May 24, 1932. P. O. ECKELS 1,860,278

PUMP OR COMPRESSOR

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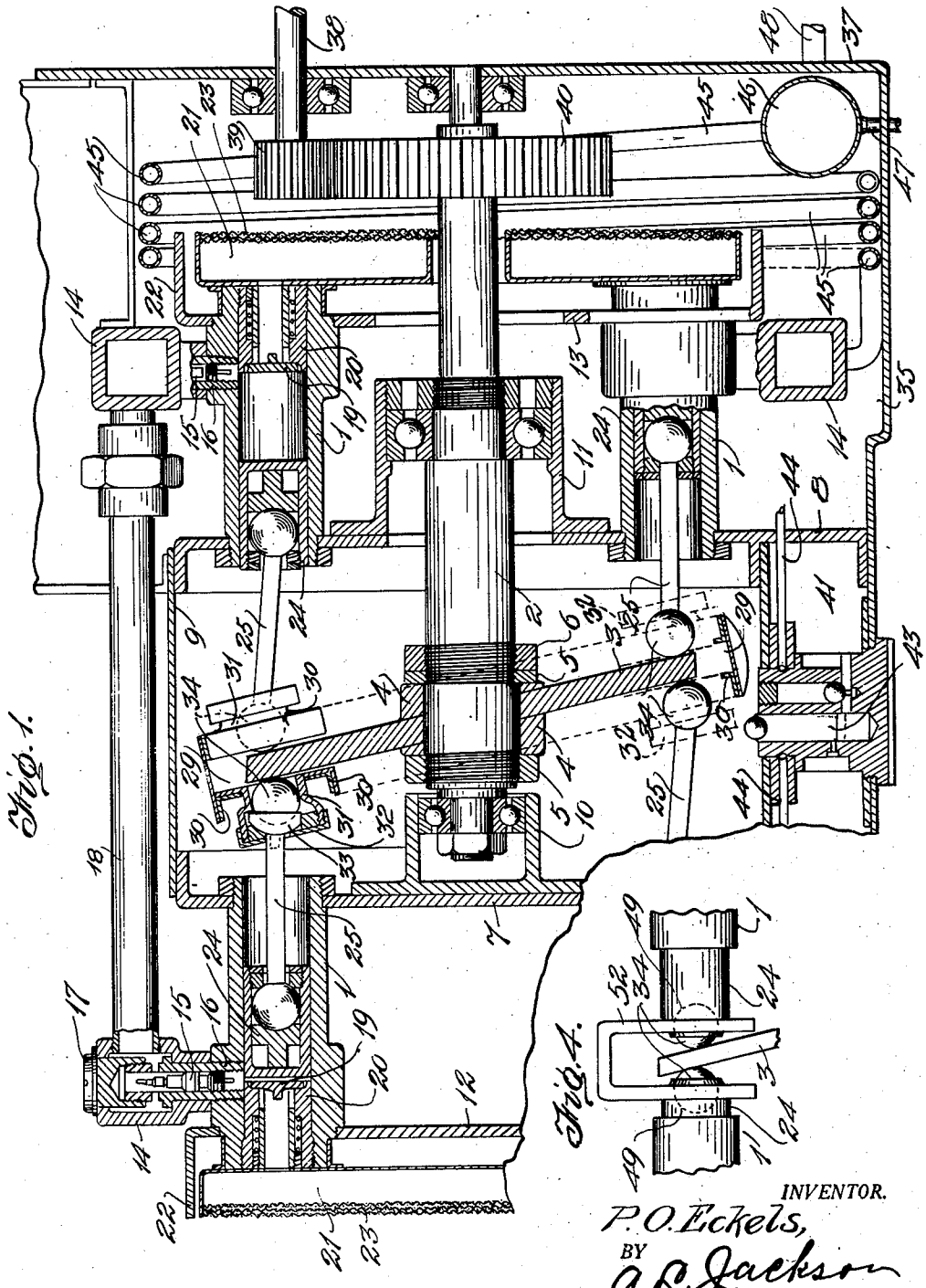


Fig. 1.

Fig. 4.

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Fig. 3.

