partially or wholly open the ports n and establish direct communication between the compressor-cylinder and the receivers J J', so as to permit of the air taken into the compressor to be expelled into the said receivers upon the inward and outward stroke of the compressing-piston. Direct communication having been established between the compression-cylinder and the receivers and the piston-stroke being in the direction indicated by arrow, then as the piston moves outward the air within the cylinder in advance thereof will be forced into receiver J, while during the movement of the piston air will be drawn, or sucked into the cylinder from the receiver J'. Upon the return stroke of the piston the air within the cylinder will be forced back into receiver J' and air drawn or sucked into the cylinder from receiver J. As before stated, the volume of each receiver equaling that of the cylinder less the space occupied by the piston it is obvious that the only work required of the piston at such times is only that required to force the air from the cylinder through an uninterrupted passage into the respective receivers. This action will continue alternately at each end of the compressor-cylinder so long as no compressed air is being used. However, the moment compressed air is again required for the driven engine the pressure in the high-pressure supply-pipe decreases and that of the low-pressure supply-pipe increases. This gives an increased back pressure from the low-pressure supply-pipe upon the piston D, which forces the same downward until the said pistons D and F reach their normal position, as illustrated in Fig. 2. The downward movement of these pistons gives a reverse action to that of the pistons H H', above described, lowering the same so as to close the ports n . When these ports stand closed, the compressor operates in the usual manner in connection with the high and low pressure supply-pipes, the action of which being fully set forth and described in Letters Patent No. 456,941, granted me on the 4th day of August, 1891, for an apparatus for transmitting power by means of compressed air, a detailed description of the same is not deemed necessary in the present application, reference being made to the aforesaid Letters Patent therefor.

Having thus described my invention, what I claim as new, and desire to secure protection in by Letters Patent, is—

1. In an unloader for air-compressors, the combination with the compressor-cylinder, of air-receivers, having approximately the same volume as that of the cylinder, valved communications between each receiver and one end of the cylinder, the high and low pres-

sure supply-pipes, and of mechanism operated by the changed pressures in said supply-pipes for controlling the valved communications between the compressor-cylinder and the receivers.

2. The combination with the compressor-cylinder of an air-compressor, of the air-receivers having approximately the same volume as that of the cylinder, valve-chambers arranged at each end of the cylinder and communicating therewith, connection between the said chambers and the receivers, piston-valves arranged within the chambers, the high and low pressure supply-pipes communicating with the compressor-cylinder, and of mechanism operated by the change of pressures within the supply-pipes for controlling the movement of the piston-valves.

3. The combination with the compressor-cylinder, of the high and low pressure supply-pipes, air-receivers of approximately the same working volume as the compressor-cylinder, communication between said receivers and the compressor, and of means operated by a change of pressures in the supply-pipes for controlling the communication between the compressor-cylinder and the air-receivers.

4. The combination with the compressor-cylinder, of the valve-chambers communicating with the interior of the cylinder near each end thereof, the air-receivers of approximately the same volume as the cylinder, connection between the valve-chambers and the receivers, a piston-valve working in each chamber so as to control the communication between the cylinder and air-receivers, the piston-cylinders, connected pistons working therein, a yoke carried thereby, connection between the yoke and piston-valves, the high and low pressure supply-pipes and the pistons whereby the said pistons are raised and lowered by the change of pressures in the supply-pipes.

5. The combination with the compressor-cylinder, of the valve-chambers communicating therewith, piston-valves working therein, air-receivers having approximately the volume of the compressor-cylinder, connection between the valve-chambers and the cylinders, the piston-cylinders, pistons working therein, connection between said pistons and the piston-valves, oil-wells connected with each piston-cylinder, the high and low pressure supply-pipes, and of connection between said wells and the supply-pipes whereby the pistons are raised or lowered by the change of pressures in the supply-pipes so as to operate the piston-valves in order to control the communication between the compressor-cylinder and the air-receivers.

In testimony whereof I hereunto affix my signature, in presence of two witnesses, this 11th day of March, 1899.

CHARLES CUMMINGS.

Witnesses:

N. A. ACKER,
WALTER F. VANE.