898,659.

H. KUEHL.

COMPRESSOR.

APPLICATION FILED AUG. 22, 1907.

Patented Sept. 15, 1908.

2 SHEETS—SHEET 1.

Fig 1

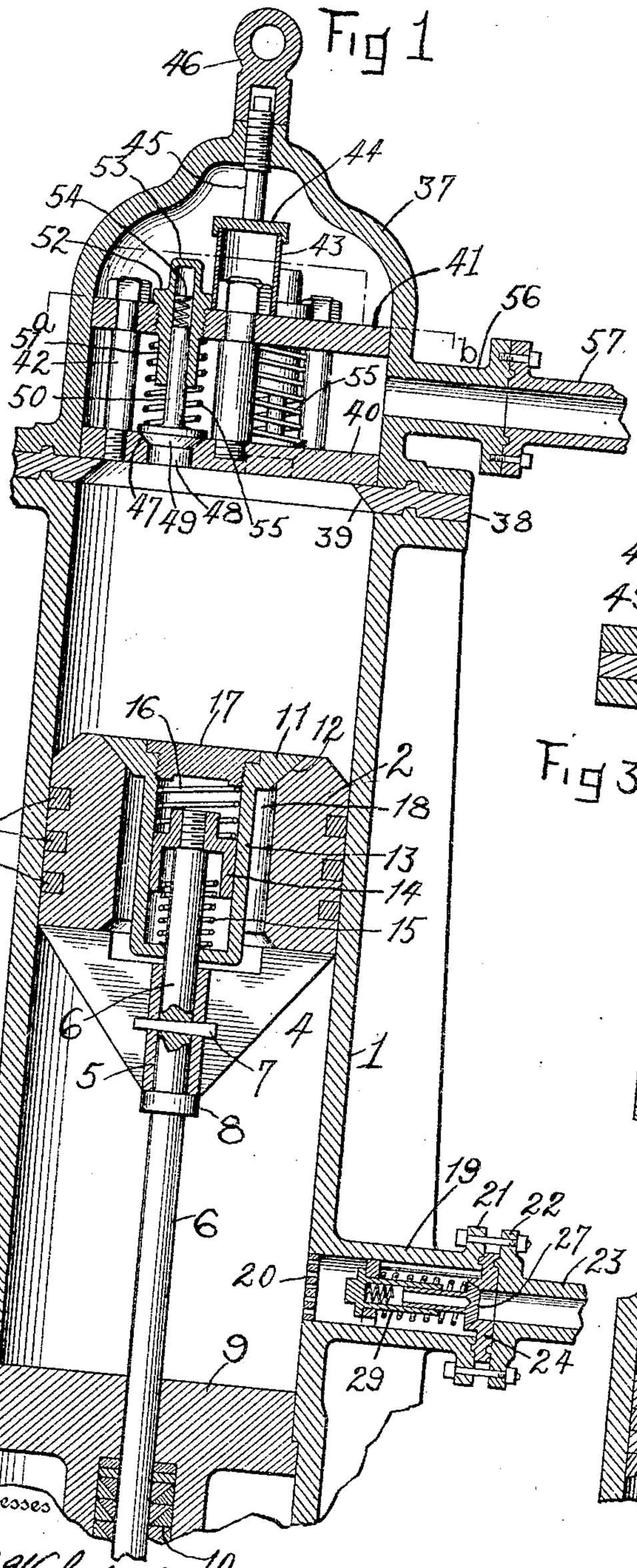

Fig 2

