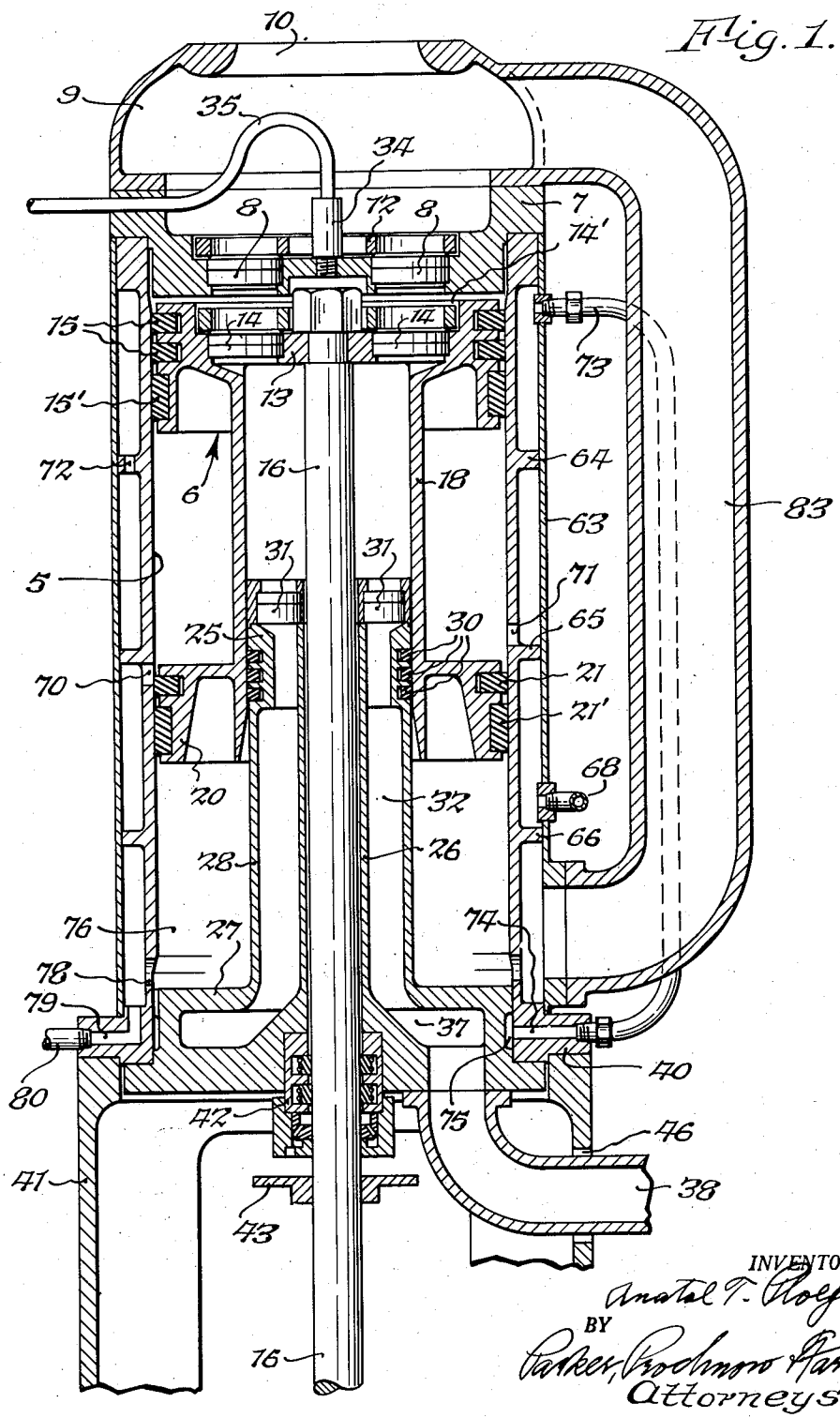
April 7, 1959 A. T. PLOEGERT 2,880,927

COMPRESSOR FOR GASEOUS MATERIALS

Filed March 13, 1956 2 Sheets-Sheet 1

Fig. 1.



INVENTOR.
Anatol T. Ploegert,
BY
Parker, Prochnow & Farmer,
Attorneys.

