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A. D. AMES ET AL

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VALVED PISTON

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Fig. 1.

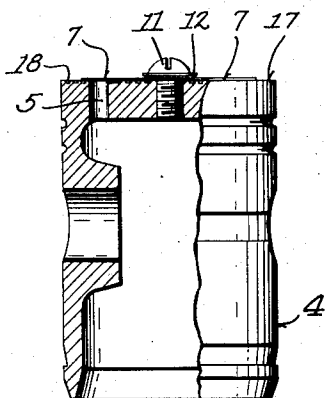


Fig. 2.

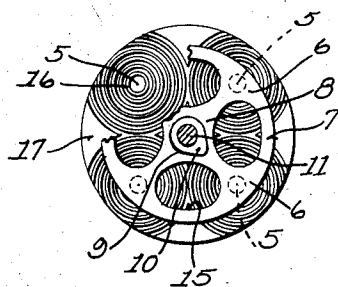
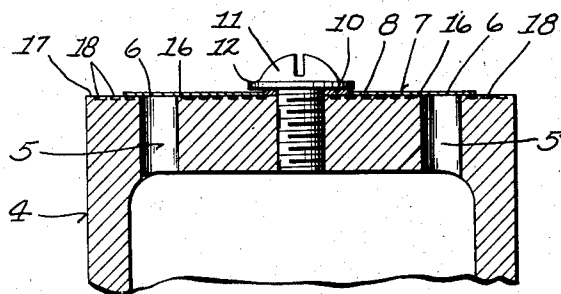


Fig. 3.



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VALVED PISTON

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13 Claims. (Cl. 230—221)

This invention relates to improvements in valved pistons, with particular reference to the pistons used in compressors.

It is the primary object of the invention to provide a novel and improved and substantially noiseless valve with substantially unrestricted free lift. It is a further and very important object of the invention to provide a valve and piston combination in which surface tension between the valve and its seat is so far minimized as to make the valve substantially noiseless and give it substantially complete freedom of operation.

It is a further important object of the invention to provide an arrangement such that a single valve element secured to the head of the piston may control a varied delivery through several ports in the piston head without being impeded by surface tension or being objectionable on account of noise.

Other objects of the invention will be apparent from the following disclosure.

In the drawing:

Figure 1 is a view of the valve and piston assembly taken partially in side elevation and partially in axial section.

Figure 2 is a plan view of the assembly with the valve element partially broken away to expose the underlying portion of the piston head.

Figure 3 is an enlarged detail view of the assembly in cross section.

Like parts are identified by the same reference characters throughout the several views.

The piston 4 is of generally conventional design. In accordance with the present invention it is provided in its head with one or more valve ports. The construction selected for the purpose of illustrating the invention includes four such ports at 5 which are symmetrically spaced about the head of the piston at equal radial distances from its center.

The several ports are individually controlled by separate valve portions 6 of a skeletonized valve disk 7. In order that the valve portions 6 of the disk may remain centered over the several ports 5, the hub portion 8 of the disk is provided with an asymmetrical opening at 9 to receive a correspondingly asymmetrical washer and guide 10 which is materially thicker than the valve disk element 7. A centrally disposed clamping screw 11 is screwed into the head of piston 4 and tightened down upon the washer and guide member 10 to fix its position. The flange 12 of the screw overhangs the washer and limits the free upward movement of the disk 7.

Since the washer and guide element 10 is fixed

as to position solely by the clamping pressure of the screw 11, it will be apparent that the valve element and its guide may be adjusted to any desired position before the screw is tightened onto the guide. Thereafter the guide will serve as a key or spline to permit the limited bodily movement ordinarily required of the valve.

In the ordinary use of a compressor piston it is quite possible that a drop of liquid may pass through one of the ports 5 at a time when the other ports may be handling gas. The port discharging the liquid may require greater valve clearance and accordingly the valve element 7 is made of very thin resilient sheet metal or other suitable flexible material so that any one or more of its valve portions 6 can readily yield independently with respect to the hub to provide a greater opening over a given port than would normally be provided in the bodily movement of the valve element.