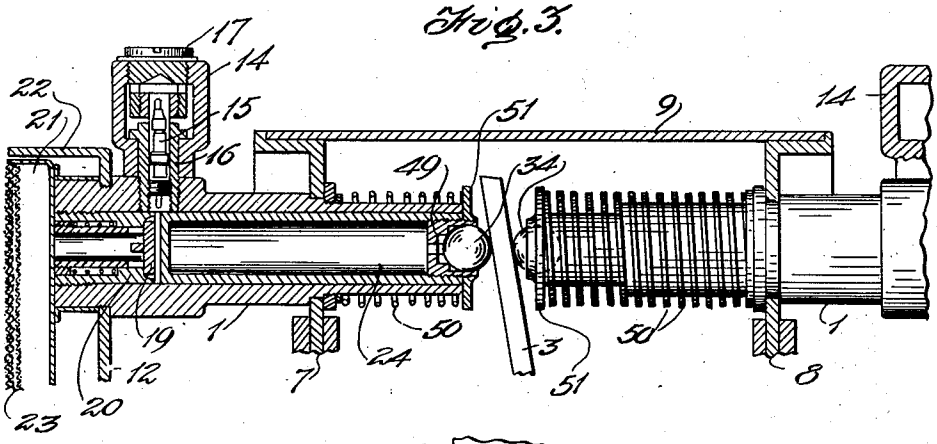
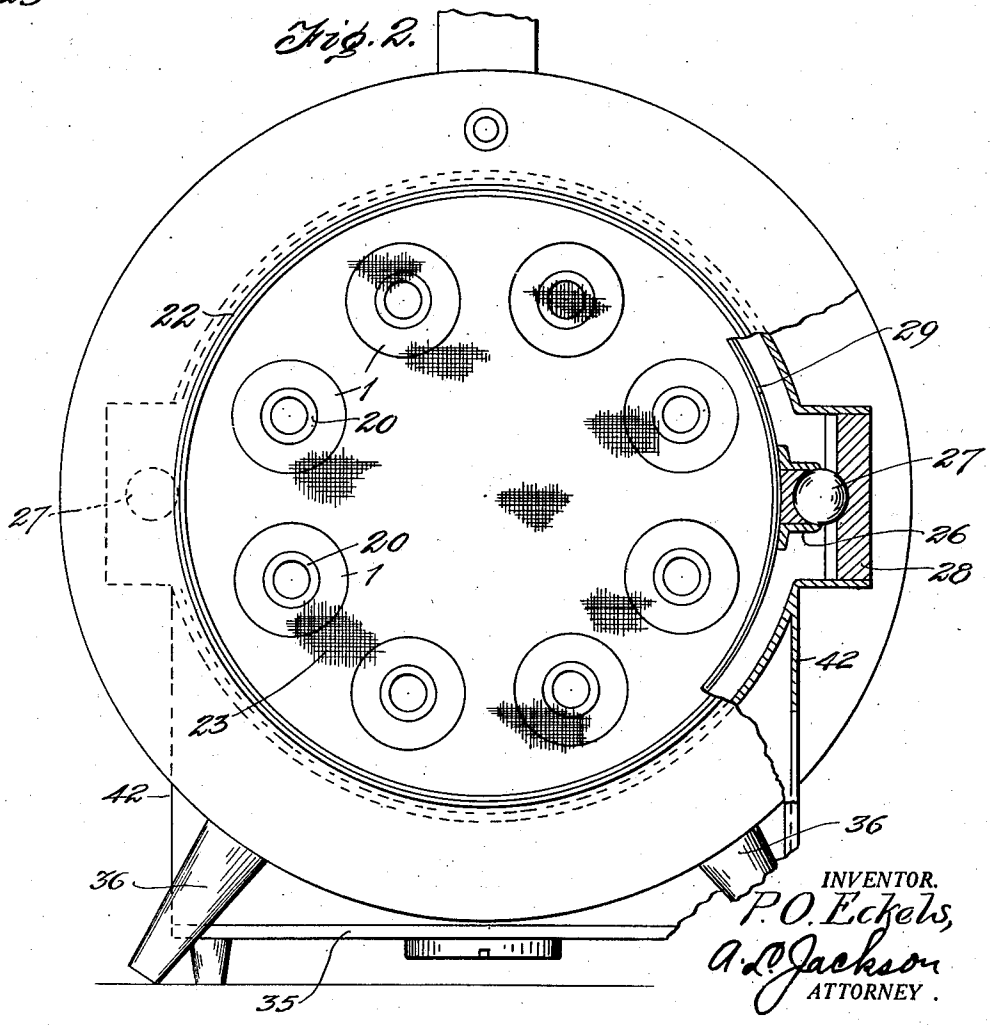


Fig. 2.