April 7, 1959 A. T. PLOEGERT 2,880,927

COMPRESSOR FOR GASEOUS MATERIALS

Filed March 13, 1956 2 Sheets-Sheet 2

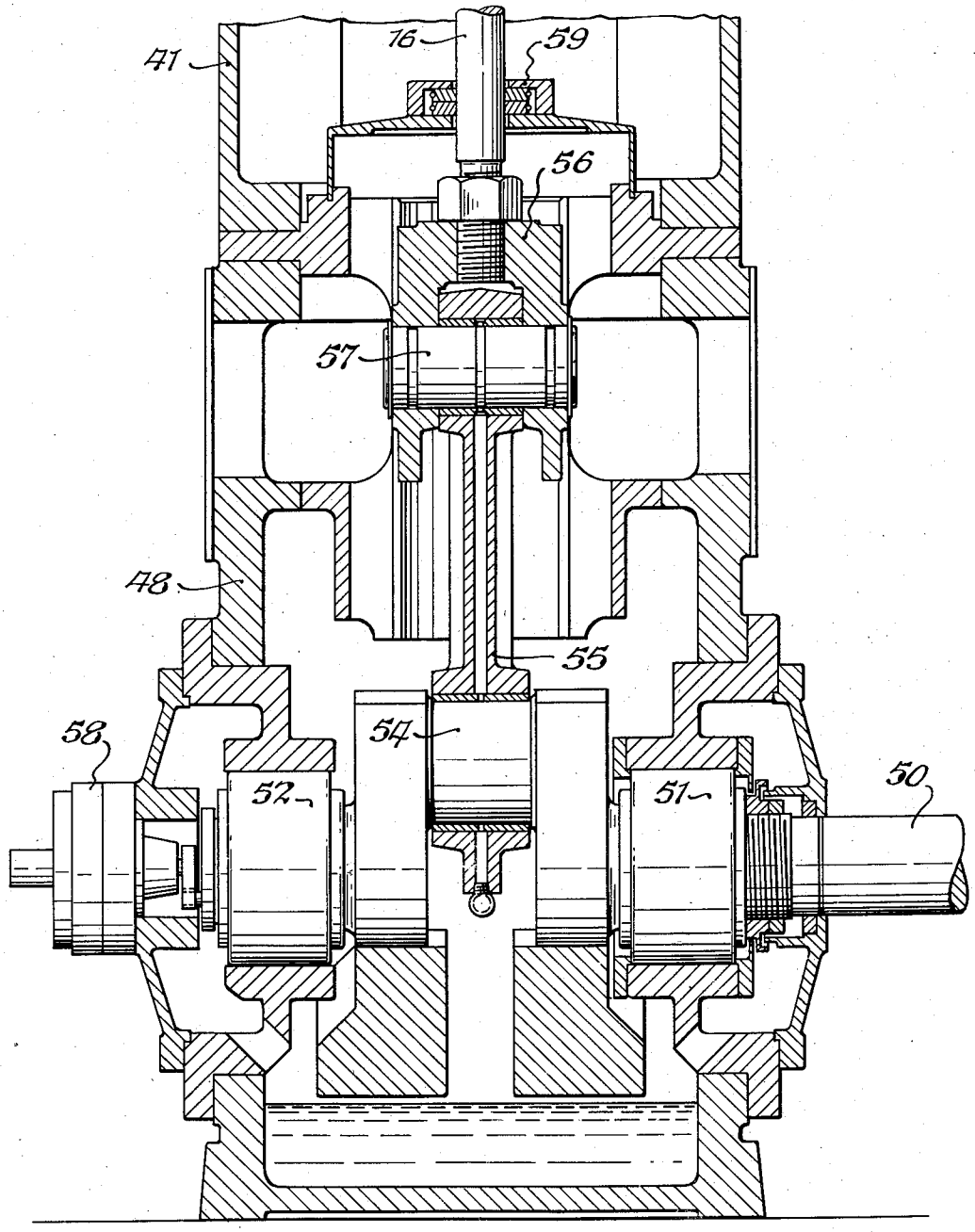


Fig. 2.

INVENTOR.
Anatol T. Ploegert,
BY
Parker, Prochnow & Hamer,
Attorneys.

