April 26, 1927. 1,626,557

W. G. E. ROLAFF

AIR COMPRESSOR OR PUMP

Filed March 13, 1918 4 Sheets-Sheet 1

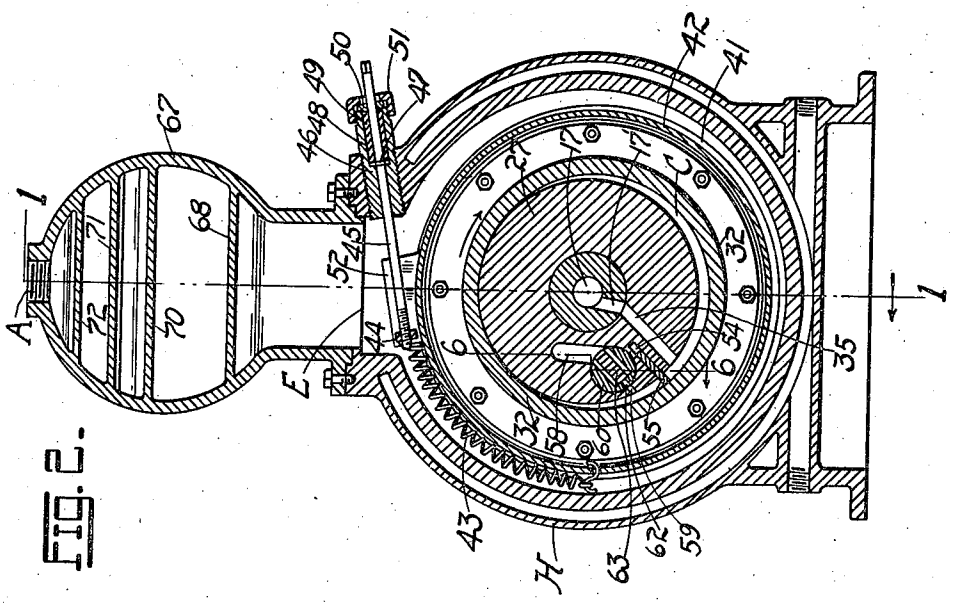


Fig. 2.

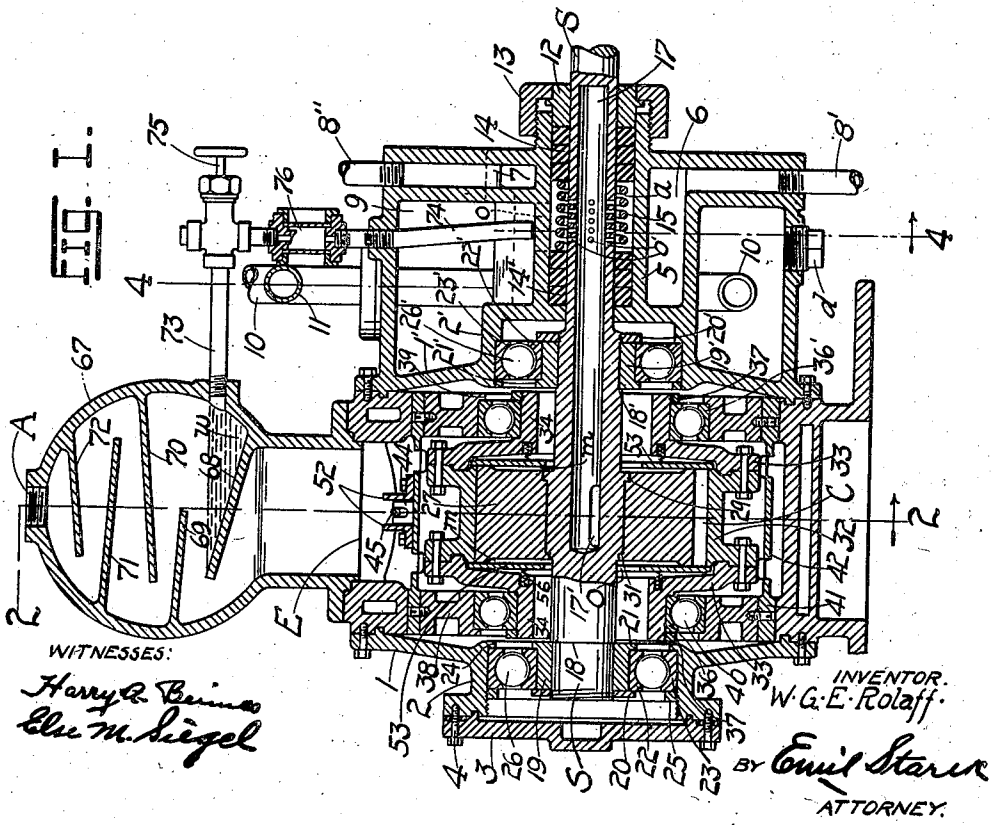


Fig. 1.

WITNESSES:

Harry L. Bruno

Elsie M. Siegel

INVENTOR.

W. G. E. Rolaff.

BY Emil Starck

ATTORNEY.

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W. G. E. ROLAFF

AIR COMPRESSOR OR PUMP

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Fig. 3.

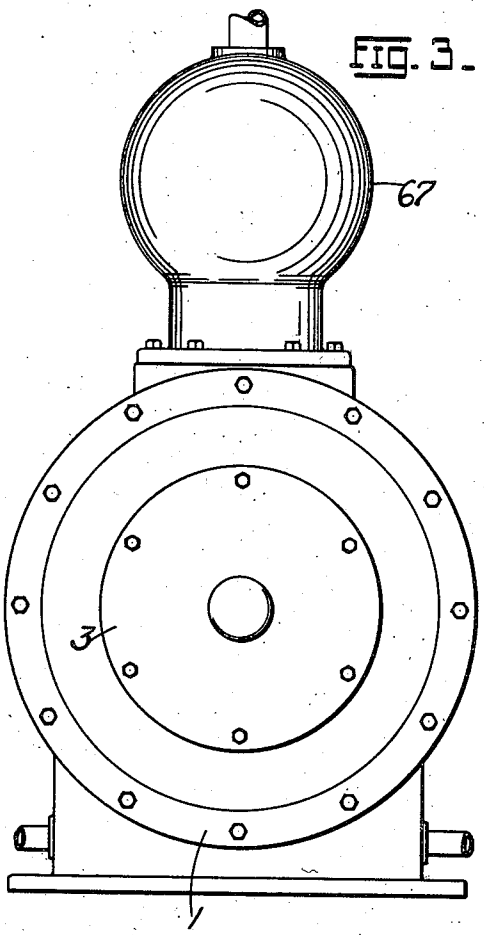
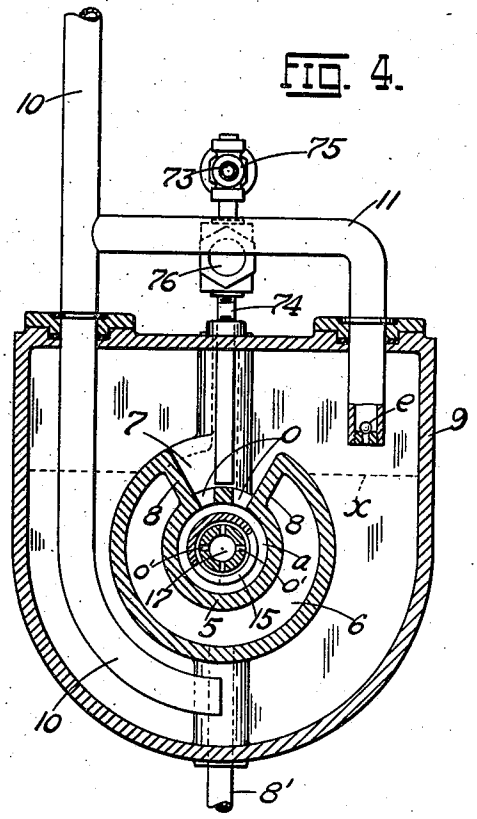


