

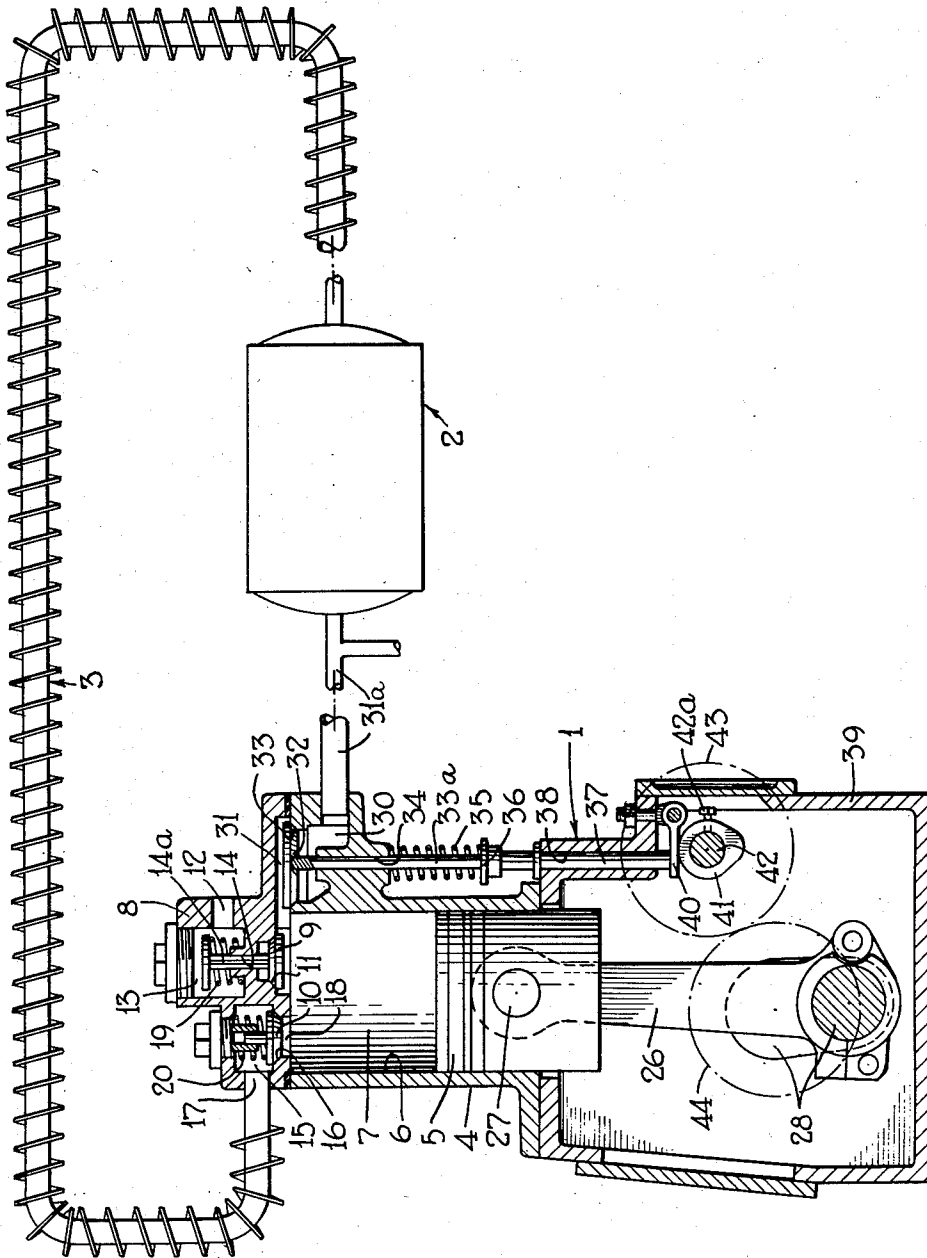
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AIR COMPRESSOR

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AIR COMPRESSOR

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This invention relates to air compressors and more particularly to means for controlling the operating temperature thereof.

In the operation of air compressors, excessive discharge temperatures, resultant from heat of compression of the air, tend to damage or otherwise cause faulty operation of the discharge valve mechanism either as a direct result of such heat or as an indirect result of carbonized oil deposits, in view of which, it is a prime object of the invention to provide a means and method whereby the temperature of operation of an air compressor may be reduced from that otherwise obtained.

Another object of the invention is to provide an air compressor capable of operating at higher discharge pressures than normally practical without excessive heating.

Other objects and advantages will become apparent from the following more detailed description of the invention.

In the accompanying drawing, the single figure is a schematic view of an air compressing system including an air compressor constructed in accordance with a preferred form of the invention.

Description

Referring to the drawing, the air compressor embodying the invention, and designated by reference number 1, is disposed in a system including a storage reservoir 2, and aftercooler coils 3.