United States Patent Office 2,880,927 Patented Apr. 7, 1959

2,880,927

COMPRESSOR FOR GASEOUS MATERIALS

Anatol T. Ploegert, Buffalo, N.Y., assignor to The Wittemann Company, Inc., Buffalo, N.Y.

Application March 13, 1956, Serial No. 571,198

14 Claims. (Cl. 230—201)

This invention relates to compressors, more particularly of the reciprocating displacement type for gases and vapors of the kind which must be kept out of contact with lubricants ordinarily used in air compressors, and in which water or the like is used as a coolant and lubricant to maintain low terminal temperatures in the cylinders and passages of the compressor.

In compressors of this type as heretofore constructed and employing water as a lubricant, there was always a danger that if too much water was admitted to a cylinder, then when the piston approached the upper limit of its stroke, and the space between it and the cylinder head was filled with water, damage to the compressor would result.

It is, consequently, an object of this invention to provide a compressor which is so constructed that there is no danger of damage to the compressor in the event than an excessive amount of water is fed to a cylinder.

A further object is to provide a compressor of this type with valves which are so located that when opened, water will be discharged through the same in advance of compressed gas.

A further object is to provide a two-stage compressor of this type which includes only a single reciprocatory piston and in which the cylinder for the second stage moves with said piston and cooperates with a stationary piston.

It is also an object of this invention to provide a compressor of this kind with means of improved construction for cooling the gases in the compressor.

Other objects and advantages will be apparent from the following description of one embodiment of the invention and the novel features will be particularly pointed out hereinafter in connection with the appended claims.

In the accompanying drawings:

Fig. 1 is a longitudinal, central sectional elevation of the upper portion of a compressor embodying this invention.

Fig. 2 is a similar view of the lower portion of the compressor showing the mechanism for imparting reciprocatory motion to the movable piston.

The compressor, which is shown in the drawings to illustrate by way of example one embodiment of my invention, includes a cylinder 5 in which a piston 6 is reciprocable in a substantially vertical direction. The cylinder is provided at the upper end thereof with a cylinder head 7 containing one or more valves 8, two being shown in the construction illustrated. Above the cylinder head 7 is an inlet chamber 9 to which the gas to be compressed may be conducted in any suitable manner, for example, through an opening 10 formed therein. The valves 8 may be of any suitable or desired construction, and since valves of this type can be readily purchased and are of more or less standard construction, they are not herein described in detail. They are held in place by means of a valve-retaining plate 12 and are inlet valves through which gas to be compressed may pass from the

inlet chamber 9 into the interior of the cylinder 5 above the piston 6.

The piston 6 includes the usual head 13 having a substantially gas-tight connection with the inner wall of the cylinder 5, and suitable compression piston rings 15 and guide or rider rings 15' may be arranged on the piston head 13 in any usual or suitable manner.

In accordance with my invention, the discharge valves through which compressed gas may be discharged from the cylinder are located below the cylinder head so that near the end of the compression stroke the water or other coolant will be discharged in advance of or simultaneously with the compressed gas. Consequently, in the construction shown, I have arranged the discharge valve or valves 14 in piston head, and preferably these valves are located in depressed portions of the upper surface of the piston head, for example, in depressions or recesses 14' in the piston head, into which water will flow by gravity during the up stroke of the piston. Consequently, when the discharge valves 14 open, water will flow through these valves before gas passes through the same. The piston is reciprocated by means of a piston rod 16 suitably secured at its upper end to the piston head 13.

The piston 6 has a downwardly extending tubular body or skirt portion 18 which may, as shown in the drawing, be formed integral with the piston head, and for proper guidance of the piston within the cylinder, this skirt portion is provided at the lower end thereof with an outwardly extending flange 20 which is also provided with suitable piston rings 21 and guide rings 21' to form a substantially gas-tight joint with the lower portion of the cylinder 5.

The downwardly extending, hollow body or skirt portion 18 is bored to form the second stage cylinder of the compressor and cooperates with a stationary piston 25 which, in the construction shown, is mounted at the upper end of two concentric cylindrical parts 26 and 28 which are formed integral at their lower ends with a lower head 27 of the cylinder 5. The two tubular parts 26 and 28 are spaced apart and the cylindrical part 28 has an upper portion of increased thickness which supports a series of piston rings 30 which cooperate with the cylinder formed by the skirt 18 of the upper piston 6.