The refrigerant circulating through the compressor of a refrigerating system generally contains enough oil to lubricate the working parts, and accumulations of oil between a disk type valve element and the head of the piston in the general assembly indicated in the drawing would make the device noisy and inefficient, and even inoperative, if precautions were not taken to minimize surface tension. Surface tension is reduced by the skeletonization of the valve disk element through the provision of the large holes shown at 15. We depend for the solution of these problems, however, primarily upon the provision at each of the ports 5 of an upstanding flange 16 of annular form which provides a seat upon which each valve portion 6 of the valve disk 7 comes to rest when the valve is closed. If the valve disk were supported only upon the several seats surrounding the respective ports 5 there might be some distortion of the valve disk which would prevent it from seating properly and completely. It is preferred, therefore, that the annular flanges 16 should not project to any great extent beyond the face of the piston, and we find it preferable that the flange 16 should not project at all beyond the piston face 17.

For the purposes of this invention it is preferred to cut into the face 17 of the piston a series of annular grooves 18 concentric with each of the ports 5. The innermost groove defines the valve seat flange 16. The ridges between the several grooves are flush with the face of the piston and constitute the series of closely spaced supports upon which the valve disk 7 rests to ensure against its distortion, while at the same time so greatly

reducing the area of surface contact between the disk and the piston as to virtually eliminate the problems incident to surface tension of oil accumulating on a piston head.

5 We claim:

1. A valved piston comprising the combination with a piston having a plurality of ports in its head at peripheral points remote from its center, of a valve element having a hub portion at said center and a valve portion co-acting with the several ports and flexible narrow spoke portions connecting said hub and valve portions, means guiding the hub portion of the valve element for bodily movement to and from the head, and means for restricting the extent of such movement, the flexibility of said spoke portions being adapted to accommodate greater movement of the valve portion than is possible to the hub portion.

2. In a device of the character described, the combination with a piston having a head portion provided with a series of ports spaced between its center and its periphery, said head providing an annular seat adjacent each port, a valve disk element provided with means centrally connecting it to said piston and having valve portions co-acting with the several seats for movement to and from said seats to close and open said ports, the surface of said head contacted by said element other than at said seats being interrupted at frequent intervals, whereby to provide closely adjacent points of support for said element while relieving the surface tension of lubricant accumulating between said element and head.

3. In a device of the character described, the combination with a piston head provided with a plurality of ports, of a valve disk element mounted on said head and provided with valve portions movable to and from the respective ports for the control of delivery therethrough, said piston head having seat portions surrounding the respective ports and terminating substantially in a common plane and other portions alternately approaching and receding from said plane whereby to relieve surface tension between said element and the head.

4. In a device of the character described, the combination with a piston head provided with a port and an annular seat surrounding said port, of a valve element movable to and from said seat, a portion of said head covered by said element about said seat being provided with a succession of annular ribs substantially at the level of said seat and intervening grooves extending circumferentially about said port.

5. In a device of the character described, the combination with a piston head provided with a plurality of ports and an annular seat contiguous to each port, the piston head being provided with grooved areas surrounding each seat, of a skeletonized valve disk element having a hub portion and valve portions individual to the respective seats and flexible portions connecting said hub and valve portions, said valve disk element being cut away between said flexible portions, and means connecting said hub portion centrally with said head.

6. In a device of the character described, the combination with a piston head provided with a plurality of valve ports and annular seats therefor spaced symmetrically between its center and periphery, of means adjacent the center of the head providing a guide for the movement of the valve, a valve disk mounted on said guide means for bodily movement to and from said head, said

disk including valve portions complementary to the respective seats, the portion of said head surrounding each of said seats being provided with a series of annular grooves concentric with the individual seat for the relief of surface tension and with ribs intervening between said grooves and substantially at the level of the respective seats for the support of said disk.