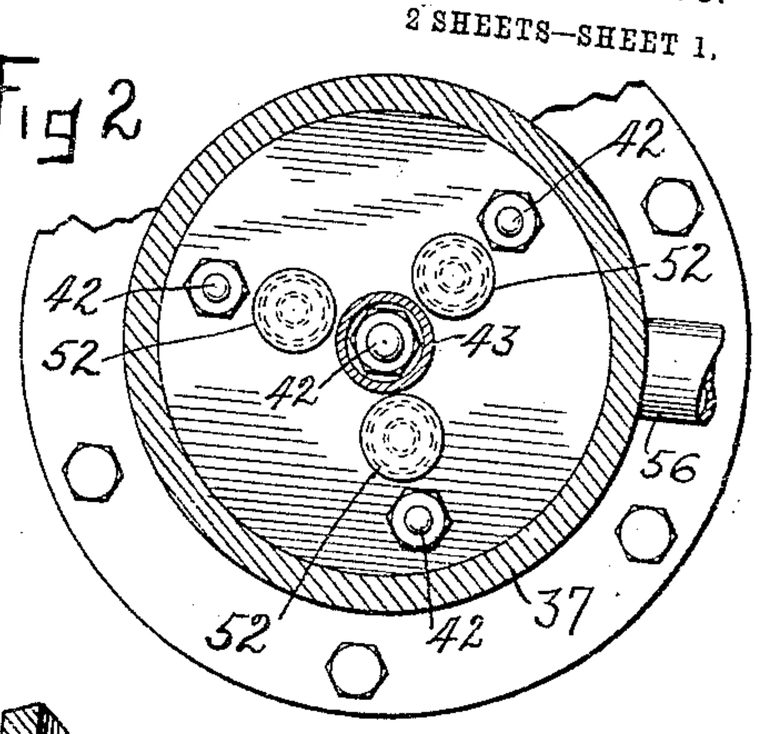

Fig 3

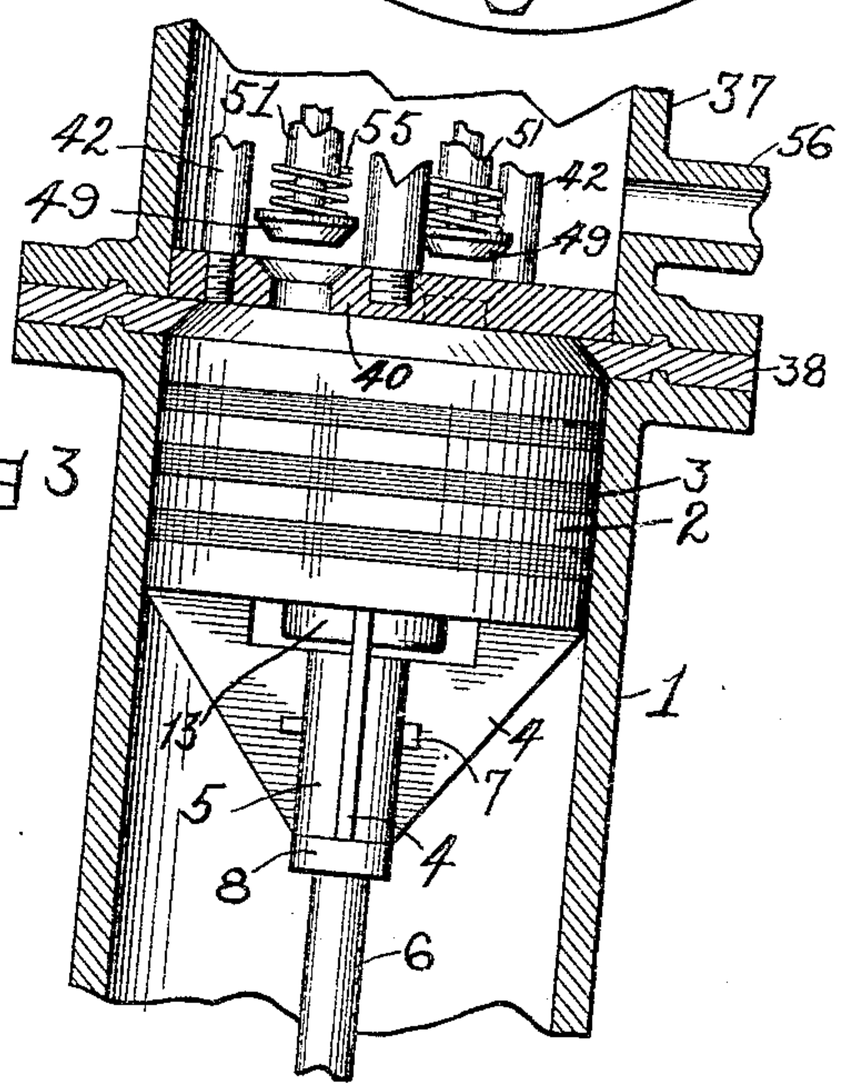

Fig 4

Witnesses

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2 SHEETS—SHEET 2.

