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C. W. HACK

OUTLET VALVE FOR COMPRESSORS

Filed June 5, 1922

Fig. 1.

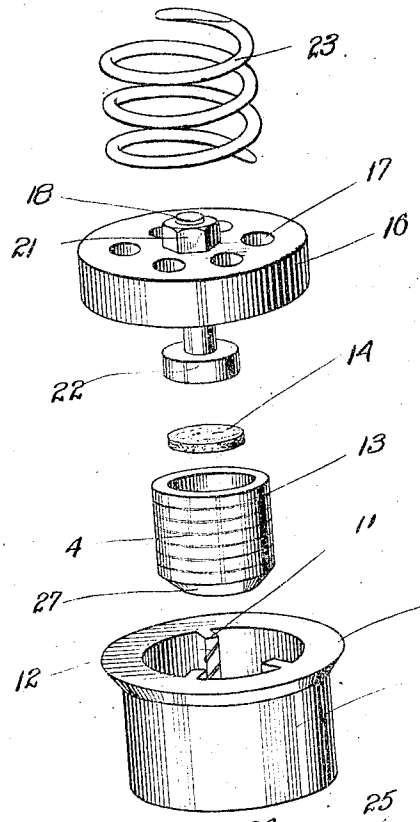
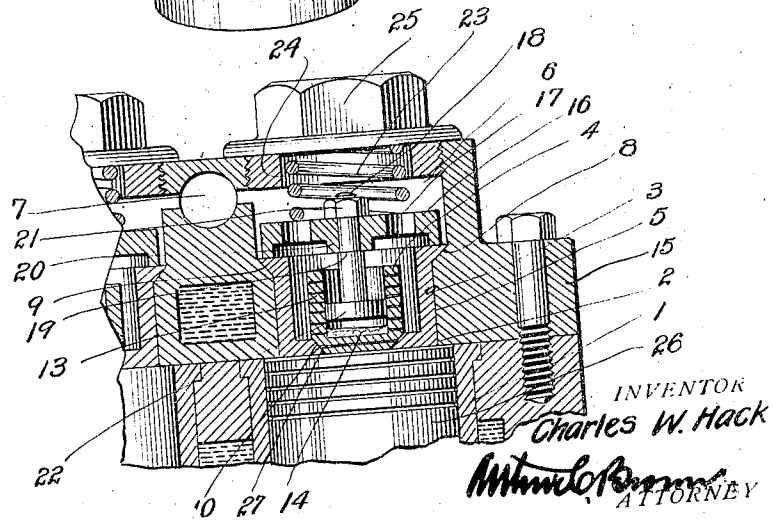


Fig. 2.



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BY

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UNITED STATES PATENT OFFICE.

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OUTLET VALVE FOR COMPRESSORS.

Application filed June 5, 1922. Serial No. 565,828.

To all whom it may concern:

Be it known that I, CHARLES W. HACK, a citizen of the United States, residing at Topeka, in the county of Shawnee and State of Kansas, have invented certain new and useful Improvements in Outlet Valves for Compressors; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the figures of reference marked thereon, which form a part of this specification.

This invention relates to an outlet valve for compressors. The primary object of the invention is to improve the construction of outlet valves for air compressors as well as to utilize a novel substance or material in connection with the lift valve whereby a uniformly efficient operation will be assured.

In carrying out my invention I prefer to use as a new material for the lift valve a suitable non-metallic, acid-resisting, resilient material such as "micarta" or "bakelite." These materials are both acid-resisting and have peculiarly tough resilient characteristics which render them particularly applicable for use as lift valves in air compressors. In actual practice I have found that when valves of such materials were employed in connection with metallic seats, they were practically noiseless, they were sensitive enough to give highly satisfactory results, they were acid-resisting, and they had the property of being practically self-lubricating in that they automatically found their own seats, this being due, I believe, to the peculiar characteristics of the material and to the fact that the valves were impacting against metal. The reciprocation of the valves offered on their seats does not cause hammer blows, such as is true of metallic valves seating upon metallic seats, but rather it has the quality of resiliently absorbing the impacts in a most efficient way and use over a considerable period indicates practically no appreciable wear. The valve, however, does form itself a seating portion conforming accurately to the valve seat so that there is no danger of leakage. The toughness of the material insures a long "life" to the valve so that the necessity for renewals is reduced to a minimum.

