

Aug. 25, 1931.

P. H. DAVEY

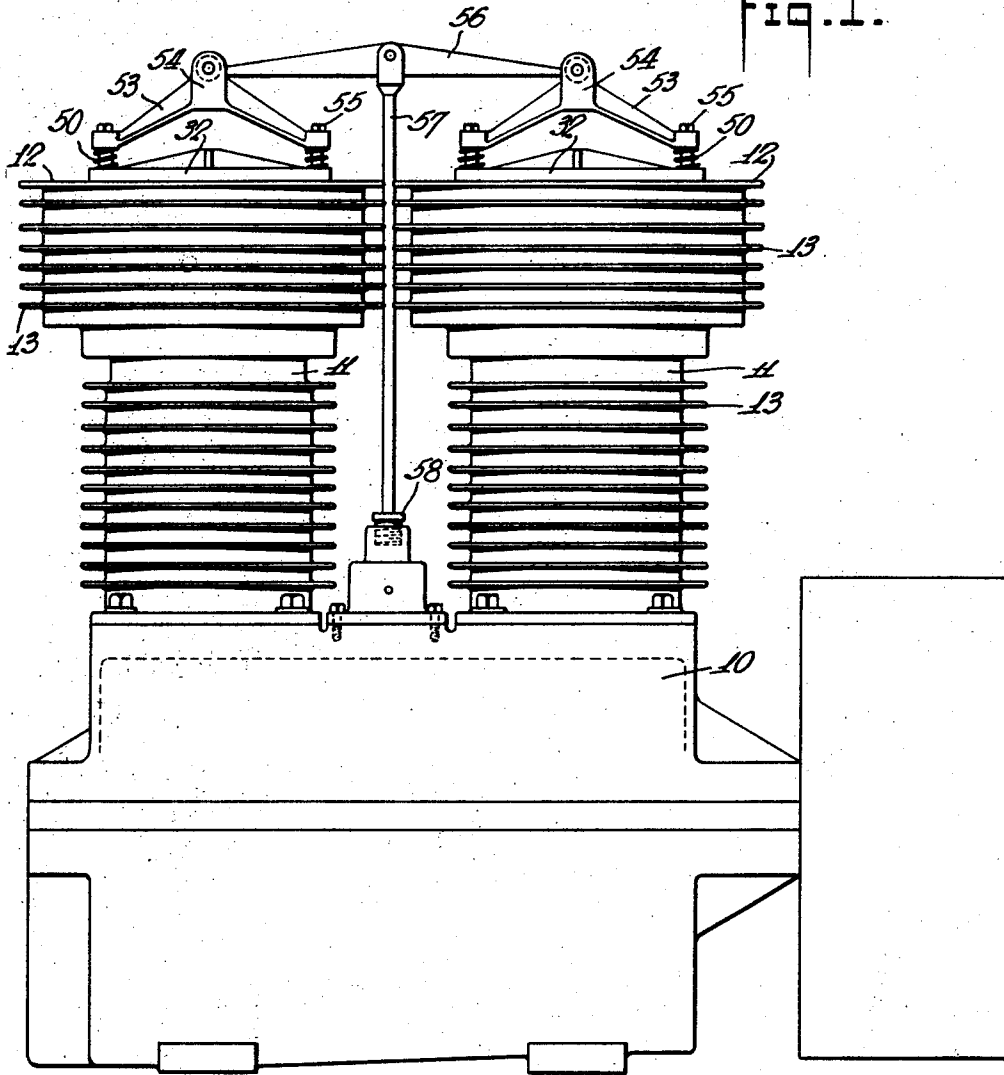
1,820,732

COMPRESSOR

Filed Feb. 9, 1929

3 Sheets-Sheet 1

FIG. 1.



INVENTOR

Paul H. Davey

BY

George A. Allen

ATTORNEY

Aug. 25, 1931.