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Fig. 5.

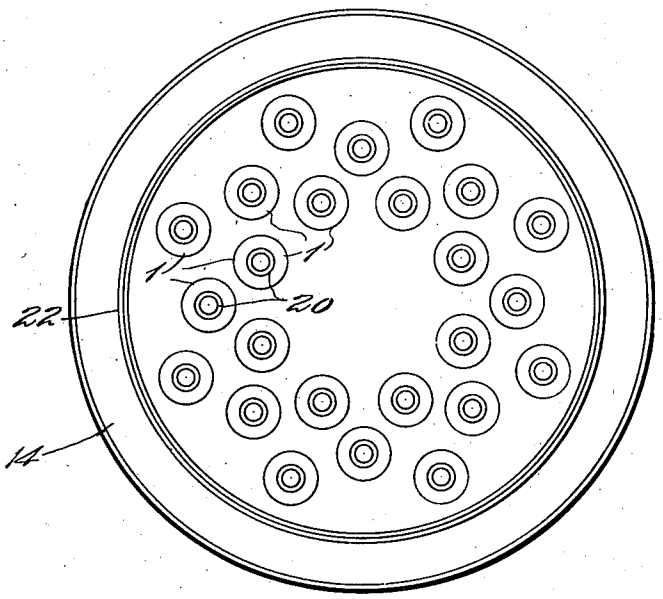
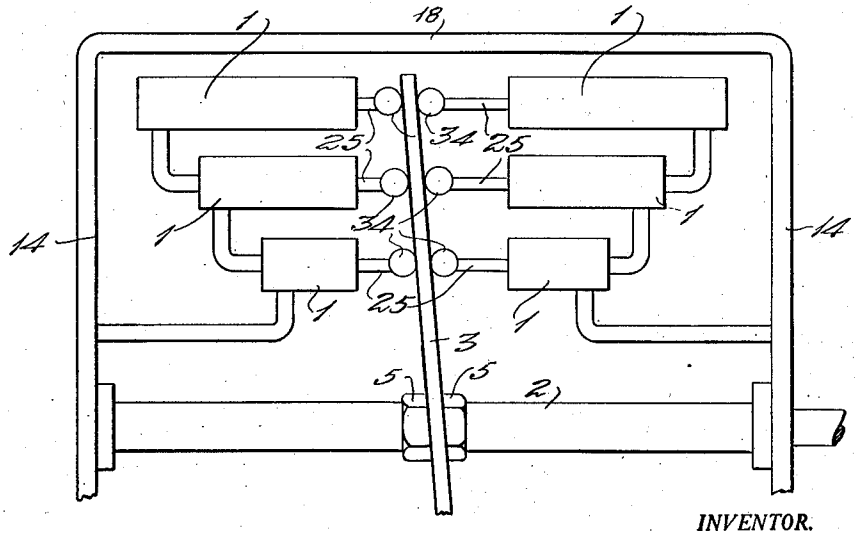


Fig. 6.



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UNITED STATES PATENT OFFICE

PARL O. ECKELS, OF CLEVELAND, OHIO, ASSIGNOR TO ECKELS ENGINEERING CORPORATION, OF CLEVELAND, OHIO

PUMP OR COMPRESSOR

Application filed January 23, 1930. Serial No. 422,816.

My invention relates to pumps and compressors and more particularly to an apparatus for increasing the output; and the object is to provide an apparatus capable of high efficiency in providing fluid pressure in quantities sufficient for a great variety of purposes, and which reduces friction to a minimum, which simplifies lubrication which reduces heating, which is small as compared with other pumps and compressors of equal capacity, which is compact and occupies less space, which weighs less, and costs less in the manufacture.