There are certain structural features of the valve and its co-operating parts which also assist in improving the compressor and all of these will be particularly referred to hereinafter, reference being had to the accompanying drawings, in which—

Fig. 1 is a disassociated view of the valve cage, the valve, a buffer, a valve guide stem, a support therefor, and a spring for maintaining the valve cage normally seated, and

Fig. 2 is a vertical, longitudinal, sectional view through the outlet end of one cylinder of an air compressor to which my invention is applied.

The air compressor may consist of a single cylinder or a plurality of cylinders, usually two on account of certain mechanical advantages which are well understood. The cylinders are provided with appropriate inlet ports which constitute no part of the present invention and each cylinder 1 is provided with an outlet port 2, normally closed by the valve cage 3 and a lift valve 4. The valve cage is slidably secured in a bore or chamber 5, having an enlarged portion 6 communicating with the outlet 7 of the compressor. The chamber 6 is somewhat larger than the bore 5 to provide a shoulder 8 against which rests the flange or collar 9 of the valve cage 3. The valve cage is substantially cup-shaped, having a valve seat comprising an opening with a conical edge 10, as clearly seen in Fig. 2. The inner wall of the valve cage is provided with a plurality of vertical valve guides 11, the edges of which are preferably rifled or spirally grooved, as indicated at 12.

Guided between these guides is a cup-shaped, non-metallic, acid-resisting, resilient valve 13, which may consist of "bakelite" or "micarta" and which preferably consists of alternate layers of the acid-resisting material, such as the "bakelite" and fabric or fiber combined under heavy pressure.

I prefer the use of these materials because both have co-efficient of expansion not greater than the metal seat so that when they become heated, due to the contact with the compressed heated gases, they will not grow enough to affect proper seating on their seats which might occur if the co-efficient of expansion of the valve were greater than the seat.

In the bottom of the valve is shown a

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buffer disk 14 of felt or similar material to absorb the shock of the impact when the valve 13 moves to the unseating limit or to the end of its seat-uncovering stroke.

The valve cage is normally held seated in the bore 5 of the head block 15 by a flanged disk 16, which bears upon the top edge of the flange 9. The disk 16 is provided with a plurality of openings 17, surrounding a valve guide stem 18. The openings 17 are in line with the interior of the valve cage so that when the valve 13 is unseated, the compressed gas can pass around the valve 13, whose diameter is considerably less than the diameter of the cage, the gas passing through the openings 17 into the chamber 6 and out through the outlet port 7.

The valve stem 18 is provided with a shoulder 19 which abuts against the hub 20 of the disk 16, the threaded end of the stem 18 receiving a nut 21 which clamps the disk 16 between it and the shoulder 19. The free end of the stem 18 is provided with a guide head 22, which is received within the cup-shaped valve 13 and in line with the buffer. The disk 16 is normally held in contact with the valve cage to resist movement thereof by an expansion spring 23, one end of which bears against the disk and the other end of which is seated in a seat 24 of the plug nut 25.

When the parts are assembled, the compression stroke of the piston 26 will compress the gas between it and the valve cage and since the inner end of the valve cage and the inner end of the valve 13 are parallel with the end of the piston, it will be apparent that very close clearances will be provided for the limit of the compression stroke of the piston with respect to the end of the compressor chamber represented by the valve cage and the valve 13. When the gas has been compressed, the valve 13 will be moved off its seat and it will be guided vertically as well as rotatably by the rifled guides 11, which will preferably be parallel with the edge of the head 22. The head will assist the guides in preventing teetering or tilting of the valve during its vertical movement. When the valve has been moved off its seat under the pressure of the gas, its upward unseating movement will be limited by the head 22, the shock or impact being absorbed by the shock absorbing pad 14. Neither the head 22 nor the guides will exert enough friction against the valve 13 to cause its sticking and the valve will be easily rotated because there will be a relatively loose fit between it and the head 22 and only enough contact between the rifled portions of the guides 11 and the outer surface of the valve to permit it to readily rotate when it is lifted off its seat. The amount of rotative movement imparted to the valve is immaterial provided it is slightly rotated each time it is lifted off its seat because in doing this, it will wear a uniform self-seating surface at 27, which will contact with the valve seat 10. Indeed, the valve will work very efficiently without the rotative movement being imparted to it but I prefer to slightly rotate it in its unseating movement as it is assisted thereby in grinding itself into the valve seat 10.

