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AMMONIA COMPRESSOR AND VALVE OPERATING MECHANISM THEREFOR.
APPLICATION FILED APR. 13, 1912.

1,048,392.

Patented Dec. 24, 1912.

3 SHEETS—SHEET 1.

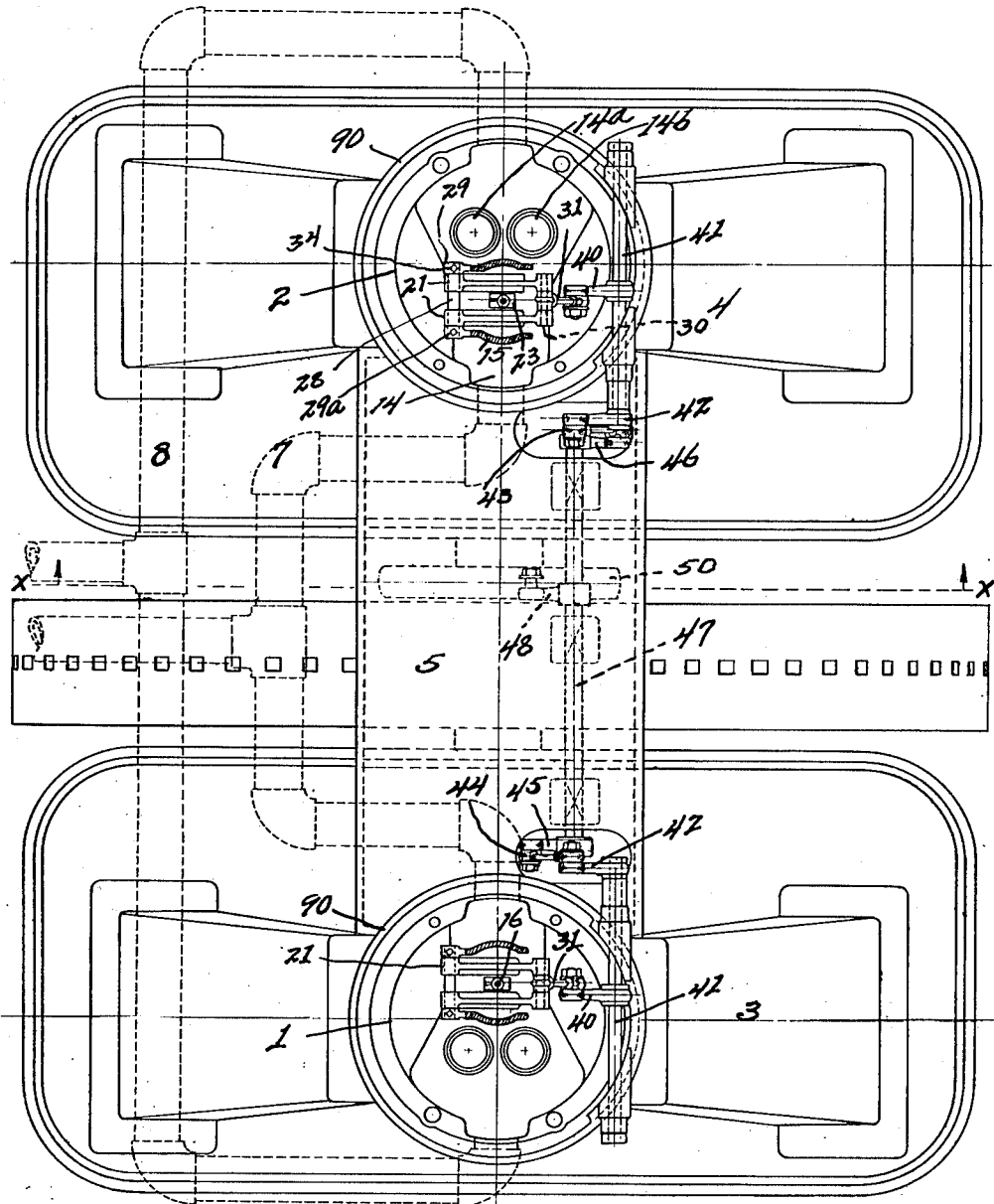


Fig. 1.