One advantage is that there is a multiplicity of operating parts or elements having short strokes and all cooperating with each other in constant succession and all actuated by a single driving element and all contacts of the driving element and of the driven elements being provided with antifriction means, and in consequence of such provisions the work accomplished is made so constant that no pulsations are observable. Other objects and advantages are fully explained in the following description and the invention will be more particularly pointed out in the claims.

Reference is had to the accompanying drawings form a part of this application.

Fig. 1 is a vertical section, showing the entire assembly.

Fig. 2 is an end elevation of the invention, a portion being broken away to disclose the means for preventing rotation of the swash plate ring.

Fig. 3 is a longitudinal section showing a variation in the construction of the cylinders, pistons, and operating means.

Fig. 4 illustrates a variation in the operating means shown in Fig. 3.

Fig. 5 is a diagrammatic end view showing the manner of positioning an increased number of cylinders.

Fig. 6 is a diagrammatic side elevation in part of the cylinder shown in Fig. 5.

Similar characters of reference are used to indicate the same parts throughout the several views.

The drawings show sixteen cylinders 1, but it is apparent that any suitable number of cylinders may be used. In the construction shown there is a driving shaft 2 to be driven by any suitable power. An actuating element 3, known as a swash plate, is made rigid with the shaft 2 by a hub construction consisting of two collars 4 which have their faces adjacent to the swash plate 3 inclined to conform to the angle which the swash plate 3 makes with the shaft 2. The two collars 4 and the swash plate 3 may be keyed to the shaft 2 or otherwise made rigid therewith in any suitable manner. Nuts are screwed on the hub portion of the shaft 2 and against the collars 4. A lock nut 6 is screwed on the hub portion of the shaft to lock the collar nuts 5 rigid.

Frame members 7 and 8 form heads or housing members for enclosing the swash plate 3 and its connections and a cylindrical cover plate 9 is attached to heads 7 and 8 and forms a housing for the operating means and holds the frame members 7 and 8 in place. The heads 7 and 8 form bearing supports for the cylinders 1, and also supports for the bearing housings 10 and 11 to which these housings are attached. Ball bearings are provided in housings 10 and 11 for the shaft 2. The heads 7 and 8 support the inner ends of cylinders 1. The cylinders 1 are supported at their outer ends by frame members 12 and 13. The cylinders 1 have enlarged body constructions at their outer ends and the frame members 12 and 13 have openings to receive the enlarged portions of the cylinders. One object of the enlarged portions is for supporting the receivers 14 and also to provide suitable mountings for the exhaust valves 15. Hollow stems 16 are tapped and screwed into the outer portions of the cylinders 1. The receivers 14 have threaded openings and plugged caps 17 are screwed into these threaded openings and enclose the outer ends of the stem 16. The caps 17 provide a means of removing and replacing the valves 15 and the stems 16. The stems 16 have suitable discharge ports for discharging to the receivers 14. The receivers 14 are connected by one or more pipes 18 to maintain a pressure balance in the receivers 14. The valves 15 prevent back flow into the cylinders 1.

The air or fluid is taken into the cylinders 1 through intake valves 19, which are provided with housings 20 which are screwed into the ends of the cylinders 1. The valves 15 and 19 are poppet valves of known type. Supply chambers 21 are attached to the ends of cylinders 1 by suitable means and the chambers are enclosed in housings 22 formed on the frame-members 12 and 13. The supply chambers 21 have ports for supplying the valves 19. The chambers 21 are closed by filters 23, if air or gases are used. If fluids are to be used, the chambers 22 are sealed air and liquid-tight and provided with feed-pipes. The cylinders 1 are provided with pistons 24, which are provided with rods 25, which are actuated by the swash-plate 3.

The periphery of the swash-plate 3 is surrounded by ring 29. The ring 29 oscillates but does not revolve. Housings 26 are attached to the periphery of the ring 29 and balls 27 are mounted in these housings and the ball-races are completed by plates 28 having arcuate ball tracks, which are attached to the cylindrical cover-plate 9, as shown in Fig. 2. The ring 29 oscillates on the ball-bearings 27, which prevent the ring 29 from revolving.