Fig 6

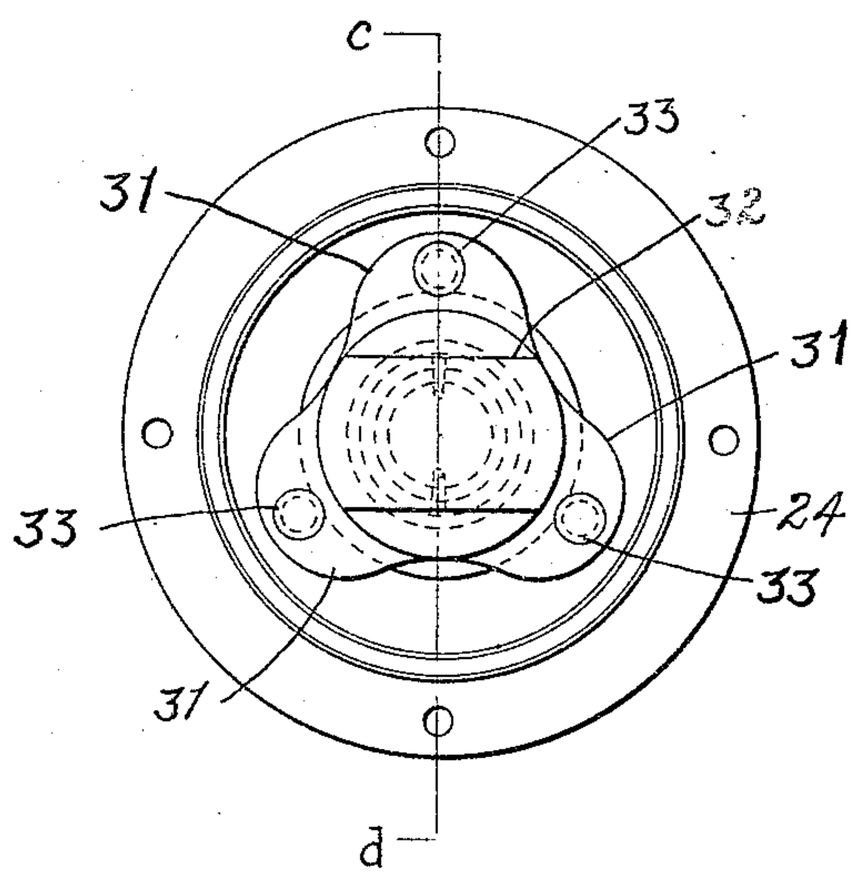
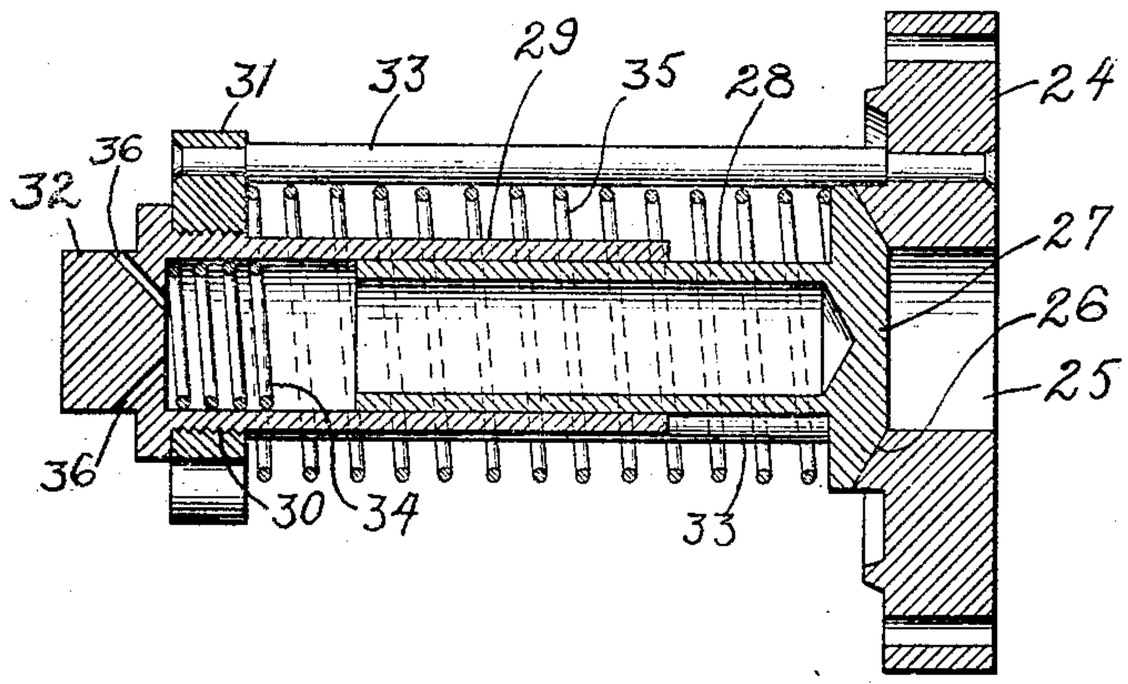