P. H. DAVEY

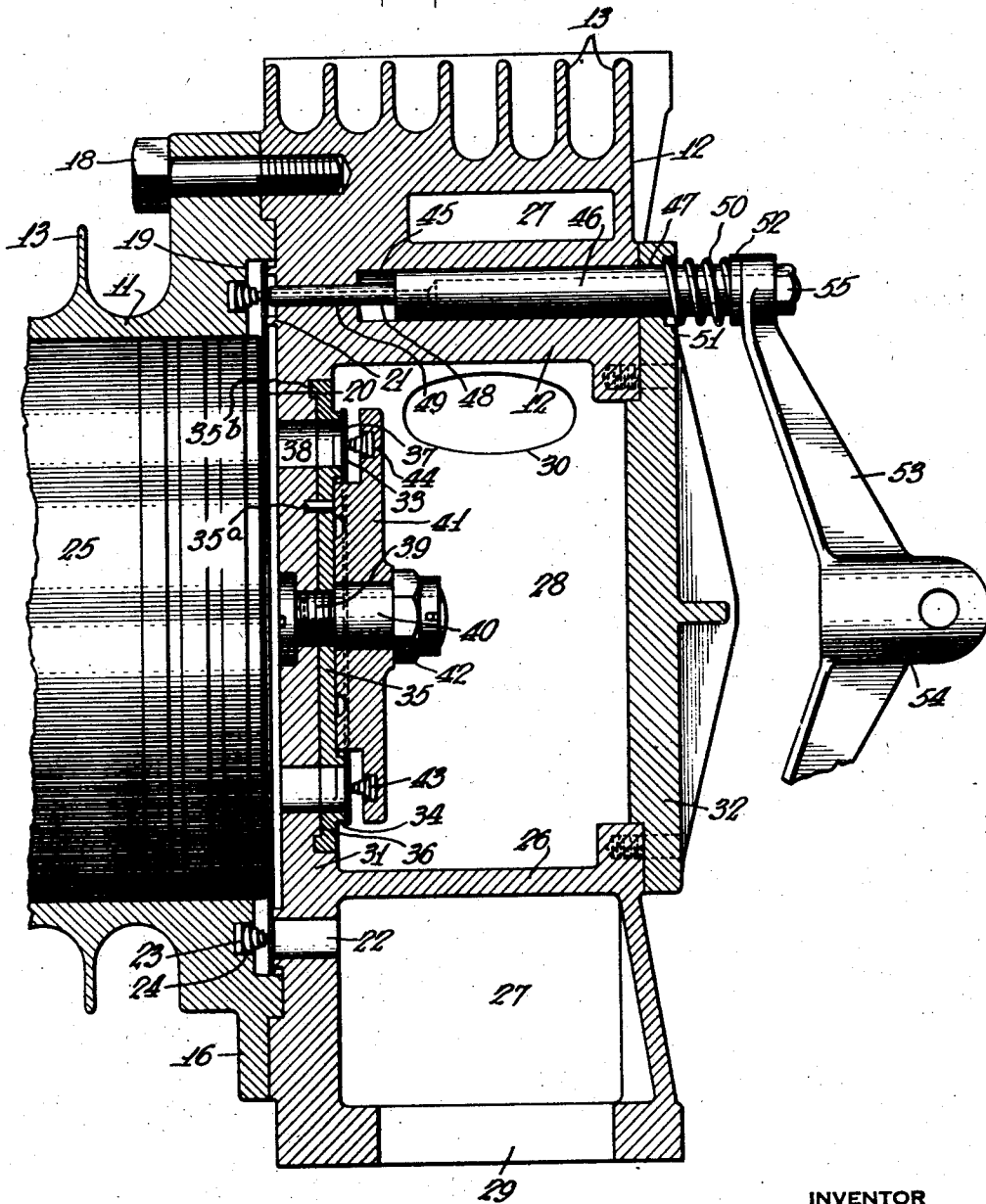
1,820,732

COMPRESSOR

Filed Feb. 9, 1929

3 Sheets-Sheet 2

FIG. 2.



INVENTOR

Paul H. Davey

BY

Charles Allen

ATTORNEY

Aug. 25, 1931.

P. H. DAVEY

1,820,732

COMPRESSOR

Filed Feb. 9, 1929

3 Sheets-Sheet 3

Fig. 3.