The ring 29 carries circular channel plates 30 which are made rigid with the ring 29. Sockets 31 are rigidly attached to channel plates 30. Cup-shaped sockets 33 are attached to the piston rods 25. Balls 34 are placed in the sockets 31, and bear against the swash-plate 3. The cup-shaped socket members 33 are held in the sockets 31 by nuts 32, which are screwed into the sockets 31. Piston-rods 25 are thus held in contact with the swash-plate 3 by ball-and-socket joints. In operation the swash-plate 3 acts constantly on the piston rods 25 for driving the pistons 24.

A base plate 35 is supported on feet 36. A frame member 37 is attached to the base 35 and extends upwardly and supports the outer end of the driving shaft 2 and provides a means of support for a power element which drives the shaft. The drawings show a portion of a power shaft 38 supported in frame member 37 and which is provided with a pinion 39 which drives the gear wheels 40 which is rigidly mounted on the shaft 2. The frame members 7 and 8 are attached to the base 35 and form a lubricator reservoir 41. Front and rear plates 42 complete the formation of the lubricator reservoir. A suitable oil pump 43 is enclosed in the reservoir 41 and is operated by the ring 29 in its oscillating motion. The pump 43 forces oil through pipes 44 to all parts which need lubrication.

The cooling means consisting of coils 45 are connected to the reservoir 14 and to an expansion chamber 46 where the moisture is expelled through the valve 47 and the dried air is conducted through suitable delivery pipe 48 for service.

If liquids are use there will be no need of cooling coils 45 and the reexpansion chamber 46. In case of use of liquids, the delivery pipe 48 will connect directly to the receiver 14.

An important feature of this invention is the large number of cylinders and pistons therefor and an actuating element so positioned that it causes only short strokes of the pistons and this is done by placing this actuating element on a shaft at a very slight angle from a right angular position on the shaft.

The principle of this invention is the divisibility of the work to be done and providing a large number of operative elements whereby a great number of operations are going on simultaneously and every element is cooperating with every other element which makes the machine balance and reduces the vibrations, and all operations are caused by a single actuating element which revolves and oscillates simultaneously.

Figure 3 shows a variation in the means for actuating the pistons by the swash-plate 3 without the aid of piston rods. Ball sockets 49 are provided on the pistons 24 for retaining the balls 34 and the balls 34 are held against the swash-plate by means of springs 50. The sockets 49 have flanges 51 which extend beyond the circumference of the cylinders 1 and form seats for the springs 50 which bear against the flanges and against frame members 7 and 8.

Figure 4 illustrates a variation from the structure shown in Figure 3. A yoke 52 carries the sockets 49 and the pistons 24 are screwed on to the yoke 52. The yoke 52 is made so that it will carry the balls 34 in contact with the swash-plate 3.

Figures 5 and 6 illustrate a plurality of cylinders arranged in concentric circles about the driving shaft so that the pistons of all cylinders can be operated by one swash-plate.

Various changes in the sizes, proportions, construction, numbers of parts, and arrangement may be made without departing from my invention.

What I claim is:

1. In an apparatus, the combination of an element having a revolving motion and an oscillating motion operating simultaneously, air filters, a plurality of cylinders for receiving filtered air, compressed air receiver, means in the cylinders for drawing air through said filters and for compressing it and forcing the same into said compressed air receivers, an expansion chamber, combined conducting and cooling means for conducting air from said receivers into said expansion chamber for expelling moisture from the air preparatory to delivering air for service.

2. An apparatus comprising air filters, a plurality of cylinders, means for collecting

the filtered air into said cylinders, means in said cylinders for compressing air, an element revolving and oscillating simultaneously for actuating said compression means, receivers for receiving compressed air forced from said cylinders by said revolving and oscillating element, an expansion chamber, and combined conducting and cooling means for forcing air from said receivers in said expansion chamber and for expelling moisture from the air preparatory to delivery of said air for service.

3. An apparatus comprising a plurality of compressing cylinders, containers associated with said compressing cylinders, operating elements in said cylinders for causing intake of air into said cylinders for compressing and causing discharge of the air in said cylinders into said container, an element constantly revolving and oscillating simultaneously for actuating said operating elements, antifriction means between said revolving and oscillating element and said operating element, ball bearings, and a driven shaft running on said ball bearings and driving said revolving and oscillating element.