Fig. 4.



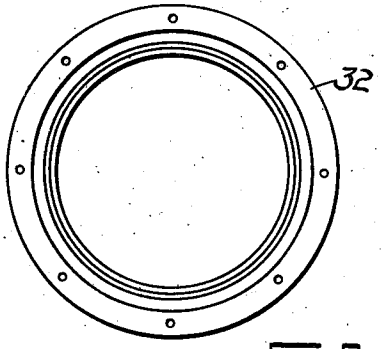


Fig. 9.

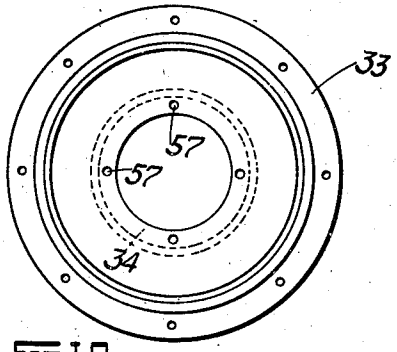


Fig. 10.

WITNESSES:
Harry A. Baines
Elsi M. Siegel

INVENTOR.
W. G. E. Rolaff.
BY Emil Starek
ATTORNEY.

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W. G. E. ROLAFF

AIR COMPRESSOR OR PUMP

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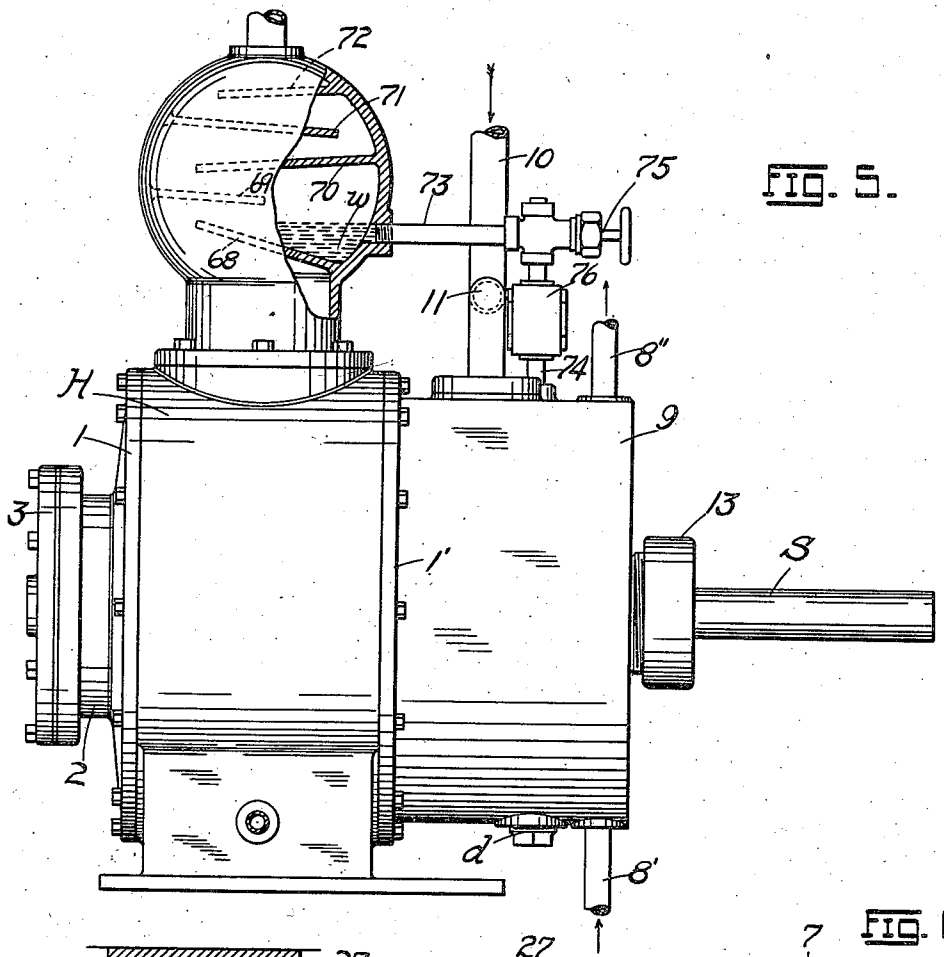


FIG. 5.

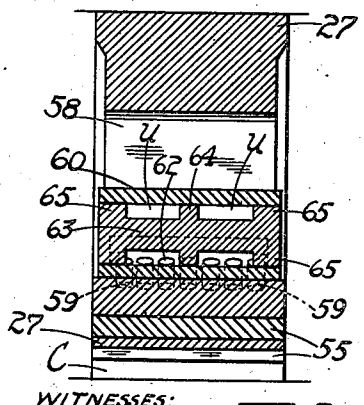


FIG. 6.

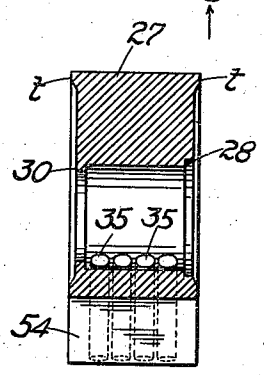


FIG. 7.

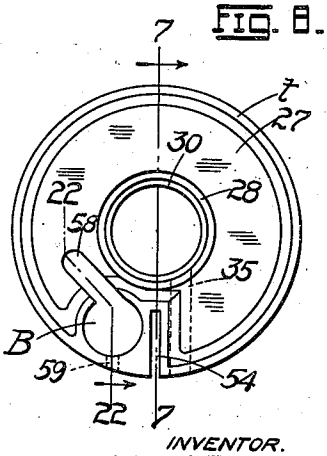


FIG. 8.