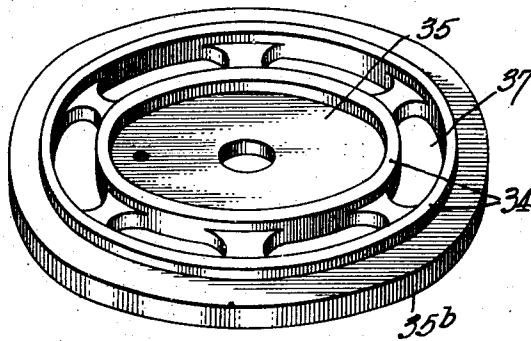


Fig. 5.

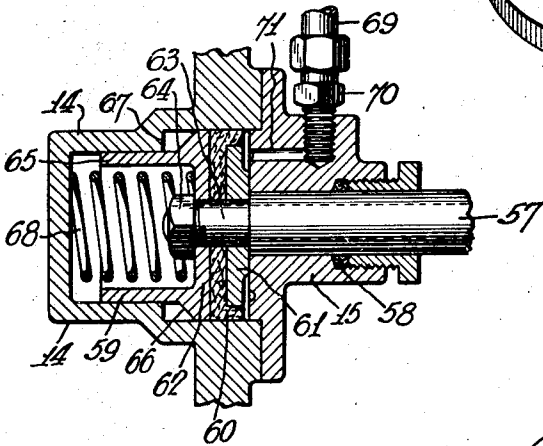
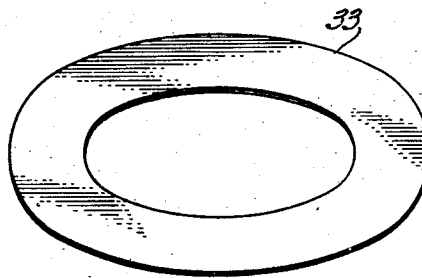


Fig. 4.



INVENTOR
Paul H. Davey
BY
George H. Sloan
ATTORNEY

UNITED STATES PATENT OFFICE

PAUL H. DAVEY, OF KENT, OHIO, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS,
TO DAVEY DEVELOPMENT COMPANY, OF KENT, OHIO, A CORPORATION OF OHIO

COMPRESSOR

Application filed February 9, 1929. Serial No. 338,649.

The present invention considered from one aspect represents a specific improvement over the compressor disclosed in my prior Reissue Patent No. 16,872, dated February 7, 1928, but in its broader sense is concerned with improvements which are of general applicability to compressors of practically all types.

In my said prior patent, there are thin annular plate valves in the compressor head normally seated by springs, the inlet valve opening inwardly against the action of the springs under differential air pressures existing on opposite sides of the valve during the intake stroke and being firmly seated during the compression stroke by such pressures plus the action of the springs.

One special feature of my present invention is the use of an inlet valve of greater diameter than the cylinder of the compressor and therefore clear of the compressor piston so that the clearance between the latter and the cylinder head on the compression stroke may be reduced to a minimum. This arrangement of the inlet valve also insures the introduction of the incoming air in a comparatively cold condition, consequently increasing the weight of the air taken in at each charge. It furthermore expedites the rush of air on the intake stroke due to the large area and low resistance of the intake ports.

Another feature is the provision of narrow raised seats for the thin annular valve plates, these seats guarding to a large extent against the valve leaks which might result from foreign particles that are more likely to lodge under the valves where the seats present broad surfaces of engagement with the valve plate; and also preventing the possibility of straining or slowing up the action of these valves by insuring uniform distribution of the differential pressure over the full area of their opposite sides. The edges of the valves seat on spaced concentric circular seats between which a circular series of ports are located. This is an important improvement over the patented device in which the valve plates rested directly on a flat surface and are subject to localized pressure differentials only at the region of the ports. At the outlet

valve where wear is most apt to occur the ring seats are integral with a removable wear plate which may be periodically discarded and replaced in order to save scrapping of the entire compressor head.

A feature of general usefulness is the provision of means for automatically causing the compressor inlet valve to act as a breather whenever the pressure in the air receiver reaches a predetermined maximum. I am thus able to render the compressor, in effect, idle or inactive at certain times when the receiver is fully loaded without any of the inconveniences incidental to stopping and starting it. This arrangement is of special advantage where the compressor is called upon to keep a receiving tank more or less continuously loaded, as is the case with the vehicle carried compressor disclosed in the patent above referred to. With the large area inlet valve which I employ, the pressures developed in the receiver would, in the absence of some special relief means, be sufficient to eventually stall the compressor and of course would operate to impose entirely unnecessary loads upon it.