The stationary piston head 25 is provided with one or more valves 31, two such valves being shown in the construction illustrated, through which liquid compressed within the second stage cylinder may pass into the space 32 formed between the two cylindrical piston-supporting members 26 and 28, for discharge from the compressor.

In the compressor as so far described, it will be obvious that on the down stroke of the main piston 6, gas will pass through the valves 8 from the inlet chamber 9 into the interior of the cylinder 5. Upon upward movement of the piston 6, this gas is compressed, and upon reaching a predetermined pressure, the compressed gas will be discharged into the second stage cylinder formed in the skirt 18. Upon downward movement of the piston 6, the gas within the second stage cylinder will be compressed, since the fixed piston 25 will of course remain in the position shown in Fig. 1. Gas compressed in this second stage cylinder will consequently be discharged through the valves 31.

When operating with certain gases such, for example, as carbon dioxide produced in the fermentation process of a brewery, it is, of course, very necessary that the compression of the gas be carried on at a low temperature so that certain taste-imparting ingredients or other constituents of the gas will not be destroyed or damaged. For this purpose, water or other coolant which also acts as a lubricant for the contacting surfaces of the cylinders

and pistons is sprayed through the cylinder head 7 by means of a suitable nozzle 34 formed on the end of a water inlet pipe 35 which, in the construction shown, extends through the inlet chamber 9 and terminates in the suitable nozzle 34. Water may be supplied to this pipe 35 in any suitable manner (not shown), and is sprayed in finely divided form into the gas which is being compressed. Some of this water will be vaporized, but enough water is injected into the cylinder so that some of this water also acts as a lubricant for the piston and cylinder. The excess water collects on top of the piston head 13, and as soon as the valves 14 open, this water will be discharged downwardly into the second stage cylinder formed within the skirt 18, and will thus serve to lubricate the second cylinder and the stationary piston and also act as a coolant for the gas compressed in the second stage. Similarly, when the piston 6 is moved downwardly by the piston rod 16, and when it approaches closely to the end of the stationary piston 25, water which has collected above the valves 31, will be discharged through these valves into the space 32 for discharge with the compressed gas to a suitable separator (not shown), in which the water is removed from the gas.

The base 27 of the cylinder 5 is provided with a gas passage 37 which connects with the space 32 and the gas from this passage is discharged from the compressor through an outlet pipe 38.

The main cylinder 5 may be supported on the compressor in any suitable or desired manner, and in the construction shown, this cylinder is provided with an outwardly extending flange 40 which rests on the upper end of a cylindrical supporting member 41. The piston rod 16 extends through a suitable stuffing box 42 arranged in the base 27 and which may be of any usual or suitable construction to prevent any lubricant from the piston reciprocating mechanism from passing into contact with the gas being compressed and to prevent water or other coolant from passing down along the rod 16 and contaminating the lubricant used in the mechanism, which actuates the piston rod. 43 represents a collar secured to the piston rod to prevent lubricant from the actuating mechanism from creeping up along the piston rod.

The discharge pipe 38 extends through a suitable hole or opening 46 formed in the supporting member 41. This supporting member in turn is supported by a suitable base or crank case 48 which rests on any desired foundation. This base houses mechanism for operating the piston rod 16 including a crank shaft 50 journalled in suitable bearings 51 and 52, mounted in opposite walls of the crank case. Rotary motion of the crank shaft 50 is converted into reciprocatory motion in the usual manner by means of a crank 54 which imparts motion to one end of a connecting rod 55, the other end of the connecting rod being pivotally connected with a cross head 56 by means of a cross head pin 57. The cross head 56 is mounted as usual, in a suitable cross head slide which may be formed as a part of the crank case 48. The lower end of the piston rod 16 is rigidly connected with the cross head 56. 58 represents an oil pump for lubricating the moving parts within the crank case and 59 represents a suitable oil seal to resist the escape of oil from the crank case along the piston rod. Any other means for reciprocating the piston may be provided.