Fig 5



Witnesses

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UNITED STATES PATENT OFFICE.

HENRY KUEHL, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR OF ONE-HALF TO THEODORE KOLISCHER, OF PHILADELPHIA, PENNSYLVANIA.

COMPRESSOR.

No. 898,659. Specification of Letters Patent. Patented Sept. 15, 1908.

Application filed August 22, 1907. Serial No. 389,698.

To all whom it may concern:

Be it known that I, HENRY KUEHL, a citizen of the United States, residing at Philadelphia, county of Philadelphia, and State of Pennsylvania, have invented certain new and useful Improvements in Compressors, of which the following is a specification.

My invention relates to a compressor, and more particularly a compressor for ammonia or other gas employed in a system of refrigeration or ice-making plant.

My invention has particular reference to the valves of the compressor proper, that is, the suction valve, the piston valve, and the discharge valve.

In the compressors heretofore employed in the art, the valves have been the seat of various troubles or disadvantages, in that they produced a great amount of disagreeable clicking or noise during operation, in that relatively large quantities of ammonia oil or liquid base oil were necessary to keep the parts suitably lubricated and in suitable working order, and in that the efficiency of conversion from the mechanical power supplied to the compressor was not sufficiently high.

It is the object of my invention to overcome these difficulties and disadvantages, and to provide valves which shall be noiseless, and which shall render the efficiency of conversion higher than heretofore and with a resulting reduction in the amount of ammonia oil or liquid base oil required. To this end, I have constructed the valves, as hereinafter shown and described, with the result of noiseless operation and higher efficiency in conversion and minimizing of oil, all determined from actual construction and continued operation.

For an illustration of one of the forms my invention may take, reference is to be had to the accompanying drawings, in which:

Figure 1 is a vertical sectional view through the compressor cylinder and the valves. Fig. 2 is a horizontal sectional view taken on the line *a*—*b* of Fig. 1. Fig. 3 is a fragmentary view similar to a portion of Fig. 1, except that the compressing piston is shown at the end of its stroke. Fig. 4 is a further fragmentary sectional view similar to a portion of Fig. 1 showing the position of the piston valve during the downward stroke of the piston. Fig. 5 is a longitudinal sectional view through the suction valve, taken on the line *c*—*d* of Fig. 6. Fig. 6 is a plan view of the valve shown in Fig. 5.

Referring to the drawings, 1 represents the compressor cylinder of a single acting ammonia or other compressor. The cylinder is here assumed to be in vertical position. Within the cylinder is the piston 2, provided with the usual packing rings 3 and provided with the web members 4 having the sleeve 5 through which passes the upper end 6 of the piston rod, to which the piston is secured by the key 7, the collar 8 upon the piston rod 6 serving as an abutment for the sleeve 5. The piston rod 6 extends out through the lower cylinder head 9 having the usual stuffing box 10.