In accordance with the present invention, the presence of unduly high pressure in the receiver is transmitted back to the compressor inlet valve as a load which opposes and overcomes the springs of this valve, thereby holding it open and causing it to act as a breather, thereby rendering the compressor idle until such time as the receiver pressure is again reduced.

Preferably the means for holding the inlet valve unseated comprises plungers which I term knockout plungers and which move through the cylinder head and knock the valve off its seat. The actuating means for the plungers includes a piston member, which is operated by reservoir tank pressure controlled by an automatic valve of well known type, through a "knockout" line which is energized or vented thereby according as the valve is under-loaded or over-loaded by the reservoir pressure. To effect operation of the knockout plungers, the pressure on this piston must overcome the predetermined tension of opposing springs which are adjust-

able to regulate the particular receiver pressure at which the knockout plungers act.

The invention may be more fully understood from the following description in connection with the accompanying drawings, wherein:

Fig. 1 is an elevational view of a two-cylinder compressor embodying the invention.

Fig. 2 is an enlarged longitudinal sectional view through the head of one of the identical compressor cylinders.

Fig. 3 is a perspective view of the removable valve seating wear block.

Fig. 4 is a perspective view of the outlet valve and

Fig. 5 is an enlarged vertical sectional detail through the air-operated piston member which controls the knockout plungers.

In the drawings, I have used the reference numeral 10 to designate the crank case of a compressor including a pair of vertical cylinders 11 and cylinder heads 12, both the cylinders and the heads being equipped with the usual heat radiating vanes or fins 13. Cast integral and depending into the crank case is a cylinder 14 shown in Fig. 5 which houses the piston for controlling the knockout plungers. This cylinder, which will be more fully described later, is closed by a head in the form of a casting 15 bolted or otherwise secured upon the top of the crank case.

Details of the cylinder heads are best seen in Fig. 2. Each head 12 comprises a relatively massive casting (preferably of aluminum) seating upon a flange 16 at the top of the cylinder 11 and bolted or otherwise secured at 18. At its extreme upper end the cylinder 11 is internally annularly enlarged, providing an annular groove or chamber 19 in which the thin flat annular inwardly opening inlet valve plate 20 is accommodated. A pair of downwardly facing concentric ring seats 21 integral with the underface of the head 12 permit the pressure of incoming air to be transmitted over substantially the entire area of the valve as the air enters through any of the numerous ports 22 of the circular inlet port series. Valve 20, which may be of spring steel such as is used for circular saws, is normally spring pressed upwardly against its seat by coiled springs 23 pocketed in suitable recesses 24 in the bottom of the groove 19. These springs are preferably of a spiral-ribbon, telescoping type, as shown. Due to the fact that the valve 20 is of larger internal diameter than the internal diameter of the cylinder 11, the clearance between the compressor piston 25 and the flat inner face of the cylinder head may be made very small so that remarkably complete evacuation of the compression chamber may be effected at each working stroke of the piston.

The cylinder head is divided by an approximately annular partition 26 into an outer generally ring shaped air intake chamber 27

and an inner generally circular compressed air outlet chamber 28. A plate 32 is secured in position to close the top of the chamber 28, and may be readily removed whenever it becomes desirable to have access to the outlet valve 33.

This valve is preferably a thin annular plate, of considerably less area and diameter than the inlet valve 20, but preferably of about the same width. Obviously the volume of compressed air which must be expelled through the valve 33 is much less than that of the outside air that is sucked in through the valve 20. The seat for the valve 33 is formed by a pair of upstanding concentric circular ribs 34 and where the head 31 is of aluminum alloy, which is relatively soft as compared with the steel valve plate, 33, these rib seats may be formed of chrome steel or, as shown, they may be integral with a removable plate, preferably of hard aluminum bronze, 35, of composition making it also a good conductor of heat. This plate is of generally circular formation, and is seated in a suitably prepared pocket 36 in the upper face of the plate 31. Between the ribs 34, ports 37 are provided, registering with and forming part of the outlet ports 38 in the plate 31.