WITNESSES:

Harry A. Beinus

Elsie M. Seigel.

INVENTOR.

W. G. E. Rolaff.

BY Emil Starck

ATTORNEY.

April 26, 1927. 1,626,557

W. G. E. ROLAFF

AIR COMPRESSOR OR PUMP

Filed March 13, 1918 4 Sheets-Sheet 4

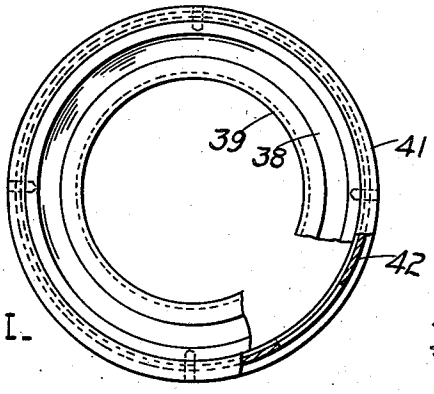


FIG. 11.

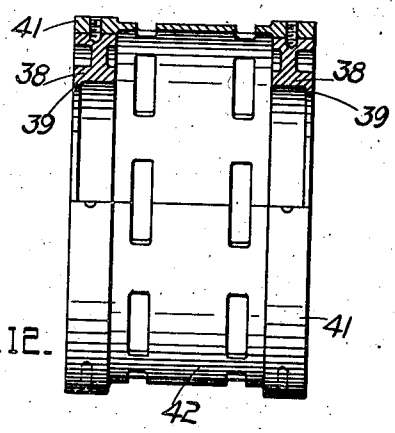


FIG. 12.

FIG. 18.

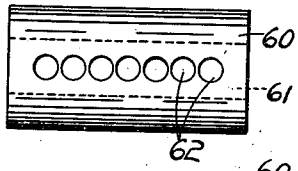
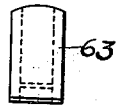


FIG. 13.



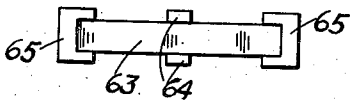


FIG. 16.

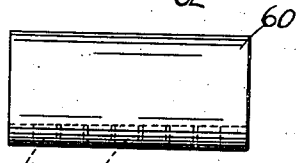


FIG. 14.

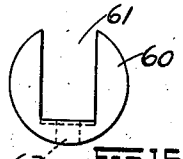


FIG. 15.

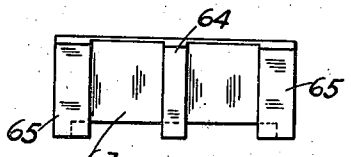


FIG. 17.

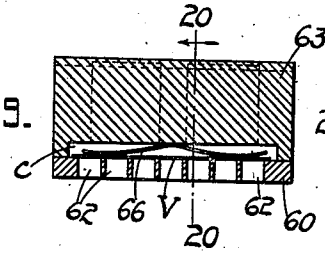


FIG. 19.

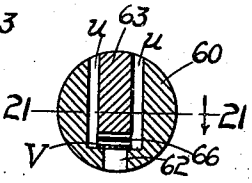


FIG. 20.

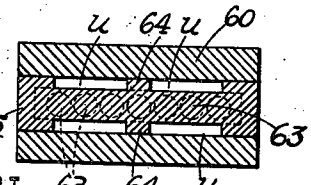


FIG. 21.

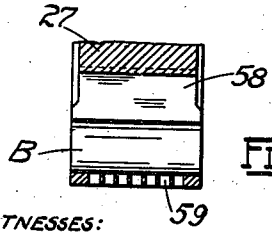


FIG. 22.

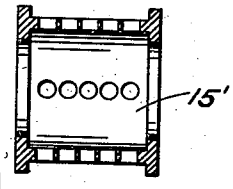


FIG. 23.

WITNESSES:

Harry Q. Baines

Else M. Siegel

INVENTOR.

W. G. E. Rolaff.

BY Emil Starck

ATTORNEY.

Patented Apr. 26, 1927. 1,626,557

UNITED STATES PATENT OFFICE.

WALTER G. E. ROLAFF, OF BELLEVILLE, ILLINOIS, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO ROTARY COMPRESSOR COMPANY, OF BELLEVILLE, ILLINOIS, A CORP. OF ILLINOIS.

AIR COMPRESSOR OR PUMP.

Application filed March 13, 1918. Serial No. 222,126.

The present invention is directed to improvements in air compressors or pumps, that is to say, apparatus for pumping and compressing atmospheric air, ammonia, and gases generally, the improvement being specifically concerned with the rotary type of compressor, or that in which a rotating piston or rotor operates in a cylinder, the compression of the air being effected by a radially reciprocating blade carried by the piston and sweeping the inner walls of the cylinder. The objects sought by the present invention are to provide a compressor of the character referred to which shall contain a minimum number of parts thereby reducing the number of joints; one in which the moving parts are so disposed as to reduce to a minimum the friction between them; one in which the wear on the parts shall be uniform and evenly distributed; one in which leakage is eliminated; one in which a thorough oiling or lubrication is assured for the moving parts; one in which the inflowing air (or gas) is scoured before passing into the cylinder; one in which the oiling system subserves the additional function of an automatic unloader or pressure equalizer, said system operating to discontinue the circulation of the oil as the apparatus is slowing down to effect the unloading, and resuming the oil circulation when the piston approaches its normal speed of rotation after the apparatus is again started; one in which suitable provision is made for regulating and maintaining in proper contact the engaging surfaces between the piston and cylinder whereby the latter may be driven by the former; one in which any possible back water finding its way into the gas or air supply pipe is absolutely prevented; one operating with a minimum expenditure of horse power; and one possessing further and other advantages better apparent from the following detailed description in connection with the accompanying drawings in which—

Certain features of this air compressor or pump are illustrated and described in applicant's co-pending application Serial No. 345,935, entitled "Rotary compressor," filed December 19, 1919, and are covered by claims in that application.

Figure 1 represents a vertical middle longitudinal section of the compressor on the line 1—1 of Figure 2; Figure 2 is a vertical transverse section taken on the line 2—2 of Figure 1; Figure 3 is an end elevation of the apparatus; Figure 4 is a vertical transverse section taken through the scrubber on the zig-zag line 4—4 of Figure 1; Figure 5 is a side elevation of the apparatus with parts broken away; Figure 6 is a longitudinal sectional detail through the rotary piston and discharge valve on the line 6—6 of Figure 2; Figure 7 is a middle longitudinal section through the rotary piston on the line 7—7 of Figure 8; Figure 8 is an end elevation of the rotary piston; Figure 9 is an end view of the cylinder shell; Figure 10 is an inside face view of the cylinder head applied to the shell; Figure 11 is an end view of the wedge ring and spacer ring coupled thereto, a part of the spacer ring being broken away; Figure 12 is a half side elevation and half middle longitudinal section of the wedge and spacer rings assembled; Figure 13 is a bottom plan of the housing of the discharge valve; Figure 14 is a side elevation thereof; Figure 15 is an end view thereof; Figure 16 is a bottom plan of the cage for the discharge valve; Figure 17 is a side view of the cage; Figure 18 is an end view thereof; Figure 19 is a middle longitudinal section of the valve housing and cage, and discharge valve assembled, the section being taken through the ports of the housing; Figure 20 is a cross-section on the line 20—20 of Figure 19; Figure 21 is a longitudinal section through the housing and cage on the line 21—21 of Figure 20; Figure 22 is a longitudinal sectional detail through the rotary piston on the zig-zag line 22—22 of Figure 8; and Figure 23 is a longitudinal middle section through the "lantern" which may be substituted for the coiled spring interposed between the packing sections on the drive-shaft on either side of the intake ports.