The piston valve 11, having the conical valve seat 12 in the piston 2, has a downwardly extending cylindrical shank or sleeve 13 perforated at its bottom to encircle and slide upon the upper end of the piston rod 6. Having a sliding fit within the sleeve 13 is a circular nut 14 secured by screw-threads upon the extreme upper end of the piston rod 6. The circular nut 14 is hollowed out, and surrounding the piston rod 6 and confined between the hollow nut 14 and the bottom of the sleeve 13 is a spiral spring 15. Similarly, above the nut 14 is a spiral spring 16 confined between the nut 14 and the screw-threaded closing cap 17 engaging in the top of the valve 11. The piston 2 has a large cylindrical central opening affording considerable space, as at 18, around the valve sleeve 13. The spring 16 is of such material, size and disposition that it carries almost all of the weight of the valve 11, thus practically balancing the valve 11 and making it sensitive and responsive to the slightest upward pressure.

The piston rod 6 is connected to a crosshead which, in turn, may be connected to the crank of a reciprocating steam engine or to any other type of prime mover, which, when a steam engine, is generally disposed in a horizontal position, while the compressor is in a vertical position.

Near the bottom of the cylinder 1 is a cylindrical tubular extension 19 which communicates with the interior of the cylinder through a perforated plate or member 20. The member 19 has a flange 21 to which is bolted the flange 22 upon the suction pipe 23, the plate 24 intervening between the flanges 21 and 22 and having tongue and groove connections therewith which are machined and

packed or otherwise suitably treated to render a gas-tight connection. The plate 24 has a central opening 25 terminating at its inner end in a conical valve seat 26 with which is adapted to engage the valve 27. The valve 27 has a cylindrical stem 28, which is adapted to reciprocate within the cylindrical sleeve 29 which, at its outer end, is screw-threaded at 30 into the plate 31, the sleeve 29 having the flattened head 32 adapted to receive a wrench or other means for screwing the sleeve 29 into the plate 31. The plate 31 is supported by a plurality of rods 33 upon the plate 24, such rods serving also to hold the plate 31 at a definite position with respect to the plate 24. Within the sleeve 29 and at one end thereof is provided a spiral spring 34, against which the valve stem 28 is adapted to abut when the valve 27 is lifted away from its seat 26. Surrounding the valve stem 28 and the sleeve 29 is a spiral spring 35 engaging between the valve 27 and the inside of the plate 31, such spring opposing the separation of the valve 27 from the seat 26. As shown in Fig. 1 the valve, the guiding sleeve, the plate 31 and its supporting rods are all disposed within the tubular member 19. Holes 36 communicate from the outside of the nut 32 with the interior of the seat 26 to afford passage for lubricating material.

At the top of the cylinder 1 is provided a dome 37 between which and the end of the cylinder 1 intervenes a plate 38 having tongue and groove connection with the dome and the cylinder to form a gas-tight joint. The plate 38 extends into the cylinder a short distance and is beveled at 39 to correspond with the bevel on the upper end of the piston 2. Upon the ledge formed by the plate 38 engages a plate 40 which is secured to the plate 41 fitting within the dome 37 by a plurality of bolts 42, said bolts having shoulders so as to space the plates 40 and 41 definitely and accurately. Over the nut of the central bolt passes a piece of tube 43 screw-threaded in the top of the dome 37. And for the pin 45 on the outside of the dome 37 is supplied a cap 46. The pin 45 is screwed down thus forcing the plate 40 firmly against the ledge formed by the plate 38 and holding the parts firmly in position.

In the topside of the plate 40 are provided three valve seats 47, all communicating by passages 48 with the interior of the cylinder 1 above the piston 2. With each valve seat engages a valve 49 having a stem 50 adapted to reciprocate vertically within the sleeve 51 screw-threaded into the plate 41. Each sleeve 51 has a flange 52 engaging the top of the plate 41 and closed at its upper end at 53. Between the valve stem 50 and the inside of the cap 53 is a spiral spring 54. And around the sleeve 51 and the valve stem 50 and confined between the valve 49 and the underside of the plate 41 is a spiral spring 55. This plurality of valves in the dome takes the place of the bucket valve heretofore commonly used in compressors of this type.