Various means may be resorted to for securing the wear plate 35 in place, but I have shown it as removably held by a relatively massive screw 39 passed through the plate 35 and head 31 and terminating flush with the inner face of the latter. This screw may be a stud, screwed, cast or riveted in said head 31. It includes an unthreaded enlarged portion 40 upon which a clamp disk 41 is mounted and held by nut 42 upon the outer end of the screw 39. The telescoping spiral springs 43, which exert downward pressure to hold the outwardly opening valve 33 on its seat are pocketed in recesses 44 in the under face of the clamping disk 41. The wear plate is held against rotation by a blind stud 35a entering a socket in the plate 31 and is accurately centered by flange 35b entering a corresponding groove in the latter plate.

At suitable intervals, say in about three places, partition 26 is considerably thickened and is bored to provide cylindrical guides 45 for the enlarged upper portions of knockout plungers 46. Cylinders 45 open through the top of the head, closure plate 32 preferably being perforated at 47 in registry with the cylinders and the reduced lower ends 48 of the knockout plungers working through the reduced bores 49 in the head and having their lower ends terminating in the space between the rings 21. The downward pressure to be applied through these plungers is sufficient to unseat the inlet valve 20 against the action of the springs 23.

The knockout plungers 46 are in themselves preferably spring held in inoperative

position by the use of coiled expansion springs 50 encircling their upper exposed ends. These springs at their lower ends are seated in annular grooves 51, in plate 32 and at their upper ends bear against collars 52 on the plungers 46.

A spider member designated generally at 54 is arranged above the cylinder head and includes downwardly inclined radiating spider arms 53, the extremities of which are slipped over the upper ends of the knockout plungers 46 and secured by nuts 55. Thus vertical movement of the spider 54 effects simultaneous operation of all of the knockout plungers.

The spider members of the two cylinders are connected by a crossbar 56, the latter in turn being coupled at its center to the upper outer end of a piston rod 57 passing downwardly between the cylinders 11, through the stuffing box 58 and engaged with a piston 59 working in the cylinder 14 (Fig. 5).

This piston may conveniently include an upwardly facing cup leather 60 clamped between the plates 61 and 62 which are secured on the reduced lower end 63 of the piston rod 57 by a nut 64. The lower plate 62 preferably forms the top of an inverted metallic cup 65 which in the region of its upper end is externally provided with a downwardly facing bevelled shoulder 66 adapted to act with a shoulder 67 in the cylinder 14 to limit the downward movement of the piston.

A coiled expansion spring 68 bearing against the bottom of the cylinder 14 and extending upwardly within cup 65 bears against the interior of this cup and tends to hold the entire piston structure in the elevated position shown in Fig. 5.

A knockout line 69 from the receiver (not shown) is coupled by a suitable fitting 70 with an air passage 71 formed in the head 15 and adapted to deliver air on top of the piston 60. Whenever the air pressure in the receiver becomes sufficiently high to move the piston downwardly against the action of the spring 58 and the assisting action of the springs 50 and 23, the knockouts will of course slide down and hold the inlet valve 20 off its seat until such time as the pressure in the receiver is again relieved. By virtue of this arrangement it becomes impossible to stall or overload the compressor itself and the danger of injuring the receiver by forcing air into it under unduly high pressures is avoided. As soon as the knockout plungers become operative, continued operation of the compressor pistons 25 simply acts to suck air into the cylinder 11 and breathe it out again through the intake ports. As soon as the receiver pressure drops the combined action of the springs 23, 50 and 68 is sufficient to overcome the reduced pressure on the top of the piston 59 and retract the knockout plungers, where-

upon the compressor will continue to operate in the usual manner.

The range of movement of the knockout plungers is small, being limited directly by the range of movement of piston 59. The slight plunger movement at fairly low speed cannot injure the thin inlet valve plate as would be the case if the plungers struck it with speed and momentum.

It will be apparent that the use of the raised annular valve seats not only minimizes the possibility of valve leaks due to foreign matter lodging under the thin valve annuli, but permits the differential pressures on opposite sides of the valves to act upon the entire valve area and make the valve movements quick and positive as opposed to the localized differential pressure action which obtained with the valves of my prior patent.