WITNESSES.
Richard Alapae.
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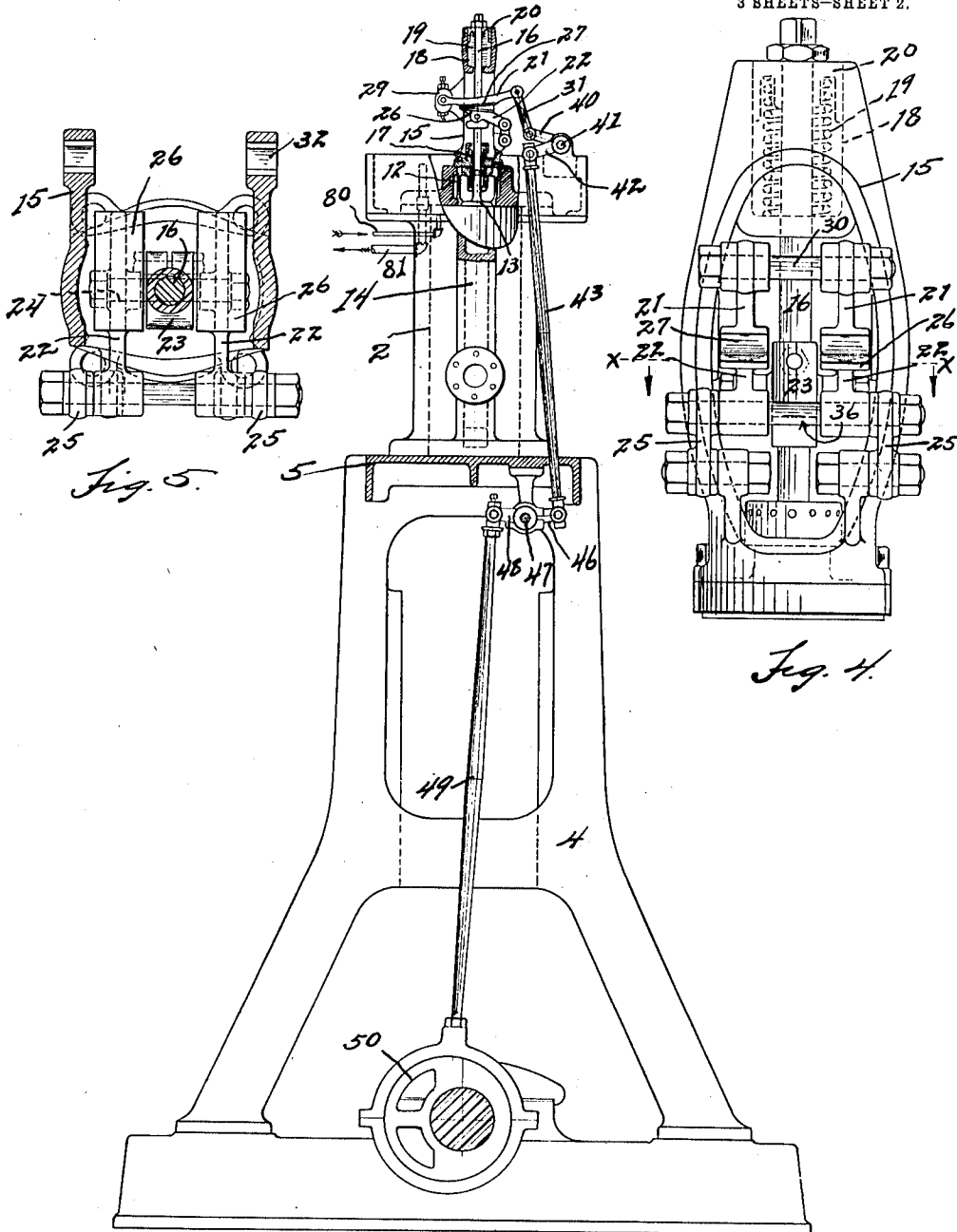
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WITNESSES.
Richard Alepas.
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Fig. 7.