All of the valves and valve seats heretofore described are preferably made of steel, mild steel, or the like, or any other suitable material which withstands usage in the presence of ammonia or other gases.

Communicating with the dome 37 is the cylindrical tubular outlet 56 to which is bolted the discharge pipe 57 as well understood in the art.

The operation is as follows: Assuming the piston 2 at the lowermost point of its stroke, on rising upwardly, as driven by the engine or other prime mover, it tends to create a vacuum in the cylinder space beneath the piston, thus creating a suction and a lower pressure on the cylinder side of the suction valve 27 than on the side of the pipe 23 which communicates with the refrigerator or refrigerating system in which the refrigerant exists in gaseous form. The gas in the pipe 23, therefore, exerts a pressure against the valve 27 raising it from its seat 26 in opposition to the spring 35. This opening of the valve 27, therefore, allows the gas to rush into the cylinder 1 behind the piston 2. As the valve 27 lifts from its seat, it is guided in the sleeve 29 and, in case its separation from its seat is excessive, the stem 28 engages the spring 34 which takes up the shock of the opening movement of the valve and prevents any noise or click due to the opening. During the upward movement of the piston 2 this suction action continues until the end of the upward stroke, whereupon the spring 35 restores the valve 27 to its seat 26 thus cutting off communication with the suction pipe 23. Upon the downward stroke of the piston 2 the gas behind the piston 2 is very slightly compressed and is prevented from passing out through the pipe 23 again by the valve 27 engaging snugly with its seat 26. This downward motion of the piston, however, causes the gas beneath the piston to raise the valve 11 from its seat 12 in the piston, as shown in Fig. 4, and to escape into the upper end of the cylinder. The valve 11, as previously stated, is practically entirely supported by the spring 16, in effect being practically balanced, so that the gas beneath the piston very readily and easily lifts the valve 11. A too great an upward movement of the valve 11 is prevented by the spring 15, which, after a definite movement, engages the upper inner side of the nut 14. As the piston reaches the lower end of its stroke, the valve 11 returns onto its seat 12. The valve 11 being practically balanced by the spring 16 this return to seat 12 is gentle and without any blow effect, thus eliminating noise and being otherwise advantageous. Then on the upward stroke of the piston again the

gas is confined between the piston 2 and the plate 40 with its valves 49. As the piston 2 advances upwardly the pressure in the upper end of the cylinder keeps increasing until the desired high pressure is reached, whereupon the valves 49 are lifted by that pressure in opposition to the springs 55, as shown in Fig. 3, thus allowing the compressed gas to escape into the space between the plates 40 and 41 and to find exit through the connection 56 and the discharge pipe 57. The piston rises to or very nearly to the plate 40, there being very small clearance by the construction shown, so that practically all the gas in the upper end of the cylinder is compressed at each stroke and discharged. When the stroke has been completed, the springs 55 restore the valves 49 to their seats, these valves being very light are easily controlled by the springs and produce practically no noise in operation. The springs 52 above the valve stem 50 serve as elastic limiting means for the upward stroke of the valves, thus also minimizing the shock and reducing noise.

By the employment of a valve of this construction or a plurality of them, as shown, the efficiency of conversion in compression is higher and more so than in the case of the bucket valve such as heretofore commonly used, and which is of considerable weight and which vibrates several times against its seat causing a series of clicks or loud noises. But aside from the noise produced the efficiency of compression was not so great as with the construction here shown where the valves are light, delicately controlled and quickly responsive, the inertia effects being a minimum.

As well understood in the art, the compressed gas, as delivered by the pipe 57, is passed through a condenser where it is chilled and assumes a liquid form, passing out of the condenser as liquid into a reservoir. From this reservoir the liquid ammonia or other gas is allowed to expand into or through the refrigerating system of pipes etc., where it again assumes the form of a gas, and in such form is again introduced into the compressor cylinder 1 through the suction valve.

While I have here shown my invention applied to a single acting compressor, it is, of course, to be understood that it may be applied to double acting machines.

