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**VARIABLE CLEARANCE VOLUME
 AIR COMPRESSOR**

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Filed Sept. 15, 1958, Ser. No. 761,106
 6 Claims. (Cl. 309-18)

This invention relates to air compressors and more particularly, although not exclusively, to compressors of the type commonly referred to as balanced head compressors.

As used herein, the term "balanced head" is intended to designate a continuous operation compressor wherein the compression pressure generated thereby is equal to the desired maximum pressure to be confined in the air storage tank supplied by the compressor. The singular advantage of such compressors is simplicity of valve construction, no provisions being required to disable compressor operation when maximum storage tank pressure has been achieved.

Conventionally, balanced head compressors have been constructed so that the clearance between the piston at top dead center and the cylinder head remains constant. When such a compressor was intended to charge an air storage tank at a desired maximum pressure of, for example, 250 p.s.i., the maximum compression pressure of the compressor was necessarily limited to 250 p.s.i. Because of this limitation of compression pressure, the recovery rate of conventional balanced head compressors is relatively low in comparison to compressors which operate periodically at optimum compression pressure.

An object of the present invention is to provide an improved air compressor.

Another object is to provide a balanced head compressor having improved recovery rate.

A further object is to provide an improved balanced head compressor which operates at high compression pressure when the compressor outlet pressure is low and at reduced compression pressure when the outlet pressure is high.

Still a further object is to provide a balanced head compressor which is adapted to provide a relatively low clearance volume when the system pressure is low and progressively increasing clearance volume as maximum system pressure is achieved.

A still further object is to provide a variable clearance volume air compressor including a piston and connecting rod structure having resilient biasing means disposed therebetween calibrated to exert a spring force equal to the desired maximum compressor outlet pressure.

These and other objects, advantages, and features of the invention will become more fully apparent as reference is had to the accompanying specification and drawings wherein:

FIG. 1 is a front elevational view, partly in section and with parts broken away, illustrating a compressor structure incorporating the invention;

FIG. 2 is a side elevational view of the structure shown in FIG. 1; and

FIG. 3 is an enlarged fragmentary view, partly in section and with parts broken away, illustrating the relative relationship of certain of the parts under dissimilar conditions of operation.

Referring now to the drawings and particularly FIGS. 1 and 2, the reference numeral 2 indicates a unitary compressor body which includes an upper cylindrical portion 4 and a lower crankcase portion 6. As seen best in FIG. 2, crankcase portion 6 is formed with a laterally facing opening 8 over which is disposed a crankshaft support 10. Rotatably supported in housing 10 is a crankshaft 12, the

inner end of which includes a counterweight 14 and crank pin 16.

Cylinder portion 4 is formed with a vertical cylindrical bore 18 having a sleeve 20 press fitted therein. Disposed over the upper open end of cylinder portion 4 is an exhaust valve plate 22 having an exhaust port 24 extending therethrough. A reed type exhaust valve 26 overlies port 24 and is connected to the upper surface of plate 22 by bolt 28. Vertically adjacent plate 22 is a cylinder head 30 which is secured to plate 22 and cylindrical portion 4 by means of machine bolts 32.

Slidably disposed in sleeve 20 is a piston 34 which is operatively connected to crank pin 16 by means of a connecting rod assembly 36 and wrist pin 38. Piston 34 has an intake passage 40 formed in its top wall 42. A reed type intake valve 44 overlies passage 40 and is secured to wall 42 by bolt 46.

In accordance with the present invention, wrist pin 38 is press fitted in a cooperating transverse bore 48 formed in the upper end of connecting rod 36 and has its opposite ends 50 and 52 extending into vertically elongated transversely extending slots 54 and 56, respectively, formed in transverse alignment in piston 34. The width of each slot 54 and 56 (see FIGS. 1 and 3) is equal to the diameter of wrist pin 38, while the vertical extent of each slot is sufficient to allow a predetermined relative vertical movement between wrist pin 38 and piston 34. It will thus be seen that piston 34 is capable of vertical displacement relative to wrist pin 38 such that the clearance between the top wall 42 of piston 34 and the bottom wall 58 of valve plate 22 may vary considerably as compared to the fixed clearance distance inherent in conventional compressor construction.