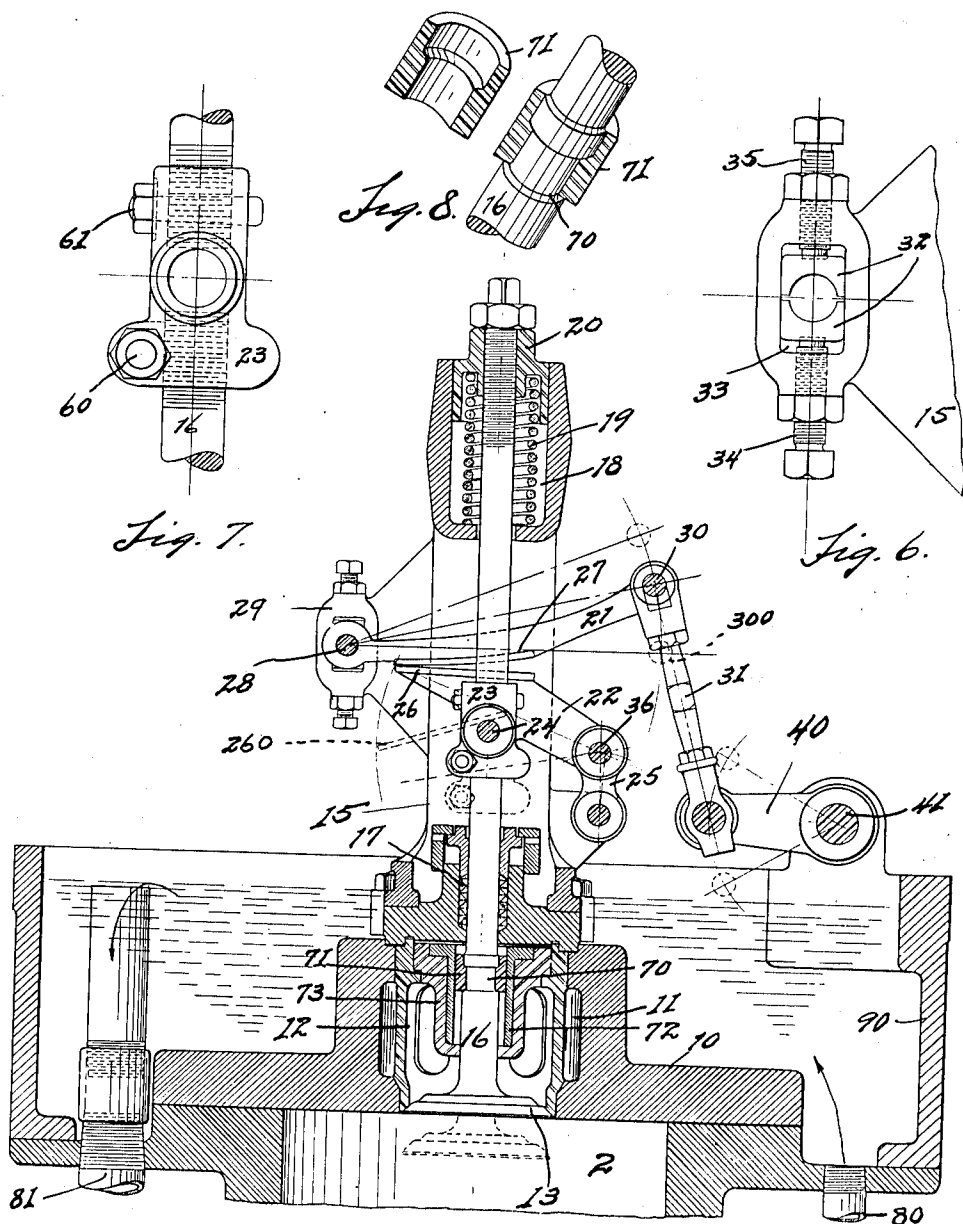
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3 SHEETS-SHEET 3.



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Fig. 3.

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UNITED STATES PATENT OFFICE.

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AMMONIA-COMPRESSOR AND VALVE-OPERATING MECHANISM THEREFOR.

1,048,392.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, JAMES H. DENNEDY, a citizen of the United States, residing at Detroit, county of Wayne, State of Michigan, have invented a certain new and useful Improvement in Ammonia-Compressors and Valve-Operating Mechanism Therefor, and declare the following to be a full, clear, and exact description of the same, such as will enable others skilled in the art to which it pertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification.