Referring to the drawings, H, represents a water-jacketed cylindrical shell provided with heads 1, 1′, which form therewith a suitable air chamber or housing, the head 1 being provided with a hollow cylindrical bearing 2 closed by a cover plate or side cap 3 secured in position by bolts 4. The bearing 2′ of the head 1′ is formed with a reduced tubular extension 5, said extension constituting the inner wall of a water jacket

6 the peripheral walls of which are in the form of a cylinder with a longitudinal section removed therefrom so as to leave a gap or space 7, the same being bounded by the diverging walls 8 connecting the tubular portion 5 with the peripheral walls of the jacket (Figure 4). The gap 7 is accordingly V-shaped in cross-section though I do not wish to be restricted to this specific form of water-jacket or cross-section of gap. The walls of the tubular portion 5 are provided with elongated air intake ports *o*, *o*, at the bottom of the gap 7 as shown. The water-jacket is supplied with water through a bottom tap opening 8′ and discharges through the upper tap opening 8″ as shown. The outer walls of the water-jacket constitute the inner walls of a scrubber or air washer 9 said scrubber forming preferably an integral extension of the head 1′ and being filled with water (or oil where ammonia gas is pumped) to the level *x* indicated in Figure 4, the air or other gas pumped by the compressor being delivered to the scrubber through a supply pipe 10 from any suitable source, the lower end of the pipe discharging at the bottom of the scrubber. The scrubber is provided with a drain plug *d* well understood in the art. The air is washed in its passage through the water in the scrubber, and as it emerges from the water it is drawn through the ports *o*, *o*, into the tubular member 5 as presently to be described. Preferably, the pipe 10 is provided with a shunt or by-pass 11 whose intake end terminates in the scrubber chamber above the water and is provided with any suitable form of check-valve *e* which in the event of back pressure (when the machine is unloaded) will unseat and allow the gases to escape into the supply pipe 10, instead of driving the water up into said pipe. The tubular member 5 projects beyond the end wall of the scrubber and is closed by a gland or follower 12 held in place by a screw cap 13 passed over said projecting portion. Traversing the tubular member 5 is the outer reduced portion of the drive-shaft S to which rotation is imparted from any suitable source of power (not shown) well understood in the art. Surrounding the drive-shaft on opposite sides of the intake ports *o*, *o*, of the tubular member 5, are series of packing rings or gaskets 14, 14′, respectively, which are maintained apart preferably by an expansion spring 15 coiled about the shaft opposite the ports, the series 14 being held firmly against the gland 12 which acts as an abutment for the packing, and the series 14′ being held firmly against the wall of the bearing 2′ closing the inner end of the tubular member 5. The reduced portion of the shaft S is thus supported by the tubular member or bearing 5, leakage being prevented by the packing rings 14, 14′. I do not wish to be restricted however, to packing rings, as any suitable form of packing material might be used. The shaft S is in the main hollow, being provided with an inner passage-way or chamber 17 which communicates with the annular space *a* formed around the shaft in the tubular stuffing box or bearing 5, through peripheral ports *o*′, the said ports being preferably opposite the intake ports or slots *o* formed in the tubular member 5. Therefore any air or ammonia gas that escapes past the packing rings 14′ into the space *a* will be drawn back into the compressor, and leakage will be prevented. The enlarged inner portion of the drive-shaft S is supported by the bearings 2, 2′, of the casing heads, the free end of such enlarged portion being offset by a shoulder 18 from the adjacent somewhat larger portion and having passed thereover a ring 19 bearing against said shoulder, a nut 20 passed over the threaded terminal of said free end holding said ring against the shoulder. The end of the ring adjacent the shoulder 18 is provided with a flange 21 between which and the portions of the nut 20 projecting beyond the ring 19 is confined the inner bushing ring 22, an outer bushing ring 23 being disposed along the inner surface of the bearing 2 between the flange 24 of the head 1 and an annular rib or ring 25 on the inside of the bearing, the members 22 and 23 having their opposing faces dished to form a suitable race-way for the ball bearings 26 as shown. In the same manner a similar flanged ring 19′ bearing against a shoulder 18′ is held in position on the shaft by a nut 20′ which confines between it and the flange 21′ of said ring, an inner bushing 22′ cooperating with an outer bushing 23′ the two bushings forming raceways for the ball bearings 26′. By the arrangement described the drive shaft is thus supported at two points on ball bearings operating in raceways within the bearings 2, 2′, of the casing heads 1, 1′, respectively.

The drive-shaft is enlarged to its maximum cross-sectional dimension at a point intermediate the slightly smaller portions supported in the bearings 2, 2′, the inner end of the longitudinal passage-way 17 terminating opposite said portion of maximum cross-section, an elongated radial port or slot 17′ leading from said inner terminal of said passage-way and opening along the periphery of the shaft. Mounted on and keyed, or otherwise secured to the shaft at the portion having the maximum cross-section is the piston or rotor 27, the same being provided with a shoulder 28 engaging a collar 29 on the shaft, and with a flange 30 engaging a shoulder 31 on the shaft, thereby arresting the piston at the proper point when once slipped over the shaft in the act of assembling the parts. The rotary piston operates in a cylinder comprising a cylindrical shell