In addition to cooling the compressed gas by means of water or other coolant sprayed into the cylinders, cooling means are also provided about the cylinder 5 in the form of jackets of any usual or suitable construction. 63 represents a cylindrical jacket member extending about the cylinder 5 and spaced therefrom by outwardly extending ribs 64, 65, 66 which separate the jacket space surrounding the cylinder into a number of different compartments. All but the lowermost of the compartments formed by these ribs are employed for the circulation of the coolant. For example, coolant may be passed into the compartment between the ribs 65 and

66 through an inlet tube or pipe 68 and passes from this compartment through an opening 70 in the cylinder 5 into the space between the piston skirt 18 and the cylinder 5, so that this space is always filled with coolant, which moves up and down with the reciprocations of the piston. The cylinder 5 is provided with a discharge opening 71 through which liquid from the space surrounding the skirt 18 is discharged into the jacket compartment between the outwardly extending flanges 64 and 65, and the flange 64 is provided with an opening 72 through which coolant flows into the upper compartment of the jacket from which it is discharged through pipe 73.

It has been found that the coolant discharged from the upper jacket compartment through the pipe 73 is sufficiently cool, so that it may be used for further cooling the gas in the compressor. Consequently, this pipe extends downwardly and terminates in a passage 74 formed in the flange 40 at the lower end of the cylinder 5. This passage leads to an annular passage 75 formed by an annular groove in the lower head 27 of the cylinder 5 and facing the flange 40. This passage 75, consequently, extends about the gas passage 37 and thus acts as a jacket to cool gas flowing in the passage 37.

From the passage 75, the coolant flows into a space 76 between the cylinder 5 and the cylindrical portion 28 of the stationary piston. This space also receives any coolant that may leak past either piston and its cylinder and this coolant, together with that discharged from pipe 73, passes through suitable holes or openings 78 leading to the lowest jacket space, and thence to a discharge passage 79 connected with a discharge pipe 80. The holes 78 are preferably spaced slightly above the surface of the lower head 27 so that a shallow body of coolant will lie on that surface and thus further absorb heat from gas in the passage 37.

Since the volume of the chamber or space 76 varies with each reciprocation of the main piston, means are provided for preventing any pressure from being generated in this space due to this change in its volume, and this is accomplished by means of an equalizing pipe or duct 83 which connects with the lowest jacket compartment and with the inlet chamber 9, so that gas in the chamber 76 during the down stroke of the piston will pass through the passages 78 into the lowest jacket chamber and then to the pipe 83 into the inlet chamber 9. During the stroke of the piston in the reverse or upward direction, the flow in the equalizing pipe 83 is reversed so that gas is received from the inlet chamber 9 and transmitted into the lowest jacket space. This construction has the advantage that a relatively even flow of gas to be compressed will enter the inlet chamber 9, since during the downward stroke of the main piston when gas is drawn from the inlet chamber 9 into the cylinder 5, some gas is also discharged from the chamber 76 into the inlet chamber 9. To compensate to some extent for that which is drawn into the cylinder 5, and during the reverse stroke when no gas is taken into the cylinder 5, a considerable quantity of gas will be drawn into the chamber 76.

By means of the construction described, it will be obvious that damage to the compressor because of excess water or other coolant being admitted into a cylinder is entirely eliminated, since if excess water is passed into a cylinder, it will pass through the discharge valve or valves in advance of the gas which is being compressed and this is equally true in both stages of compression. It is, consequently, possible by means of the construction shown to admit more coolant to the cylinders than has heretofore been considered practical, and consequently, more efficient cooling of the gases is effected, as well as thoroughly efficient lubrication of the bearing surfaces between the cylinders and pistons, so that a cooler for the gases between the two stages of compression is not necessary. The maintaining of a relatively large body of water in the space between the piston head and the lower piston flange 20 ensures adequate lubrication of the main piston and its

cylinder and also ensures efficient cooling of the second stage cylinder 18.

It will be understood that various changes in the details, materials, and arrangements of parts which have been herein described and illustrated in order to explain the nature of the invention, may be made by those skilled in the art within the principle and scope of the invention, as expressed in the appended claims.