This invention relates to ammonia compressors and valve operating mechanism therefor, and an object of the invention is a compressor for use in refrigerating systems and the like having a greater efficiency per horse-power involved than has heretofore been attained in the art. In attaining this primary object various novel features of construction, constituting minor objects of the invention, are employed involving the use of two compression cylinders having pistons therein arranged in alternate relation and connected to a single actuating shaft, whereby a substantially constant flow of gas through the pipe lines may be provided and, in connection therewith, further involves the use of mechanically actuated induction valves operating in timed relation with the movement of the pistons and in such manner that the flow of gas through the valve is proportional to the piston displacement resulting in a constant velocity of flow in the pipe lines, and avoiding the surging of the gas therein. As hereinafter more fully described such arrangement and operation of the induction valves results in each cylinder being filled with gas at substantially the same pressure as the source of supply, and no loss of pressure is incurred as is usual in the use of the ordinary puppet valve with which a difference in pressure of gas in the source of supply and in the cylinder is depended upon to open the valve. By such arrangement therefore greater efficiency in operation is attained, as the duty performance per horse-power involved is proportional to the pounds of gas circulated which is practically determined by the back pressure in the expansion tank and pipe lines which form the source of supply for the cylinders. The means by which these and further objects of the invention may be attained and the novel features of construction involved

are hereinafter more fully described and claimed.

In the drawings—Figure 1, is a plan view of a compressor embodying my invention. Fig. 2, is a vertical section on line $x-x$ of Fig. 1. Fig. 3, is a vertical section through an inlet port of a cylinder showing the induction valve and actuating mechanism. Fig. 4, is an elevation of the valve operating mechanism. Fig. 5, is a section of the line $x-x$ of Fig. 4. Fig. 6, is a detail of the means for adjusting the relative position of the valve operating shoes. Fig. 7, is an elevation of the valve stem coupling, to which one of the shoes is connected. Fig. 8, is a perspective view of the split nut on the stem of the valve for preventing a movement thereof beyond certain limits.

Similar characters refer to similar parts throughout the drawings and specification.

As may be seen more particularly in Figs. 1 and 2, compression cylinders 1 and 2 are mounted on bases 3 and 4, which are united by a table 5. The pistons within the cylinder are of the ordinary type and are connected to the actuating shaft in the usual manner, as by a connecting rod and crank (not shown). As is also usual and well known in this type of machine, the pistons are arranged to operate in an alternate manner, that is, when one piston is on its compression stroke the other piston is on its intake stroke and, as the inlet ports of both cylinders are connected to a single source of supply, as by the pipe 7 shown in dotted lines in Fig. 1, and the compressed charge from both cylinders is delivered to a single pipe line indicated by dotted lines 8 in the said figure, there is practically a continuous flow of gas from the source of supply into the pipe line 8 leading to the usual expansion tank or coils (not shown) to which the pipe 7 is connected at the expansion end forming a source of supply for the cylinders. So far as described, this is the usual circuit of gas and the ordinary means employed in circulation and said system is defective in following particulars. In such ordinary construction described and although the flow of gas may be practically continuous as stated, the velocity of the flow is not constant for reasons hereinafter more fully outlined, consequently a surging of the gas in the pipe lines is produced resulting in excessive friction losses. Also with the arrangement of parts as outlined the back pressure is comparatively low,

and the cylinders are therefore supplied with a somewhat rarefied medium resulting in loss of efficiency as the results to be obtained in such systems is largely dependent upon the pounds of gas circulated. A further loss of efficiency is incurred through the use of puppet valves at the intake ports of the cylinder. With such device the pressure of the gas in the cylinder, prior to the compression stroke of the piston, is less than the back pressure due to the fact that, upon the intake stroke of the piston, the valve is opened by reason of the excess of pressure in the supply lines over that in the cylinder, and therefore less weight of gas is delivered per stroke of the piston, than would be the case if the cylinder became filled with gas having a pressure substantially equal to the back pressure.

It is a primary object of the invention herein disclosed to overcome these defects in operation and this may be accomplished by so arranging the coöperative parts that the cylinders may, on their intake stroke, be filled with gas having substantially the same pressure as the supply lines involving the use of a mechanically actuated inlet valve and further involving a method and means of its actuation, whereby a substantially constant velocity of flow of gas through the pipe lines may be attained and a uniform, maximum volume thereof circulated.