32 surrounding the piston, and terminal heads 33 bolted to the shell and arched or bowed outwardly therefrom, said heads being provided with hollow trunnions 34 traversed by, and spaced from the shaft S. The rotation axis of the cylinder is eccentric to the common rotation axis of the shaft S and its piston, a portion of the inner surface of the cylinder shell engaging a corresponding portion of the periphery of the piston whereby there is formed between the shell and piston a compressing chamber C substantially crescent shaped in cross-section between which and the passage-way 17 of the shaft communication is established through the longitudinally extended port 17′ and a series of radial ports or passages 35 formed in the piston or rotor and in permanent register with said radial port. The cylinder is rotatably supported on adjustable members which may be adjusted to maintain the engagement of the piston with the shell. These adjustable members are preferably in the form of eccentric rings adjustably supported on the casing, and these rings support the cylinder rotatably on an axis eccentric to the axis of rotation of the piston. For this purpose, carried by the trunnions 34 of the cylinder heads are the inner race-way rings or bushings 36, the same being secured in position by nuts or screw rings 37, said bushings cooperating with the outer race-way rings 36′ carried by the spacer rings 38 formed with flanges 39 for holding the said race-way rings in position. The race-ways of the rings 36, 36′, are provided with ball bearings 40 on which the cylinder is free to revolve. Interposed between the spacer rings 38 and the shell H of the outer casing or housing is a wedge ring, the same comprising terminal, eccentric ring formations 41, 41, connected by an open peripheral portion or shell 42 to allow the air to freely circulate through the chamber of the housing, the purpose of said wedge ring being to so control the spacer rings as to cause the latter to exert the desired pressure on the trunnions of the cylinder heads to maintain the necessary driving contact between the engaging surfaces of the piston and the shell of the cylinder propelled thereby. The wedge ring being an eccentric ring it is apparent that a slight turn thereof and of the spacer rings (to which it is secured in any mechanical manner) will exert pressure on the trunnions of the cylinder and thereby force the shell of the cylinder into firm engagement with the periphery of the piston. The wedge ring and spacer rings coupled thereto are controlled by an expansion spring 43 one end of which is secured to the periphery of the wedge ring between the terminal rings 41 thereof, the opposite end of the spring being secured to a nut 44 traversed by a screw-stem 45 operating through a bearing 46 on the shell H of the housing, said stem being provided with a collar 47 resting on the bottom of a pocket 48 of the bearing, the said pocket being provided with a packing 49 and closed by a gland 50 which is held in place by a screw-cap 51 through which the operating end of the stem projects. The nut 44 is prevented from rotating by being confined between the angle plates or equivalent guide pieces 52 secured to the wedge ring. By applying to the outer polygonal end of the stem a suitable wrench and giving the stem a turn or two in proper direction, the nut will be caused to move outwardly and pull on the spring 43 causing the latter to impart the necessary rotary movement to the wedge ring to accomplish the result desired. The spring 43 is essential as the same is free to yield thereby preventing excessive action of the wedge ring on the spacer rings and thus avoiding excessive pressure of the cylinder shell against the rotary piston.

It was stated above that the cylinder heads 33 bowed away from the shell 32. There is thus left a space between the shell and piston and said heads. In this space I provide means interposed between the heads and the ends of the piston and shell operating under a differential fluid pressure that holds this means against the piston and shell and forms an air-tight joint. This means may be in the form of floating heads, plates, or disks 53 which are of sufficient diameter to close the ends of the compressing chamber C, the plates being provided with central openings O sufficient in diameter to leave a space around the drive-shaft S, but reduced sufficiently to maintain the openings well within the inner boundary of the compressing chamber. In other words (Figure 1) no air can escape from the compressing chamber directly through the openings O of the floating heads but only by way of the discharge valve to be presently described. Forward of the radial piston ports 35 the piston is provided with a substantially radial recess or groove 54 in which is free to reciprocate across the compressing chamber C a suitable blade 55, the depth of the recess being sufficient to allow the outer edge of the blade to come flush with the periphery of the piston. In its reciprocations the blade naturally rubs with its sides (or ends, if we regard the length of the blade to be the dimension along the axis of the piston) against the inner faces of the floating heads 53. Since the cylinder is propelled by the piston by frictional contact and without slipping, it follows that the circumferential velocities of the piston and cylinder along their surfaces or points of contact will be the same; but since the piston is of smaller diameter than the cylinder, the angular velocity of

the piston will be greater than that of the cylinder, and the piston will necessarily make the greater number of revolutions in a given unit of time. It will be seen (Figure 1) that the contacts between the inner faces of the heads 53 and the cylinder shell 32 and piston 27 respectively are at different radial distances from the rotation axis of the piston (the cylinder having a rotation axis of its own); and since the heads can not accommodate themselves to conform to the rotation of two bodies (27, 32,) having different angular velocities, it follows that there will be a constant slipping between the heads and said bodies (27, 32,) causing said heads to creep in a rotary direction so that at no time will the same portions of the inner faces of the floating heads be presented to the sides of the reciprocating blade. By the present arrangement therefore the blade can no longer wear a groove in the head as would be the case were the head rigidly secured to the cylinder shell, as in that event the blade would rub against the same portions of the surface of the head and soon wear a radial groove therein, causing leakage. It is to obviate the formation of the grooves in the heads that the heads closing the ends of the compressing chamber are made floating. It will be observed that the outer faces of the floating heads have a larger area exposed to the gases than the inner faces, whereby the said heads are held against the piston and cylinder shell by the differential between these pressures, notwithstanding the fact that the pressures per unit of surface on the opposite faces of the heads are substantially the same. Ordinarily this differential of air pressure together with the capillary attraction of the lubricating oil film between the contacting surfaces will suffice to hold the floating heads tightly against the piston and cylinder shell; but as an additional precaution I prefer to supplement this action by suitable expansion springs 56 (four is usually sufficient) interposed between the floating heads 53 and the fixed heads 33, the ends of the springs bearing against the fixed heads being preferably received in suitable pockets or depressions 57 in said heads (Figure 10). The spaces between the floating heads 53 operate as receiving chambers for the compressed fluid that exerts its pressure on the outer faces of the floating heads. It may be stated in passing that the sides of the piston 27 are formed with marginal offsets *t* adjacent the periphery whereby the heads 53 are permanently spaced from the main body of the piston, said space (marked *m* in Figure 1) initially receiving the air discharged from the compressing chamber C.

Drilled in the piston in advance of the recess 54 and parallel to the piston axis, is a cylindrical opening B from which leads inwardly and in a direction away from and at an angle to the said recess, a leg or extension 58, said leg forming a port or passageway passing entirely the width of the piston and discharging into the spaces *m* between the floating heads 53 and the piston. Leading from the opening B at a point substantially diametrically opposite the leg 58 are a series of intake ports 59, said ports establishing communication between the compressing chamber and the said opening B.