In order to locate piston 34 in the proper relation to wrist pin 38 in accordance with the invention, a compression type coil spring 60 surrounds the stem portion 62 of connecting rod assembly 36. This spring is calibrated to exert a pressure equal to the desired maximum compressor outlet pressure. The lower end of spring 60 engages shoulder 64 on the lower end 66 of connecting rod assembly 36, while the upper end of the spring engages a washer 68 which surrounds stem 62 and seats against the semi-circular base 70 of piston 34. By reference to FIGS. 1 and 2, it will be evident that spring 60 exerts a force causing piston 34 to move upwardly in relation to wrist pin 38 so that the latter is resiliently seated in the base of elongated slots 54 and 56. As a result, the normal clearance between piston top wall 42 and valve plate wall 58 is extremely limited. Accordingly, when the pressure in cylinder head outlet 72 is low, displacement of the piston through its full stroke develops a relatively high compression pressure. However, as the outlet pressure approaches the desired maximum, the piston is subject to increased resistance which causes spring 60 to compress and allow the piston to move downwardly in relation to wrist pin 38. The downward movement of piston 34 in relation to wrist pin 38 results in increased clearance between piston top wall 42 and wall 58 of plate 22 and a corresponding decrease in compression pressure. In FIG. 3, the change from initial clearance volume to final clearance volume is illustrated by the position of piston 34 in dash-dot lines and solid lines, respectively. Since the spring 60 is calibrated to exert a force equal to the desired compressor outlet pressure, it will be apparent that as soon as the desired outlet pressure is achieved, spring 60 will yield on each compression stroke sufficiently to allow the full downward displacement of the piston relative to the wrist pin 38 shown in FIG. 3. Thereafter, each compression stroke of the compressor will generate a compression pressure in the compression chamber 74 which exactly equals the compression pressure in outlet 72 and will, therefore, prevent further displacement of air

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through exhaust valve 26 since the pressure is equal on both sides thereof, thereby producing the "balanced head" condition.

It will now be seen that a compressor according to the present invention retains the simplicity of conventional balanced head construction yet affords greatly increased compressor efficiency when compressor outlet pressure is low, thereby substantially improving the recovery rate of a system in which the invention is incorporated.

While but one embodiment of the invention has been shown and described, it will be apparent that other changes and modifications may be made therein. It is, therefore, to be understood that it is not intended to limit the invention to the embodiment shown, but only by the scope of the claims which follow.

I claim:

1. In a gas compressor having a predetermined maximum outlet pressure, a piston having a vertically elongated slot extending transversely therethrough, a connecting rod, a wrist pin secured in said rod and extending into said slot, and resilient means reacting between said connecting rod and piston biasing said wrist pin into engagement with the lower end of said elongated slot. 20
2. The structure set forth in claim 1 wherein the biasing force of said resilient means equals the force exerted by the maximum outlet pressure. 25
3. In a gas compressor, a piston having a vertically elongated slot extending transversely therethrough, a connecting rod, a wrist pin secured in said rod and extending into said slot, and resilient means surrounding said rod yieldably urging said piston and said rod in opposite 30

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directions causing said wrist pin to engage the lower end of said elongated slot.

4. The structure set forth in claim 3 wherein said resilient means exerts a spring load on said piston equal to a predetermined compressor outlet pressure. 5

5. In a gas compressor, a piston having a pair of vertically elongated transversely aligned slots extending therethrough, a connecting rod, a wrist pin secured in said rod and having end portions extending into each of said slots, respectively, and resilient means surrounding said rod and yieldably engaging said piston and connecting rod so as to urge the latter in a direction causing said wrist pin end portions to engage the lower ends of the respective elongated slots. 10

6. The structure set forth in claim 5 wherein said resilient means comprises a coil spring disposed in compression between said piston and a portion of said connecting rod. 15

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