The valve structure and actuating mechanism therefor preferably used in this connection is shown in Fig. 2, and each cylinder is provided with a like inlet valve arranged to operate in alternate relation as is required by reason of the alternate movement of the pistons. The valve cage and supporting frame work and the actuating mechanism are shown in detail in Fig. 3 and, as there shown, the cylinder 2 is provided with a head 10, recessed at 11 to receive the valve cage 12 which is of the usual construction providing a seat for the valve head 13. The recess or chamber 11 is in communication with a channel 14 on the side of the cylinder, with which the pipe line 7 is connected as may be seen in Fig. 1, and as may be seen in said figure the pipe line 8 is in communication with the eduction valves 14^a and 14^b in like manner.

The cage 12 is held in position in the cylinder head by means of the frame 15 bolted thereon and provided with a packing to prevent a leakage of gas between the cage and the head. The valve stem 16 is reciprocally mounted in alined apertures in the frame 15, and a packing gland 17 is provided to prevent an escape of gas about the stem. A pocket 18 is provided in the upper end of the frame 15 within which is a spring 19 engaged by a cap nut 20 fitted within the pocket and the spring normally holds the valve on its seat. Movement is imparted

to the valve stem by means of the actuating cam levers 21 and 22 hereinafter called a controller. The stem is in two parts having a threaded engagement with a coupling 23, which has a central aperture at right angles to the longitudinal axis of the stem in which a pin 24 is located.

As may be seen in Fig. 5 there are two cam levers 22 pivotally supported upon each side of the valve stem by the projecting ends of the pin 24 and both these levers are also pivoted to the frame work 15 by means of like links 25, and are also each provided with a flat surface or shoe 26, designed to be contacted by a curved cam surface or shoe 27 on the lever 21. There are two of these levers 21 correspondingly positioned above each lever 22, and the two levers 21 are mounted on a rod 28 journaled in adjustable bearings 29 and 29^a upon each side of the frame 15, as may be seen clearly in Fig. 1. Through the opposite ends of the two levers 21 passes a pin or rod 30 to which is connected a link 31 through which movement is imparted to the levers 21 in a manner hereinafter shown. A detail of the adjustable bearing 29 is shown in Fig. 6 and it may there be seen that the rod 28 is supported between two like blocks 32 vertically adjustable in the opening 33 by means of the adjusting screws 34 and 35. The bearing surfaces of the shoes 26 and 27 are so formed as to have a rolling contact with each other during the movement thereof to open the valve. To produce the desired movement of the valve the point of initial contact between the two cam surfaces 26 and 27 should be on a straight line uniting the centers of the rod 28 of the levers 21 and, the pin 36 of the lever 22 as may be seen in Fig. 3, which shows the parts in the positions assumed, when the piston in the cylinder 2 starts upon its intake stroke and the shaft 30 to which the two levers 21 are attached moves from the position shown in full lines in the figure to the position shown by the dotted circle 300 and back to the position as shown in full lines, and when the shaft 30 is at the extreme limit of its movement indicated by the dotted circle 300, the shoes 26 of the cam levers 22 assume the position shown by the dotted lines 260 in which position of the two levers the valve is at its full open position as indicated by the dotted lines and, as more fully shown hereinafter the arrangement of the cams and levers is such that the valve reaches its full open position at the time the piston is at the center of its intake stroke and is again closed at the time the piston reaches the limit of its stroke. By reason of the shape and the relative movement of the cam shoes, the valve is caused to so open and close that the area of the opening at any point is proportional to the piston displacement, and the velocity

of the flow of gas through the port is therefore practically constant. As the valve and its seat become worn through constant use, the shoes will assume somewhat different positions from that shown in Fig. 3, but by adjusting the shaft 28 up or down as the case may demand in the manner heretofore described, the point of initial contact between the shoes 26 and 27 may be made to take place in the described manner and, as shown in said figure, the point of initial contact takes place at a point on the levers 21 having a low speed of movement and at the time the piston speed is the lowest. As the levers 21 continue in their downward movement the point of contact between the shoes approaches and eventually passes beyond the center line of the valve stem at which point the highest speed of movement of the valve is produced which occurs at the time the piston speed is the highest. During the last half of the intake stroke of the piston the reverse movement of the cam levers takes place and the valve begins to close, under action of a spring 19, in a decreasing speed ratio until the valve is closed at the time the piston has reached the limit of its intake stroke. It therefore becomes evident as before mentioned that the area of the valve opening is at all times proportional to the piston displacement. If the shaft 28 on which the levers 21 are pivoted be raised and the shoe 26 correspondingly raised the point of initial contact between the shoes will be nearer the stem of the valve and a quicker opening of the valve obtained as may be demanded by the piston movement and the reverse condition may be brought about by lowering the shaft 28 in the bearings, and inaccuracies in the machining as well as wearing of the cam faces thus compensated for.