Mounted in the opening B is the discharge valve which, in the present embodiment of my invention is constructed substantially as follows: It consists of an outer housing 60 which is in the form of a cylindrical body with a longitudinal channel or recess 61 substantially oblong in cross-section and open at both ends, the bottom of the channel being slightly inclined or pitched to the axis of the cylinder so as to exert a wedge effect. Leading from the bottom of the channel are a series of ports 62 registering with the air intake ports 59 of the piston. The channel 61 receives the valve cage, the same comprising a block 63 with middle side ribs 64 and combined terminal and side ribs 65, said ribs projecting at the bottom beyond the block and forming feet therefor, the supporting faces of the feet being disposed in a plane pitched to conform to the pitch of the inclined bottom of the channel 61 so that the two members when assembled will operate as wedges when one is moved longitudinally over the other. The face of the block 63 and the ends of the ribs 64, 65, opposite the flat ends conform to the cylindrical curvature of the periphery of the housing 60 so that upon assembling of the parts their combined cross-section will be a cylindrical body adapted for insertion into the opening B of the piston. The extension of the ribs 64, 65, beyond the bottom of the block 63 to form supporting feet therefor leaves the bottom of the block raised above the bottom of the channel of the valve housing thereby forming a chamber *c* in which is inserted a longitudinally extended metal strip or valve V the same being of proper dimensions to cover the ports 62 over which it is deposited. Interposed between the valve V and the roof of the chamber *c* and bowed to engage the said roof (or bottom of the block 63) is a flexed spring 66, the ends of the spring bearing against the corresponding ends of the valve V. Both the valve and the retaining spring 66 are confined in the chamber *c* by the feet terminals of the ribs 64, 65, the spring being a comparatively weak one and employed as a mere precautionary measure to maintain the valve over the ports 62. The widths of the valve V and spring 66

correspond substantially to the width of the block 63. The presence of the ribs 64, 65, results in the formation of passages or ports *u* between the block 63, the side walls of the channel 61, and the ribs, the intake ends of these channels communicating with the chamber *c* (which is in communication with the ports 62), and the discharge ends communicating with the leg 58 provided of course that the assembled parts are properly inserted into the opening B. When properly inserted, the ports 62 will be in register with the ports 59, and the passages *u* with the leg 58, so that communication is established between the compressing chamber C and the chamber of the outer housing. When the assembled sections of the discharge valve are inserted into the opening B they may be tightly wedged therein by driving one member up the inclined face of the opposite member as clearly obvious from the drawing From the foregoing it will be obvious that the bowed spring 66 permits the passage of air past the valve V from the compressing chamber to the pump housing, the valve which is unseated in such air passage instantly seating with any back pressure from the housing.

In the present embodiment of my invention the outlet E from the outer casing or housing discharges into a suitable oil separator 67 equipped with baffles 68. 69, 70, 71, 72, the air or gas separated from the oil or lubricant discharging through the opening A, and by means of suitable pipes (not shown) leading from said opening being conducted to any storage or compressed air tank (not shown) or to any suitable point of consumption. Leading from a point above the bottom baffle 68 is a shunt or by-pass comprising a horizontal pipe or leg 73 and a vertical leg 74, the latter passing through the roof of the scrubber and discharging between the inclined walls 8 of the gap 7 directly over the air intake ports *o*, *o*. The horizontal leg 73 is provided with a needle or equivalent regulating valve 75, and the vertical leg with a transparent sight section 76 for observing the action in the shunt. It will be seen that the bottom baffle 68 inclines downward toward the inner end of the pipe 73 forming with the wall of the separator a basin *w* for collecting the lubricating oil intercepted by and which runs down from the upper baffles, the pressure of the air in the separator automatically forcing the oil accumulated in said basin, through the shunt or by-pass (73, 74,) whence it is discharged into the gap 7 and returned to the shaft S and other operating parts of the compressor, the oil being thus circulated without material loss and without special attention on the part of the engineer. As the compressor comes to a stop or slows down preparatory to stopping, the oil in the basin *w* has virtually been expelled from the basin and from the shunt pipes 73, 74, leaving the shunt open for free communication between the separator chamber (and chamber of the housing) and the chamber of the scrubber where ordinary atmospheric pressure prevails, this intercommunication serving to automatically equalize the pressures between the two chambers, or in other words to unload the machine. Thus the oil separator and oil circulating shunt serve automatically in the capacity of an unloader or equalizer when the machine or compressor is coming or comes to a stop, to again operate as an oil separator and circulator when the machine attains the required speed and sufficient pressure has been accumulated in the housing and oil separator chamber. It is of course well understood in the art that the machine should be unloaded before it is started up so as to facilitate the starting operation and keep down the resistance as much as possible until the machine has attained the necessary speed and momentum to overcome it.

The operation of the machine may be briefly described as follows: Rotation being imparted to the shaft S in proper direction (that is to say, in a direction to cause the piston blade to follow the discharge valve as indicated by the arrow in Figure 2), the air (or other gas) delivered to the scrubber 9 through the pipe 10 will be drawn through the ports *o*, *o*, into the annular space *a* around the shaft S, thence through the ports *o'* into the passage-way 17 of said shaft. From the passage-way 17 the air or gases flow through the port 17' and passages 35 into the compressing chamber C behind the blade 55 (where a vacuum is constantly forming). The piston 27 being in driving engagement with the shell 32 of the cylinder, imparts rotation to the latter in the same direction with itself (or the shaft S) the blade 55 by reason of centrifugal action being maintained in permanent engagement with the inner surface of the cylinder shell, and being caused to reciprocate across the compressing chamber by reason of the eccentricity between said shell and piston as clearly obvious from the drawings. As the blade revolves it expels the air or gases delivered to the compressing chamber (the gases flowing into the chamber behind the blade being brought in front of the blade after the latter has passed the line of contact of the piston periphery with the inner walls of the cylinder), this expulsion taking place through the valve-controlled ports 59, 62, the valve chamber *c*, passages or ports *u*, passage 58, spaces *m*, openings O of the floating heads 53, and hollow trunnions 34, the gases finding their way from the trunnions 34 into the outer casing or

housing, whence they are free to flow through the oil separator, passing thence to any suitable storage tank or reservoir (not shown) or other point of consumption. The accumulated pressure of the gases in the oil separator forces the oil which settles in the basin *w* to circulate by way of the shunt or by-pass 73, 74, as already described.

It was stated above that the spring 43 is free to yield to prevent excessive action or pressure of the wedge ring upon the cylinder. In practice the spring operates as an equalizer or unloader, it being found that when the gas pressure in the outer casing (and hence in the compressing chamber in front of the blade 55) becomes too great or in excess of the tension of the spring, there is imparted to the cylinder and to the spacing ring and wedge ring a rotation in a direction opposite to the rotation of the piston, thereby separating the contacting surfaces between the piston and cylinder and reducing the rate of gas expulsion and hence reducing the pressure. The probable explanation of this action is that the excess pressure referred to acting on the walls of the cylinder, is communicated to the wedge ring, which, not being free to yield in the direction of the radial component of the pressure must, if it yield at all, yield in the direction of the tangential component of said pressure, and rotate in a direction opposite to that in which the spring tends to rotate the ring. Of course these disengagements and reverse rotations are spasmodic and of short duration but still they occur in actual practice. The spring 43 thus serves as an equalizer or pressure regulator in addition to its primary function as a means of causing the wedge ring and spacing rings (which operate as a unit) to maintain a driving contact between the cylinder and piston.