4. In a compressing pump, the combination of a casing composed of two heads and a cylindrical cover plate attached to said heads, a driving shaft journaled in said heads and ball bearings for said shaft and housings for said ball bearings attached to said heads, a swash plate rigidly mounted on said shaft at an angle thereto, a plurality of compressing cylinders concentrically arranged about said shaft on both sides of said swash-plate and the open ends of said cylinders supported in said heads, frame members supporting the outer ends of said cylinders, operating means in said cylinders operatively connected to said swash-plate for drawing air into said cylinders and compressing it and expelling it therefrom, and containers receiving the compressed air operatively connected to said cylinders.

5. In a pump, the combination of means for compressing great quantities of fluid in relatively short definite periods of time including a driving shaft, a relatively large number of oppositely disposed operating elements for dividing the work of compressing the fluid, and a swash plate rigid with said shaft at an angle thereto and projecting loosely between said oppositely disposed elements for operating all of said elements constantly with relatively short strokes and with great rapidity.

6. In a pump, the combination of means for compressing great quantities of fluid in relatively short definite periods of time including a driving shaft, a relatively large number of oppositely disposed operating elements for dividing the work of compressing the fluid, a swash plate rigid with said shaft at an angle thereto and projecting loosely between said oppositely disposed elements for operating all of said elements constantly with relatively short strokes and with great rapidity, and means for cooling the compressed fluid.

7. In a pump, the combination of means for compressing great quantities of fluid in relatively short definite periods of time including a driving shaft, a relatively large number of operating elements for dividing the work of compressing the fluid, a swash plate rigid with said shaft at an angle thereto and projecting loosely between said oppositely disposed elements for operating all of said elements constantly with relatively short strokes and with great rapidity, means for cooling the compressed fluid, and means for drying the cooled compressed fluid.

8. In a pump, the combination of means for filtering fluid, means for compressing great quantities of fluid in relatively short definite periods of time including a driving shaft, a relatively large number of oppositely disposed operating elements, for dividing the work of compressing the fluid, and a swash plate rigid with said shaft at an angle thereto and projecting loosely between said oppositely disposed elements for operating all of said elements constantly with relatively short strokes and with great rapidity.

9. In a pump, the combination of means for filtering fluid, means for compressing great quantities of fluid in relatively short definite periods of time including a driving shaft, a relatively large number of oppositely disposed operating elements for dividing the work of compressing the fluid, a swash plate rigid with said shaft at an angle thereto and projecting loosely between said oppositely disposed elements for operating all of said elements constantly with relatively short strokes and with great rapidity, means for directing the compressed fluid to a cooling means, and means for cooling the compressed fluid.

10. In a pump, the combination of means for filtering fluid, means for compressing great quantities of fluid in relatively short definite periods of time including a driving shaft, a relatively large number of oppositely disposed operating elements for dividing the work of compressing the fluid, a swash plate rigid with said shaft at an angle thereto and projecting loosely between said oppositely disposed elements for operating all of said elements constantly with relatively short strokes and with great rapidity, means for directing the compressed fluid to a cooling means, means for cooling the compressed fluid, and means for drying the compressed fluid.

11. In a device of the kind described, a shaft, a swash plate mounted on said shaft, a pair of cylinders alined on opposite sides of said shaft, pistons carried in said cylin-

ders and having ball sockets at the ends adjacent said swash plate, balls in said sockets bearing on said swash plate, and spring means holding said balls against said swash plate.

12. In a device of the kind described, a shaft, a swash plate mounted on said shaft, a pair of cylinders alined on opposite sides of said shaft, pistons carried in said cylinders and having ball sockets at the ends adjacent said swash plate, balls in said sockets bearing on said swash plate, collars on said cylinders and said ball sockets, and springs surrounding the cylinders and each bearing against the respective collars on a cylinder and its piston.

13. An air compressing pump including a driven shaft, a series of pairs of compression cylinders arranged in alined pairs with the cylinders of each pair on opposite sides of the swash plate, intake chambers each communicating with all of the cylinders on a respective side of the swash plate, air filtering means on the inlet side of said chambers, pistons working in said cylinders and having operative connection with said swash plate, and annular receiving chambers each surrounding the cylinders on a respective side of the swash plate ad having pipe connection with each other, each of said cylinders having valved port communication with a respective receiving chamber.

In testimony whereof I set my hand this 18th day of January, 1930.

PARL O. ECKELS.