I claim as my invention:

1. A compressor including an upright cylinder having a cylinder head at the upper end thereof, a valve in said cylinder head for admitting gas into said cylinder, a piston reciprocable in said cylinder for compressing gas between said piston and said cylinder head, said piston having a second cylinder fixed thereon on the face thereof opposite to said cylinder head, a stationary piston fitting within said second cylinder, a discharge valve in said reciprocatory piston for discharging gas compressed thereby downwardly into said second cylinder for further compression, a discharge valve mounted on said stationary piston for discharge of the compressed gas, and a reciprocable piston rod secured to said first mentioned piston and extending downwardly lengthwise through said stationary piston.

2. A two-stage compressor including a cylinder having a cylinder head on the upper end thereof containing a valve for admitting gas into said cylinder, a piston reciprocable in said cylinder for effecting the first stage of compression between said piston and said cylinder head, a second stage cylinder fixed to the lower face of said piston coaxially therewith, a valve in said piston through which gas from the first stage of compression is discharged into said second stage cylinder, a stationary piston fitted within said second stage cylinder and cooperating therewith during reciprocation of said first mentioned piston, a valve in said stationary piston through which gas from the second stage is discharged, said first mentioned piston being provided with an enclosure surrounding said second stage cylinder, means in said cylinder head for supplying liquid coolant to said enclosure, and means for imparting reciprocation to said first mentioned piston.

3. A compressor according to claim 2, in which said enclosure is formed by a flange extending outwardly from the lower part of said second stage cylinder into sliding contact with said first mentioned cylinder and spaced from the head of said first mentioned piston.

4. A compressor according to claim 2, in which openings are provided in said first mentioned cylinder for admitting cooling liquid into and discharging the same from said enclosure.

5. A two-stage compressor including a cylinder having a cylinder head containing a valve for admitting gas into said cylinder, a piston reciprocable in said cylinder for effecting the first stage of compression between said piston and said cylinder head, said piston including a head and a flange which cooperate with said cylinder and which are spaced apart and connected by a second stage cylinder of smaller diameter than said head and flange, to form an enclosure for coolant between said first mentioned cylinder and said second stage cylinder, a valve in said piston through which gas from the first stage of compression is discharged into said second stage cylinder, a stationary piston which said second stage cylinder is fitting and which cooperates during reciprocation of said first mentioned piston, a valve in said stationary piston through which gas from the second stage is discharged, means in said cylinder head for supplying coolant to said enclosure, and means for reciprocating said first mentioned piston.

6. A two-stage compressor including a first stage cylinder having annular spaced ribs extending outwardly therefrom, a jacket member extending about said cylinder and engaging said ribs and forming therewith a water jacket divided by said ribs into a plurality of compartments, a piston for reciprocation in said cylinder and having a head engaging with said cylinder, a second stage cylinder formed integral with said piston and extending downwardly therefrom, an outwardly extending flange on said second stage cylinder, spaced from said cylinder head, said head, flange and said second stage cylinder forming between them an annular space, said first stage cylinder having an opening communicating with one of said compartments of said jacket for admitting coolant to the space in said piston and having another opening communicating with another compartment for discharging coolant from said space, a stationary piston fitted within said second stage cylinder, and means for reciprocating said first mentioned piston.

7. A two-stage compressor including a first stage cylinder having a piston arranged therein, said piston comprising a head at the upper end thereof and a flange at the lower end thereof, said head and flange being connected by a cylindrical skirt which forms the cylinder for the second stage and which is of smaller diameter than said head and flange, means for admitting coolant into and discharging coolant from the space between said head and said flange and said first and second stage cylinders through openings formed in said cylinder, a stationary piston fitted within said second stage cylinder, and valves on said compressor for controlling the flow of gas through said compressor and discharging the same therefrom.

8. A two-stage compressor including a first stage cylinder, an inlet chamber arranged above said cylinder, a piston in said cylinder, said piston having a downwardly extending skirt portion forming a cylinder for the second stage, a stationary piston fitted within said second stage cylinder, said first mentioned piston having a head at the upper end thereof cooperating with said first mentioned cylinder and a flange at the lower end of said skirt spaced from said head and also having a sliding engagement with said first mentioned cylinder, said stationary piston being supported on a head secured on the lower end of said cylinder, the space between said lower head and said flange of said piston being variable in volume during the reciprocation of said first mentioned piston, a tube connecting said space with said inlet chamber, valves on said compressor controlling the flow of gas through said compressor, the space above said flange at the lower end of said skirt forming the space for coolant, jackets for coolant extending about said first stage cylinder, and openings in said first stage cylinder for conducting coolant from said jacket into said space and for discharge of coolant from said space into said jacket.