During the operation of the compressor, if the pressure within the cylinder should rise suddenly to a dangerous point, as might occur for example, from the sudden vaporizing of ammonia liquor in the cylinder, the floating heads 53 will fly outward, thereby opening the ends of the cylinder; they, therefore, operate as relief heads.

In lieu of employing the spring 15 to keep the packings 14, 14', separated as shown in Figure 1, I may use a perforated cylindrical sleeve or "lantern" 15' as shown in the modification in Figure 23.

It will be evident that when the compressor is starting up, the compressed fluid or air will flow freely through the by-pass and be returned thereby so as to pass again through the compressor. This prevents the full pressure load from coming onto the compressor immediately. According to my invention, it will be noted, I provide means for choking this by-pass, the effect of which is to bring the pressure load gradually onto the compressor. This result is brought about very effectively by circulating the lubricating oil through the by-pass as described above.

Having described my invention what I claim is:

1. In a compressor of the character described, a rotary piston, a rotary cylinder therefor mounted eccentrically thereto and having a portion of its inner wall engaging a portion of the peripheral wall of the piston, the remaining portions of said walls being spaced apart to form a compressing chamber between them, suitable members carried by the cylinder at opposite ends thereof, and means interposed between said members and the adjacent ends of the cylinder and piston and operating under a differential of gas pressure for closing the ends of the compressing chamber and effecting gas tight joints with the ends of the piston and cylinder respectively.

2. In a compressor of the character described, a rotatable cylinder comprising a cylindrical shell and heads attached to the shell, a rotatable piston mounted eccentrically in the cylinder and engaging the inner side of the shell whereby the rotation of the piston rotates the cylinder, said piston and cylinder co-operating to form a compressing chamber, and means interposed between said heads and the adjacent ends of the shell and piston, operating under a differential of pressure for closing the ends of the compressing chamber, and forming fluid-tight joints with the ends of the piston and shell, respectively.

3. In a compressor of the character described, a casing, a rotatable cylinder mounted in said casing comprising a cylindrical shell and heads attached to the shell, a rotatable piston, mounted eccentrically in the cylinder and engaging the inner side of the shell whereby the rotation of the piston rotates the cylinder, said cylinder and piston co-operating to form a compressing chamber, said casing having receiving chambers adjacent said heads commuicating with the compressing chamber and receiving the compressed fluid from the compressing chamber, and means interposed between said heads and the adjacent ends of the shell and piston and pressed against the ends of the shell and the ends of the piston by the pressure of the fluid in the receiving chambers.

4. In a compressor of the character described, a rotary piston, a cylinder therefor mounted rotatably and eccentrically thereto and having a portion of its inner wall engaging a portion of the peripheral wall of the piston, the remaining portions of said walls being spaced apart to form a compressing chamber between them, heads car-

ried by the cylinder and spaced from the adjacent ends of the compressing chamber, plates having opposite faces exposed to different gas pressures, engaging the opposite ends of the piston and cylinder for closing the ends of the compressing chamber, and expansion springs interposed between the plates and heads for maintaining the plates in firm contact with the ends of said piston and cylinder and make a gas tight joint therewith.

5. In a compressor of the character described, a rotary piston, a cylinder therefor mounted rotatably and eccentrically thereto and having a portion of its inner wall engaging a portion of the peripheral wall of the piston, the remaining portions of said walls being spaced apart to form a compressing chamber between them, members carried by the cylinder at opposite ends thereof, and plates operating under a differential of gas pressure interposed between said members and adjacent ends of the piston and cylinder for closing the ends of the compressing chamber, said plates being free to adjust themselves rotatively to the rotary movements of the piston and cylinder, the inner faces of the plates having a free play over the ends of the piston and cylinder engaging said faces.

6. In a compressor of the character described, a rotary piston, a cylinder therefor mounted rotatably and eccentrically thereto and having a portion of its inner wall engaging a portion of the peripheral wall of the piston, the remaining portions of said walls being spaced apart to form a compressing chamber between them, members carried by the cylinder at opposite ends thereof, plates operating under a differential of gas pressure interposed between said members and adjacent ends of the piston and cylinder for closing the ends of the compressing chamber, said plates being free to adjust themselves rotatively to the rotary movements of the piston and cylinder in response to the different angular velocities of said members at the points they respectively engage said plates, an outlet port in the piston leading from the periphery thereof to a point opposite one of the plates and interior to the compressing chamber, the last mentioned plate having an opening in communication with the discharge end of the port aforesaid to permit the compressed air to be discharged from the cylinder.

7. In a compressor of the character described, a rotary piston and cylinder forming between them a compressing chamber open at the ends, and floating plates operating under a differential of gas pressure engaging the piston and cylinder for closing the ends of the compressing chamber, said plates adjusting themselves rotatively to the movements of the piston and cylinder in response to the different angular velocities of said members at the points of their respective engagement with said plates.

8. In a compressor of the character described, a rotary piston, a cylinder therefor mounted rotatably and eccentrically thereto and actuated thereby, a rotary wedge ring cooperating with the cylinder to maintain the proper contact between the cylinder and piston, an expansion spring having one end secured to the wedge ring periphery, a nut secured to the opposite end of the spring, means for preventing rotation of the nut, an adjusting stem operating through the nut for exerting tension on the spring, and a fixed support for said stem.

9. In a compressor of the character described, a casing, a rotary compressor mounted therein, air or gas intake and discharge means, a liquid container or scrubber coupled to the casing, a source of air or gas supply, means for causing the air or gas to pass through the liquid in the container prior to its passage into the compressor, a drive shaft for the compressor, a bearing for the shaft in the scrubber, and additional bearings for the shaft in the casing.

10. In a compressor of the character described, a suitable casing, a rotary compressor mounted therein, air or gas intake and discharge means, a scrubber forming an extension of the casing, a tubular bearing on the scrubber, a drive-shaft for the compressor passing through the tubular bearing aforesaid, packings disposed about the shaft in said tubular bearing and spaced apart, and an expansion spring surrounding the shaft interposed between the two packings.

11. In a compressor, a liquid container or scrubber, a drive-shaft having a passage-way traversing the scrubber, ports leading from said passage-way into the scrubber, means surrounding the ports for preventing the influx of the liquid into the ports, an air or gas suply pipe discharging beneath the liquid in the scrubber, and a valve-controlled by-pass leading from the scrubber above the liquid therein to the supply pipe, for the purpose set forth.

12. In a compressor of the character described, a rotary piston and cylinder therefor, a casing in which the piston and cylinder are mounted, said casing forming a compressed air chamber, an oil separator disposed in the path of discharge of the gases from said chamber, and a valve-controlled by-pass leading from the separator and discharging against a moving element in a region of different pressure from that obtained in the casing, the by-pass operating as a pressure equalizer when drained of its oil contents.