The cam levers 21 are actuated by means of a link 31 connected to a rock arm 40 of a rock shaft 41 mounted in bearings on the cylinder head, and as may be seen in Fig. 1, each cylinder is provided with a like link and rock shaft. On the ends of each of these shafts are like rock arms 42 connected by links 43 and 44 to rock arms 45 and 46 on the rock shaft 47 mounted in bearings on the table 5. The rock arms 45 and 46 are oppositely positioned as shown in said Fig. 1, so that oscillation of the shaft 47 in one direction simultaneously oscillates the two rock shafts 41 in opposite directions. Therefore during the interval in which one of the inlet valves is open the other is closed. Movement is imparted to the shaft 47 by means of a rock arm 48 thereon connected by means of link 49 to an eccentric 50 on the main actuating shaft.

In Fig. 2 the parts are shown in the position when the inlet valve is about to open and the opening of the inlet valve takes

place during half a revolution of the eccentric causing the opening and closing of the inlet valve during that half of the revolution of the shaft during which the intake stroke takes place. As the movement of the eccentric continues during the time the valve is closed, the lever 21 moves away from the lever 22 forming an idle movement thereof during the time the piston is on its compression stroke and again reaches the position shown by full lines in Fig. 3 at the time the piston has completed its compression stroke.

The valve stem 16 is in two parts in threaded engagement with a coupling 23 and they are locked in engagement with the coupling by reason of the coupling being split for a distance at each end, at which points it is provided with the binding screws 60 and 61 securely holding the stems in place and preventing a rotation thereof. By such arrangement the shoes 26 may be adjusted in position relative to the shoes 27 which is an adjustment in addition to that of the levers 21 by means of which wear may be taken up and the shoes maintained to their proper relative position. By reason of the levers 21 being removably secured in the bearing 29 and 29^a these levers may be entirely withdrawn from engagement with the shoes on the levers 22 and the assembled frame, casing, valve, stem and shoe 28, may be removed from the cylinder head as a unit and the condition of the parts may be readily ascertained without dismounting the parts involving the necessity of their re-adjustment.

To prevent the valve from dropping into the cylinder in the event of the removal of the coupling 23 from the stem, I have provided an annular groove 70 on the stem about and within which a split nut 71 is placed. This nut fits within the tubular member 72 carried in the cup shaped member 73 mounted in the valve casing 12 shown in Fig. 3. The member 73 is provided with an aperture in the bottom in which the valve stem is mounted which is of less diameter than the nut 71. The nut 71 is held in position on the stem by the tubular member 72 and the chamber formed by the tubular member is slightly greater in length than the required movement of the valve which is unaffected by this relation of parts. In the event of the stem 16 being released from engagement with the coupling the split nut retains it in place.

A troublesome feature in connection with devices of this class is the leakage of gas about the stems of the valves caused principally by the degree of heat evolved during the compression of the gas which affects the packing. To overcome this difficulty I have provided the head of each cylinder with a shallow open receptacle 90 for water as shown in Figs. 2 and 3. Water may be

introduced into the receptacle by means of a pipe 80 connected at any convenient point with the receptacle as shown in Figs. 2 or 3. The receptacle is also provided with an outlet pipe 81 extending up into the receptacle as high as the required water level. Water constantly passes into the receptacle through the inlet pipe 80 and overflows through pipe 81 and the valve stem, packing, etc., may therefore be maintained at a substantially uniform temperature.

Having thus fully described my invention and the manner and means by which the object thereof may be accomplished, what I claim and desire to secure by Letters Patent of the United States is—

1. An ammonia compressor comprising a pair of cylinders, pistons therein arranged to be actuated in alternate relation from a single actuating shaft, automatic eduction valves for each cylinder, and an induction valve for each cylinder, a controller for each induction valve comprising a pair of pivoted levers provided with bearing surfaces arranged to have a rolling contact, one of said levers being pivoted to the valve stem and adjustable thereon, the other lever being adjustable relative to the first mentioned lever, and means for actuating the second lever of each controller during the intake stroke of the corresponding piston.