Such a valve as above described is noiseless in operation, it will readily gravitate back to its seat, and does not require springs to force it into its seat: therefore, while it has a relatively free movement, it will efficiently seal off communication between the interior of the valve cage 3 and the compression chamber of the cylinder 1 on the intake stroke of the piston and will open only when the compression stroke of the piston has moved sufficient to compress the gas to the requisite numbers of atmospheres to unseat it.

In the event that the piston entrained a liquid on the compression side of the cylinder, as sometimes happens, the compressor is liable to become wrecked or damaged unless some means is provided for relieving it so in order to provide for this, the valve cage is allowed to have sliding movement in the bore 5 against the spring 23. Therefore, if a non-compressible fluid enters the compression chamber of the cylinder, the valve cage will move outwardly against the spring 23 a sufficient distance to compensate for the pressure exerted against it on account of the foreign substance. The compression chamber will simply be enlarged enough to take care of the liquid, thereby eliminating liability of damage to the compressor. I prefer to so arrange the cage that it will simply move outwardly without permitting the liquid to enter the port 7 because I prefer to maintain the liquid within the compression chamber rather than have it forced out into the pipe line.

It will be observed, it is believed, from the foregoing that an outlet valve mechanism constructed in accordance with the foregoing description will insure uniform operating performance and that it will possess manifold advantages and relieve difficulties now inherent in compressors now upon the market.

What I claim and desire to secure by Letters-Patent is:

1. The combination with the valve head of an air compressor having a bore therein, a valve cage slidably mounted in said bore and having a shoulder at its outer end to abut against the shoulder in the valve head, an opening in the valve cage surrounded by a valve seat, a spring-pressed, perforate disk resting upon the shoulder in the valve cage, a headed stem carried by the disk and in line

with the opening surrounded by the valve seat, and a cup-shaped valve having free sliding movement on the headed stem.

2. The combination with the valve head of an air compressor having a bore therein, a valve cage slidably mounted in said bore and having a shoulder at its outer end to abut against the shoulder in the valve head, an opening in the valve cage surrounded by a valve seat, a spring-pressed, perforate disk resting upon the shoulder in the valve cage, a headed stem carried by the disk and in line with the opening surrounded by the valve seat, a cup-shaped valve having free sliding movement on the headed stem, and a buffer in the bottom of the valve to contact with the headed stem during movement of the valve thereon, the buffer being designed to receive the shock of impact of the valve against the headed stem.

3. The combination with the valve head of an air compressor having a bore therein, a valve cage slidably mounted in said bore and having a shoulder at its outer end to abut against the shoulder in the valve head, an opening in the valve cage surrounded by a valve seat, a spring-pressed, perforate disk resting upon the shoulder in the valve cage, a headed stem carried by the disk and in line with the opening surrounded by the valve seat, a cup-shaped valve having free sliding movement on the headed stem, a buffer in the bottom of the valve to contact with the headed stem during movement of the valve thereon, the buffer being designed to receive the shock of impact of the valve against the headed stem, and guides in the valve cage about the outer face of the valve.

4. The combination with the valve head of an air compressor having a bore therein, a valve cage slidably mounted in said bore and having a shoulder at its outer end to abut against the shoulder in the valve head, an opening in the valve cage surrounded by a valve seat, a spring-pressed, perforate disk resting upon the shoulder in the valve cage, a headed stem carried by the disk and in line with the opening surrounded by the valve seat, a cup-shaped valve having free sliding movement on the headed stem, a buffer in the bottom of the valve to contact with the headed stem during movement of the valve thereon, the buffer being designed to receive the shock of impact of the valve against the headed stem, and guides in the valve cage about the outer face of the valve, said guides having means for rotating the valve with respect to the valve cage when the valve unseats.

In testimony whereof I affix my signature.

CHARLES W. HACK.