What I claim is:

1. In a compressor, the combination with a cylinder, of a piston movable therein, a piston rod for driving said piston, a valve member having a seat on said piston, a guide nut upon said piston rod upon which said valve member is movable, and resilient means on either side of said nut engaging said valve member.

2. In a compressor, the combination with a cylinder, of a piston movable therein, a piston rod for driving the same, a valve member having a seat on said piston, a nut upon said piston rod, a hollow valve stem upon said valve member, said nut engaging in said hollow stem and operating as a guide therefor, and resilient means on either side of said nut engaging said valve member.

3. In a compressor, the combination with a cylinder, of a suction tube communicating therewith, a suction pipe secured to said tube, a valve seat secured by and intervening between said tube and pipe, a valve member engaging with said seat and having a stem, a hollow guide for said valve stem, a spring within said hollow guide for opposing said valve stem, and means supporting said guide and secured to said valve seat.

4. In a compressor, the combination with a cylinder, of a dome thereon, and a valve system disposed in said dome and comprising separated fixed plate members, a plurality of valve seats in one of said plate members, a valve coöperating with each seat and having a stem, and a valve stem guide for each valve secured in the other plate member, a spring within the valve stem guide, a spring opposing the opening of each valve, and means engaging said dome and holding said valve system in fixed position.

5. In a compressor, the combination with a cylinder, of a piston movable therein, a piston rod for driving said piston, a valve having a seat in said piston, a hollow valve stem upon said valve, a guide member secured upon said piston rod and engaging within said valve stem, resilient means confined between the bottom of said valve stem and said guide member, and resilient means on the other side of said guide member and confined in said valve stem between said guide member and a valve stem closure.

6. In a compressor, the combination with a cylinder, of a suction tube communicating therewith, a pipe secured to said tube, a valve seat held between said pipe and tube, a valve engaging with said seat and having a stem, a hollow guide for receiving said valve stem, a support for said guide, and means secured in said valve seat for supporting said guide support.

7. In a compressor, the combination with a cylinder, of a suction tube communicating therewith, a pipe secured to said tube, a valve seat secured between said pipe and tube, a valve member engaging said seat and having a stem, a hollow guide for receiving said stem, a guide support, and means secured in said valve seat for supporting said guide support, said valve, guide and support inclosed in said tube.

8. In a compressor, the combination with a cylinder, of a suction tube communicating therewith, and a valve in said tube and comprising a valve seat, a valve member engag-

ing therewith and having a stem, a hollow guide for receiving said stem, a guide support, a plurality of rods secured in said valve seat member and supporting said guide support, resilient means within said hollow guide, and resilient means surrounding said guide and valve stem and intermediate the same and said rods.

9. In a compressor, the combination with a cylinder, of a suction tube communicating therewith, a suction pipe, a valve seat member secured between said suction tube and pipe, a valve member adapted to engage with said seat member, a stem on said valve member, a hollow guide adapted to receive said stem, a guide support, and means secured to said valve seat member and within said suction tube for supporting said guide support.

10. In a compressor, the combination with a cylinder, of a dome thereon, and a valve system disposed in said dome and comprising separated parallel plate members secured to each other, a plurality of valve seats in one of said plate members, a valve coöperating with each seat and having a stem, a hollow valve stem guide for each valve secured in the other plate member, resilient means within each guide, resilient means opposing the opening of each valve, and means engaging said dome for securing said valve system in fixed position.

11. In a compressor, the combination with a cylinder, of a dome secured thereon, a member secured between said dome and cylinder and forming a ledge in said dome, and a valve system disposed in said dome and fixedly secured against said ledge, said valve system comprising separated plate members, a plurality of valve seats in one of said plate members, a valve coöperating with each seat and having a stem, and a valve stem guide for each valve secured in the other plate member, a spring within each valve stem guide, a spring opposing the opening of each valve, and an exhaust port communicating with the space between said plate members.

In testimony whereof I have hereunto affixed my signature in the presence of the two subscribing witnesses.

HENRY KUEHL.

Witnesses:
C. D. EHRET,
ANNA E. STEINBOCK.