13. In a compressor, a casing forming a chamber into which the gases are initially

discharged, a moving member for driving the gases into said chamber, an oil separator in the path of the gases discharged from said chamber, and a valve-controlled by-pass leading from the separator and discharging in a region of lower pressure than the pressure in the chamber of the casing, the by-pass operating as a pressure equalizer when drained of its oil contents by establishing open communication between the casing and the region aforesaid.

14. In a compressor, a casing for receiving the gases discharged from the compressor cylinder, an oil separator in the path of discharge from said casing, a gas scrubbing chamber independent of the casing, and a by-pass leading from the separator to the scrubber chamber for circulating the oil from the separator to the compressor, said by-pass operating as an unloader or equalizer when drained of its oil content.

15. In a compressor, an outer casing or housing, a pump delivering gases thereto, an oil separator chamber in communication with the casing, oil circulating pipes conducting the oil from the separator chamber to the pump mechanism at a point in a region of comparatively lower pressure than the pressure in the separator chamber, the said oil pipes serving to establish free communication between the separator and region of oil discharge upon stopping of the machine, whereby the compressor is automatically unloaded.

16. In a compressor, an outer casing or housing, a pump delivering gases thereto, an oil-controlled unloader between the casing and a region of comparative lower pressure in which the pump operates, said unloader operating to circulate the oil from the casing to the pump at a given point in said region of lower pressure, the circulation of the oil automatically discontinuing upon stoppage of the machine and allowing the gases to freely circulate between the casing and region of low pressure, whereby the machine is automatically unloaded.

17. In a compressor of the character described, a rotary piston, a cylinder therefor mounted rotatably and eccentrically thereto and having a portion of its inner wall engaging a portion of the peripheral wall of the piston, the remaining portions of said walls being spaced apart to form a compressing chamber between them, heads carried by the cylinder and spaced from the adjacent ends of the compressing chamber, and suitable floating members interposed between said heads and piston and cylinder respectively, and engaging the ends of said piston and cylinder, whereby gas-tight joints are made therewith and a rotary creeping movement is imparted to the members for the purpose set forth.

18. In a compressor of the character described, a rotary cylinder, a rotary piston mounted in the same and eccentrically thereto, said piston having a portion of its peripheral wall engaging a portion of the inner wall of the cylinder, the remaining portions of said walls being spaced apart to form a compressing chamber between them, and suitable floating members engaging the ends of the piston and cylinder for closing the ends of the compressing chamber, said members having a rotary creeping movement imparted thereto, for the purpose set forth.

19. In apparatus of the class described, the combination of a fluid compressor, a by-pass for leading the compressed fluid back through the compressor to prevent placing the full pressure load on the compressor in starting up, and means for circulating a lubricating fluid through the compressor and through the by-pass to choke the by-pass when the compressor is operating at normal speed and thereby place the full pressure load on the compressor when it has substantially attained its normal speed, said by-pass operating to become open to the compressed fluid when the speed of the compressor is substantially reduced, thereby preventing further delivery of the compressed fluid.

20. In apparatus of the class described, a rotary compressor including a casing having means for catching a lubricating oil thrown off from said compressor, a by-pass leading from said casing and permitting the fluid and oil when starting up the compressor to pass through it and thereby prevent immediate development of high pressure within the casing, and means associated with said by-pass for gradually choking the by-pass and thereby operating gradually to increase the pressure load on the compressor.

21. In apparatus of the class described, the combination of a rotary fluid compressor, a casing therefor having an intake port, and having means for catching lubricating oil passing within the casing, a by-pass for conducting the oil back to the intake port of the compressor, whereby the oil circulates through the compressor with the fluid being compressed and back to the catching means, said by-pass operating when the compressor starts up to permit circulation of the fluid compressed by the compressor, the accumulation of oil in said catching means operating to choke the by-pass gradually and thereby enable pressure to be gradually developed in the casing.

22. In compressing apparatus, the combination of a casing having an intake port for the fluid to be compressed, a rotary compressor having bearings in said casing, means for circulating lubricating oil through said bearings and through the interior of

the compressor, a basin in which the lubricating oil may accumulate, a by-pass leading from the basin to the intake port whereby both the compressed fluid and the lubricating oil circulate through said compressor when starting up, said basin being constructed so as to accumulate the oil to a level which chokes the by-pass with the oil, excludes the fluid from the by-pass, and thereby enables pressure to be developed in said casing as the rotary compressor attains substantially its normal speed.

23. In a fluid compressing apparatus, the combination of a rotary compressor, a casing surrounding the same and having a stuffing box for said compressor with an intake port in the stuffing box for the fluid to be compressed, means for delivering a lubricating oil to said intake port to effect circulation of the oil through the compressor and through the stuffing box, a basin within the casing for catching the oil, and means for returning the oil from the basin to said intake port.

24. In a fluid compressing apparatus, the combination of a rotary compressor, a casing containing the same and having an intake port for the fluid to be compressed, means for delivering lubricating oil to the intake port whereby the lubricating oil passes into the compressor, a basin within the casing in which the oil accumulates, and a by-pass pipe for the fluid and oil leading from said basin back to the said intake port, whereby, when the compressor starts up, the compressed fluid circulates through said by-pass until the oil accumulates in the basin sufficiently to choke the by-pass when the compressor attains normal speed, the accumulation of oil in the by-pass operating to exclude the compressed fluid and thereby enable pressure to be developed in said casing, the inlet to said by-pass pipe from said basin being substantially on a level with the overflow edge of said basin, whereby the compressed fluid resumes circulation through the by-pass pipe when the compressor reduces its speed, and thereby unloads the compressor.

25. In a fluid compressing apparatus, the combination of a rotary compressor, a casing surrounding the same, a stuffing box for the said compressor, having an intake port therein for the fluid to be compressed, means for delivering a lubricating oil to said intake port to effect circulation of the oil through the compressor and through the stuffing box, and means for returning the oil from the casing to said intake port.

26. In a fluid compressing apparatus, the combination of a cylinder-shell, a rotary drum eccentrically mounted in the shell and co-operating therewith to form a compression chamber, relief heads disposed against the ends of the drum and shell, and constituting the end walls of the compression chamber, and means for admitting the fluid pressure to the outer sides of the relief heads to hold the same against the ends of the cylinder and drum.

27. In a rotary compressor, the combination of a casing, compressor parts mounted to rotate within said casing and adapted to throw the oil by centrifugal force against the wall of the casing, a cup projecting from the wall of the casing to catch the oil moving by centrifugal force along the surface of the wall of the casing, and means for returning the oil to lubricate the rotating parts.

28. In a rotary air compressor a rotating compression cylinder, a rotor having a chamber in each end eccentrically mounted in said rotating cylinder, automatic means for adjusting said compression cylinder towards the rotor and at right angles to the axis of rotation of said rotor, movable heads for said cylinder, and elastic means for holding said heads in fluid tight contact with the ends of the rotor and the cylinder.

In testimony whereof I affix my signature.

WALTER G. E. ROLAFF.