For the purpose of illustration, the air compressor 1 comprises a cylinder casing 4 having the usual piston 5 reciprocable therein in sliding sealing engagement with the usual inner cylinder wall 6 formed in the casing. In the well-known manner, the piston 5 serves as a movable abutment defining one end of the usual cylinder chamber 7, the opposite end of which chamber 7 is closed by a pressure head 8 containing the usual inlet and discharge valves 9 and 10, respectively, which control admission of free air to and discharge of compressed air from the cylinder chamber 7, respectively; inlet valve 9 being arranged for cooperation with a valve seat 11 to control communication between an inlet port 12 in pressure head 8 and the cylinder chamber 7 via an inlet chamber 13, constantly connected to port 12, and a bore 14 in which a fluted stem 14a attached to inlet valve 9 is slidably guided; and exhaust valve 10 being disposed in a discharge chamber 15 and arranged for cooperation with a valve seat 16 to control communication between a discharge port 17 and the cylinder chamber 7 by way of the chamber 15 and a port 18. A light compression spring 19, disposed in the inlet chamber 13 is arranged to cooperate with the fluted stem 14a to bias the inlet valve 9 toward its seated position, in which it is shown in the drawing, closing off the cylinder chamber 7 from the inlet port 12, and a similar light compression spring 20, disposed in the discharge chamber 15 is arranged to bias the discharge valve 10 toward its seated position, in which it is shown in the drawing, closing off the cylinder chamber 7 from the discharge port 17.

In the well-known manner, movement of the piston 5

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through its suction stroke from top dead center position in proximity of the pressure head 8 to bottom dead center position in which it is shown in the drawing, will cause a suction in cylinder chamber 7 which causes the unseating of inlet valve 9 and admission of air from the atmosphere into said chamber 7 via inlet port 12, inlet chamber 13, bore 14, and the unseated inlet valve. Subsequent movement of the piston 9 through its compression stroke in the opposite direction, that is, from its bottom dead center position to its top dead center position, will cause compression of the air in chamber 7 and displacement of such air therefrom via port 18, discharge chamber 15, and port 17 by unseating of the discharge valve 10 against opposition of reservoir 2 pressure as experienced in discharge chamber 15 and of the light bias spring 20.

The air compressor 1 further comprises the usual connecting rod 26 which operably connects, via a pin 27, the piston 5 to the usual crank shaft 28 suitably driven by means (not shown) to cause reciprocating movement of the piston in the well-known manner.

The inlet port 12 is constantly open to the atmosphere and the discharge port 17 is constantly connected to the reservoir 2 via the aftercooler coils 3 which cool the compressed air discharged from the compressor enroute to the reservoir.

According to the invention, means are provided in the compressor 1 for effecting admittance of cooled compressed air from the reservoir 2 into cylinder chamber 7, during each successive compression stroke of the piston 5, for cooling purposes in order to limit the operating temperature of the compressor, in manner as hereinafter described.

Such means, as above referred to, may comprise a second inlet chamber 30, preferably formed within a portion of the casing 4, in constantly open communication with the reservoir 2 via such as a pipe 31a; an auxiliary air inlet passage 31, which may be formed in the pressure head 8, opening into the upper end of the cylinder chamber 7; an auxiliary-air-admission-controlling inlet valve 32 interposed between chamber 30 and chamber 31 in cooperation with a seat 33 to control communication between said chambers; a valve stem 33a attached at one end to valve 32 and slidably guided within a suitable opening 34 in the casing 4 for reciprocably moving the valve 32 into and out of engagement with its seat 33; a compression spring 35 encircling the stem 33a, in abutment at its one end with an accommodating portion of the casing 4 and in abutment at its opposite end with a collar element 36 suitably attached to the valve stem 33a, to urge said stem in the direction for causing engagement of the attached valve 32 with its seat 33; a pin 37, slidably disposed in a suitable casing opening 38 and extending into the interior of the crankcase portion 39 of the compressor device, adapted at its outermost end for engagement with the free end of the valve stem 33a; a pivotally mounted finger 40 disposed within crankcase portion 39 in operative engagement with the innermost end of the pin 37; a cam 41 also disposed within crankcase portion 39 in operative engagement with the finger 40; a cam shaft 42 secured through the medium of such as a set screw 42a to rotate the cam 41; and intermeshing gears 43 and 44 secured to rotate with the cam shaft 42 and compressor crankshaft 28 to cause rotation of the former with respect to the latter.

Operation

According to the invention, during each compression stroke of the piston 5, the valve 32 is unseated for a portion of such stroke by action of the crankshaft rotated cam 41 through the medium of the valve stem 33a, pin 37 and finger 40 to allow cooled compressed air from

the reservoir 2 to flow via pipe 31a into the cylinder chamber 7 to mix with the initial charge of air therein admitted from the atmosphere past inlet valve 9 during the suction stroke of the piston 5 for purposes of reducing the temperature of the air discharged from such cylinder chamber past discharge valve 10.