9. A compressor including a cylinder having a cylinder head, a piston reciprocable in said cylinder and having an enlarged head, a second stage cylinder formed integral with said piston and reciprocable therewith, a stationary piston fitted within said second stage cylinder, and means for passing coolant about the exterior of said second stage cylinder including a flange at the lower end of said second stage cylinder which extends into sliding engagement with said first mentioned cylinder and which forms a space within said first mentioned cylinder and about said second stage cylinder between said piston head and said flange, and on said compressor means for circulating coolant through said space.

10. A compressor including a cylinder, a piston reciprocable in said cylinder, said piston having a downwardly extending skirt portion forming a second stage cylinder, a stationary piston fitted within said second stage cylinder, a hollow cylindrical member supporting said stationary piston, and terminating at its lower end in a head, said head closing the lower end of said first mentioned cylinder, a valve in the upper end of said stationary piston through which compressed gas enters into the space within said cylindrical member, said lower cylinder head having openings therein through which the compressed gas passes for discharge from the compressor, said lower cylinder head having a groove formed therein

which lies adjacent to said first mentioned cylinder and forms a passage for coolant for absorbing heat from the gas passing through said lower cylinder head.

11. A two-stage compressor including a vertical cylinder having a cylinder head, a valve in said head for admitting gas into said cylinder, a piston reciprocable in said cylinder and having a head, means mounted on said cylinder for supplying a coolant into said cylinder above said piston, a valve in said piston head through which coolant and compressed gas pass, and a second stage cylinder on the lower face of said piston into which said coolant and compressed gas are delivered by said last mentioned valve.

12. A two-stage compressor including a vertical cylinder having a cylinder head, a valve in said head for admitting gas into said cylinder, a piston reciprocable in said cylinder, means mounted on said cylinder for supplying a coolant into said cylinder above said piston, a valve in said piston through which coolant and compressed gas pass, a second stage cylinder fixed to the lower face of said piston and into which gas and coolant pass downwardly from said valve in said piston, a stationary piston fitted within said second stage cylinder, a valve in the upper end of said stationary piston through which gas and coolant are discharged downwardly, and means for imparting reciprocatory motion to said first mentioned piston.

13. A compressor including an upright cylinder having a cylinder head at the upper end thereof, a valve in said cylinder head for admitting gas into said cylinder, a piston reciprocable in said cylinder for compressing gas between said piston and said cylinder head, said piston having a second cylinder fixed thereon on the face thereof opposite to said cylinder head, a stationary piston fitting within said second cylinder, a discharge valve in said

reciprocatory piston for discharging gas compressed thereby downwardly into said second cylinder for further compression, a discharge valve mounted on said stationary piston for discharge of the gas, and means for supplying a cooling and lubricating liquid to the gas in said first mentioned cylinder, which is discharged through said discharge valve into said second cylinder in advance of the gas compressed in said first mentioned cylinder.

14. A compressor including an upright cylinder having a cylinder head at the upper end thereof, a valve in said cylinder head for admitting gas into said cylinder, a piston reciprocable in said cylinder for compressing gas between said piston and said cylinder head, said piston having a second cylinder fixed thereon on the face thereof opposite to said cylinder head, a stationary piston fitting within said second cylinder, a discharge valve in said reciprocatory piston for discharging gas compressed thereby downwardly into said second cylinder for further compression, a discharge valve mounted on said stationary piston for discharge of the gas, said cylinders and pistons being arranged on a substantially vertical axis with said cylinder head uppermost, and means for discharging a cooling liquid into the gas above said first mentioned piston, whereby said liquid will flow by gravity in advance of the compressed gas through said discharge valves when the same are open.

References Cited in the file of this patent

UNITED STATES PATENTS

495,348	Lawson	Apr. 11, 1893
1,113,873	Boring	Oct. 13, 1914
1,681,280	Bruckner	Aug. 21, 1928
1,791,364	Lewis	Feb. 3, 1931
1,998,264	Aikman	Apr. 16, 1935