2. An ammonia compressor comprising a pair of cylinders, pistons therein arranged to be actuated in alternate relation from a single actuating shaft, automatic eduction valves for each cylinder, a mechanically actuated induction valve for each cylinder, means whereby the induction valves may be alternately actuated by a single actuator, said means comprising a rock-shaft having oppositely positioned rock arms thereon, a secondary rock-shaft for each cylinder provided with a rock arm and arranged to actuate the valve operating mechanism, and links connecting each rock arm of the main rock-shaft with the rock arm of the corresponding secondary rock-shaft.

3. In an ammonia compressor or the like, a controller mechanism for the induction valve thereof comprising a spring seated valve provided with a stem, a support in which the stem is reciprocatingly mounted, a lever pivotally attached to the stem, a link pivoted to the support and to the lever, a second lever pivoted to the support adapted to actuate the first lever, said levers being provided with bearing surfaces arranged to have a rolling contact, and means for adjusting said second lever relative to the first lever.

4. An ammonia compressor comprising a pair of cylinders, in vertical relation, pistons therein, a shaft arranged to actuate the pistons in alternate relation, automatically actuated eduction valves for each cylinder,

an induction valve for each cylinder, a controller for each induction valve, a rock shaft for each controller, a rock arm and links connecting each rock shaft with its corresponding controller, and a means for simultaneously rocking said shafts in opposite directions to alternately actuate the controllers.

5. An ammonia compressor comprising a frame work, a pair of cylinders mounted thereon in vertical relation, pistons in said cylinder, a shaft arranged to actuate the pistons in alternate relation, an automatically actuated eduction valve for each cylinder, an induction valve for each cylinder, a controller for each induction valve, a rock shaft for each controller to which it is connected by means of a rock arm, a main rock shaft mounted in bearings on the frame-work, a rock arm on said main rock shaft for each controller rock-shaft connected thereto by links, the rock arms being oppositely positioned on said main shaft, an eccentric on the main actuating shaft and a link connecting the main rock shaft with the eccentric.

6. A controller mechanism for induction valves of compressors and the like, comprising a spring seated valve provided with a stem, a support in which the stem is reciprocatingly mounted, a lever pivotally attached to the said stem and vertically adjustable thereon, and so pivoted to the support as to allow vertical movement with the stem, a second lever pivoted to said support adapted to actuate the first lever, said levers being provided with bearing surfaces arranged to have a rolling contact, and means for adjusting the relative position of the second lever to the first lever.

7. A controller mechanism for induction valves of compressors and the like comprising a valve, a valve cage provided with a seat for the valve, said valve having a stem, a support in which said stem is reciprocatingly mounted, said stem being in two parts united by a coupling, said coupling being adjustable vertically on the stem, a lever pivotally attached to said coupling and pivoted to the support by means of a link, a second lever pivoted to said support adapted to actuate the first lever, said levers being provided with bearing surfaces arranged to have a rolling contact, and means for adjusting the relative position of the two levers.

8. A controller mechanism for induction valves of compressors and the like, comprising a valve provided with a stem, a support in which the stem is reciprocatingly mounted, a spring tending to hold the valve on its seat, a lever pivotally attached to said stem and to the support in a manner to allow a vertical movement of the lever, a second lever pivoted to said support adapted to actuate the first lever to open the valve, said le-

vers being provided with bearing surfaces arranged to have a rolling contact and means for adjusting the second lever relative to the first lever.

- 5 9. An ammonia compressor comprising a pair of cylinders, pistons therein, a shaft arranged to actuate the pistons in alternate relation, automatically actuated induction valves for each cylinder, an induction valve
10 for each cylinder, a controller for each induction valve comprising a lever pivotally attached to the stem of the valve and to a support, a second lever adjustably pivoted

to said support, said levers being provided with bearing surfaces arranged to have a rolling contact, and means for alternately actuating said second lever of each controller to open and close the induction valves in each cylinder during the intake stroke of the piston. 15 20

In testimony whereof, I sign this specification in the presence of two witnesses.

JAMES H. DENNEDY.

Witnesses:

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RICHARD ALSPAS.