7. In a device of the character described, the combination with a piston head provided with ports and corresponding annular seats spaced between its center and periphery, of a screw threaded centrally to said head, an asymmetrical washer mounted on said screw and clamped thereby to said head, and a flexible valve disk element thinner than said washer and provided with a complementary opening fitted over said washer for movement on said washer between said screw and piston head, said valve disk element having predetermined valve portions complementary to the respective seats and held by said washer in registration therewith for movement to and from said seats.

8. In a device of the character described, the combination with a cylinder head provided with ports and corresponding annular seats spaced between its center and periphery, of a screw threaded centrally to said head, an asymmetrical washer mounted on said screw and clamped thereby to said head, and a flexible valve disk element thinner than said washer and provided with a complementary opening fitted over said washer for movement on said washer between said screw and piston head, said valve disk element having predetermined valve portions complementary to the respective seats and held by said washer in registration therewith for movement to and from said seats, the surface of said valve head about said seats being provided with alternate ridges and channels for the relief of surface tension.

9. In a device of the character described, the combination with a member having centrally disposed guide means, and a series of ports disposed about said guide means, of a valve element having a hub portion reciprocally mounted on said guide means for movement to and from said member, said element also having valve portions central with respect to the several ports, and flexible spoke portions integrally connecting said valve portions with said hub portion, said valve element being skeletonized by the provision of apertures between said spoke portions whereby each of said valve portions is independently yieldable from its associated port beyond the range of movement of its hub portion, a detent connected with the central guide means for limiting the movement of the hub portion.

10. In a device of the character described, the combination with a member provided with guide means and with ports at different sides of said guide means, of a valve element having a portion reciprocally mounted on said guide means for movement to and from said member, a detent limiting said movement, and valve portions integrally connected with said element and projecting as valves over the several ports, said member having a continuous annular rib surrounding each such port, and being provided externally of said rib with a series of supporting surfaces, and at least one groove intervening between said rib and said surfaces to provide support for said valve portions while limiting the area of contact of said valve portions with said member, whereby to re-

duce surface tension, and to distribute surface tension substantially uniform about each port.

11. In a device of the character described, the combination with a member provided with a guide and a series of ports arranged substantially symmetrically about said guide, of a skeletonized valve element comprising a central hub mounted on said guide member, valve portions disposed over the several ports and spoke portions connecting the valve portions with the hub, a detent retaining said hub on said guide, said hub being reciprocable on said guide to and from said member to the extent permitted by said detent, and said member having each of its ports completely surrounded by an annular seat and alternating high and low areas at all sides thereof, the high areas being finished approximately to a common level to provide spaced supports for said valve portions about said seat, and the intervening low areas being adapted to relieve high surface tension of lubricant accumulating between said member and said element.

12. In a device of the character described, the combination with a member provided with a guide, and with points disposed substantially symmetrically thereabout, of a valve element having a hub portion reciprocable on said guide to and from said member, said element being provided integrally with a continuous peripheral rim and with flexible spoke portions joining said rim with said hub and broadened at said rim to provide valve portions co-acting with the sev-

eral ports, a detent on said guide for limiting the reciprocation of said hub, the valve portions being independently yieldable to an extent beyond the movement permitted to said hub, and means interacting between said guide and hub for restraining said hub against angular displacement whereby to maintain said valve portions in registry with the respective ports, said member being formed to provide a series of alternating depressed areas and intervening support areas completely surrounding each of said ports independently of other ports for the relief of surface tension between said member and said element.

13. In a device of the character described, the combination with a piston head provided with a plurality of valve ports spaced symmetrically between its center and periphery, said head being provided around each port with an annular seat and at least one concentric groove, and means spaced from said seat outside said groove and at substantially the level of said seat providing supplemental support, guide means disposed centrally of said head, and a valve disk mounted on said guide means for bodily movement to and from said head, said disk including valve portions complementary to the respective seats and surrounding portions resting on the several supports to be sustained from said head with substantial relief of surface tension.

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