It is intended that the compressor 1 be employed in conjunction with the usual automatic means (not shown) for controlling operation of such compressor, by starting and stopping or loading and unloading, to maintain pressure of air in the reservoir 2 within a selected range between upper and lower limits, such as one hundred pounds per square inch and ninety pounds per square inch, for example. Under such conditions of operation, the profile of the cam 41 and its angular position with respect to shaft 42 are selected such that, following opening of valve 32 during each successive compression stroke of the piston 5 to permit entrance of compressed air from reservoir 2 into cylinder chamber 7, the spring 35 will be permitted to close said valve 32 before the pressure of the air in cylinder chamber 7 attains a value greater than that maintained in reservoir 2, to thus prevent air compressed in cylinder chamber 7 from flowing to the reservoir 2 via pipe 31a. This assures that the air compressed in cylinder chamber 7 will be discharged to the reservoir 2 exclusively by way of the discharge valve 10 and cooler coils 3 as the pressure of air in cylinder chamber 7 is increased to a value above the pressure in the reservoir during completion of each compression stroke of the piston following closure of the valve 32.

It should be pointed out that, for any given discharge pressure, the additional work necessary to drive the compressor 1 as a result of such cooling air admittance in the novel compressor system, as well as the cooling effect produced by the admission of the compressed air to the chamber 7 during the compression stroke of piston 5 in manner as described, both depend upon the duration of such admission, that is, the length of time that valve 32 remains open, and upon the time during such compression stroke at which such admission commences, that is, the time at which valve 32 is unseated during movement of piston 5 in its compression stroke.

It has been found by test that a certain single-cylinder compressor of a particular size, operating at a particular speed and at a discharge pressure of 150 pounds per square inch, for example, for a tolerable increase in work input to such compressor might realize maximum cooling effect by opening of the valve 32 at the time that the piston 5 has completed substantially half of its compression stroke; the discharge temperature under such conditions being in the vicinity of 370° F., approximately two hundred degrees less than a prohibitive temperature that would otherwise prevail were the compression of the initial charge from atmospheric pressure to 150 p. s. i. performed by piston 5 without admittance of cooling air into chamber 7. At a discharge pressure of 50 p. s. i., it was found that desired cooling input to the compressor might be realized by unseating of valve 32 at a time closer to the beginning of the compression stroke.

Accordingly, therefore, in keeping with another feature of the invention, by provision of means such as the set screw 42a, the cam 41 may be adjusted to different angular positions on the cam shaft 42 to attain the desired opening time of the valve 32 with respect to operation of piston 5 for any given discharge pressure of the compressor.

Summary

From the foregoing, it will be apparent that I have provided an air compressor, incorporating improved cool-

ing air admittance control means, which is capable of operating at relatively high discharge pressures, in the neighborhood of 150 p. s. i., for example, without excessive heating.

In operation of the novel compressor, the usual charge of atmospheric air is drawn into the compressor cylinder during each successive suction stroke of the compressor piston and such charge compressed and discharged during each successive compression stroke of the compressor piston. The compressed air thus discharged from the compressor is cooled and fed into the usual storage reservoir for use, and, according to the invention, for a certain interval during each successive compression stroke of the compressor piston, a portion of the cooled compressed air from the storage reservoir is admitted into the cylinder for cooling purposes.

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

1. In combination with a source of cooled gas under pressure, a compressor having a gas compressing chamber and piston means defining an end wall of said chamber movable alternately and successively through a suction stroke in which said chamber is expanded from a minimum size and through a compression stroke in which said chamber is contracted from a maximum size to its minimum size, a rotatable crankshaft operatively connected to said piston means, pressure differential operated inlet valve means connected to said chamber and responsive to reduction in pressure of gas in said chamber resultant from movement of said piston means through its suction stroke to open said chamber for admission thereto of an initial charge of gas to be compressed, cooling-gas-admission-control valve means connected to said chamber and to said source for controlling admission of gas under pressure from said source into said chamber, bias means connected to and urging said cooling-gas-admission-control valve means towards a closed position, and cam means operatively connected to said cooling-gas-admission-control valve means and connected to said crankshaft for rotation in synchronism therewith to open said cooling-gas-admission-control valve means for a period during the compression stroke of said piston means and permitting said cooling-gas-admission-control valve means to be closed by said bias means at all other times.

2. The combination as set forth in claim 1, including compressor discharge control valve means connected to the compressor, and conduit means connected to said discharge valve means and to said source for delivering gas under pressure from said gas compressing chamber to said source.

3. The combination as set forth in claim 2, wherein means is included for cooling the gas in said conduit means.

4. The combination as set forth in claim 1, including manual means for adjusting the position of said cam means relative to said crankshaft to change the timing of admission of cooled gas under pressure by said cooling-gas-admission-control valve means from said source to said chamber during the compression stroke of said piston means.

References Cited in the file of this patent

UNITED STATES PATENTS

2,420,098 Rouleau May 6, 1947

FOREIGN PATENTS

4,448 Great Britain Aug. 17, 1905
96,726 Switzerland Nov. 10, 1922
260,984 Great Britain Jan. 30, 1928