About the only place where excessive wear is likely to occur is on the seat of the outlet valve and this seat may not only be readily replaced but if made of bronze tends additionally to wear much more slowly than the aluminum head itself. The arrangement of the annular inlet valve radially beyond the compression cylinder coupled with an ample number of inlet ports insures low resistance to the rapid inrush of substantially cold air on each intake stroke.

I claim:—

1. A compressor including a piston, a cylinder, a cylinder head formed with a central exhaust and an annular intake surrounding the exhaust and concentric annular plate intake and exhaust valves, in combination with a plurality of equally spaced knock out rods each having one end adjacent the intake annular valve and slidably mounted in and projecting outside the cylinder head for external operation.

2. A compressor including a piston, a cylinder, a cylinder head formed with a central exhaust and an annular intake surrounding the exhaust and concentric annular plate intake and exhaust valves, in combination with a plurality of equally spaced knock out rods each having one end adjacent the intake annular valve and slidably mounted in and projecting outside the cylinder head, a retracting spring for each of said rods and exterior means for depressing said rods.

3. A compressor including a piston, a cylinder, a cylinder head formed with a central exhaust and an annular intake surrounding the exhaust and concentric annular plate intake and exhaust valves, in combination with a plurality of equally spaced knock out rods each having one end adjacent the intake annular valve and slidably mounted in and projecting outside the cylinder head for external operation, and means including a piston actuated by pressure of the receiver when its pressure exceeds a predetermined maximum.

4. A compressor including a piston, a cylinder, a cylinder head formed with a central exhaust and an annular intake surrounding the exhaust and concentric annular plate intake and exhaust valves, in combination with a plurality of equally spaced knock out rods each having one end adjacent the intake annular valve and slidably mounted in and projecting outside the cylinder head for external operation, and means including a piston actuated by pressure of the receiver when its pressure exceeds a predetermined maximum, said piston means being located substantially out of the heated region of the compressor. 70
5. A compressor including a piston, a cylinder, cylinder head, piston and valves, a cylinder head partitioned to form an inner exhaust chamber and an outer intake chamber and concentric annular plate intake and exhaust valves, and the intake valve being of greater diameter than the piston, in combination with means for unseating the intake valve including a knock out rod having one end adjacent the intake annular valve and slidably mounted in an enclosing guide carried by the partition, and projecting outside the cylinder head. 80
6. A compressor including a piston, a cylinder, cylinder head, piston and valves, a cylinder head partitioned to form an inner exhaust chamber and an outer intake chamber and concentric annular plate intake and exhaust valves, and the intake valve being of greater diameter than the piston, in combination with means for unseating the intake valve including a knock out rod having one end adjacent the intake annular valve and slidably mounted in an enclosing guide carried by the partition, and projecting outside the cylinder head, and exterior means for depressing said rod, including a piston actuated by pressure of the receiver when its pressure exceeds a predetermined maximum. 85
7. A compressor including a piston, a cylinder, cylinder head, piston and valves, a cylinder head partitioned to form an inner exhaust chamber and an outer intake chamber and concentric annular plate intake and exhaust valves, and the intake valve being of greater diameter than the piston, in combination with means for unseating the intake valve including a knock out rod having one end adjacent the intake annular valve and slidably mounted in an enclosing guide carried by the partition, and projecting outside the cylinder head, and exterior means for depressing said rod, including a piston actuated by pressure of the receiver when its pressure exceeds a predetermined maximum, and said piston means being located substantially beyond the region heated by the compressor. 90
8. A twin cylinder compressor, each cylinder having pressure-actuated, annular-plate intake and exhaust valves and external-ly projecting knock out rods for forcing its intake valve off of its seat and means for actuating said rods simultaneously, including a piston located between the cylinders actuated by the compressed air when its pressure exceeds a predetermined maximum, and intermediate actuating mechanism including an equalizing bar to the center of which the piston is pivoted. 95
- Signed at New York, in the county of New York, and State of New York, this 8th day of February A. D. 1929. 100
- PAUL H. DAVEY. 105
- 110
- 115
- 120
- 125
- 130