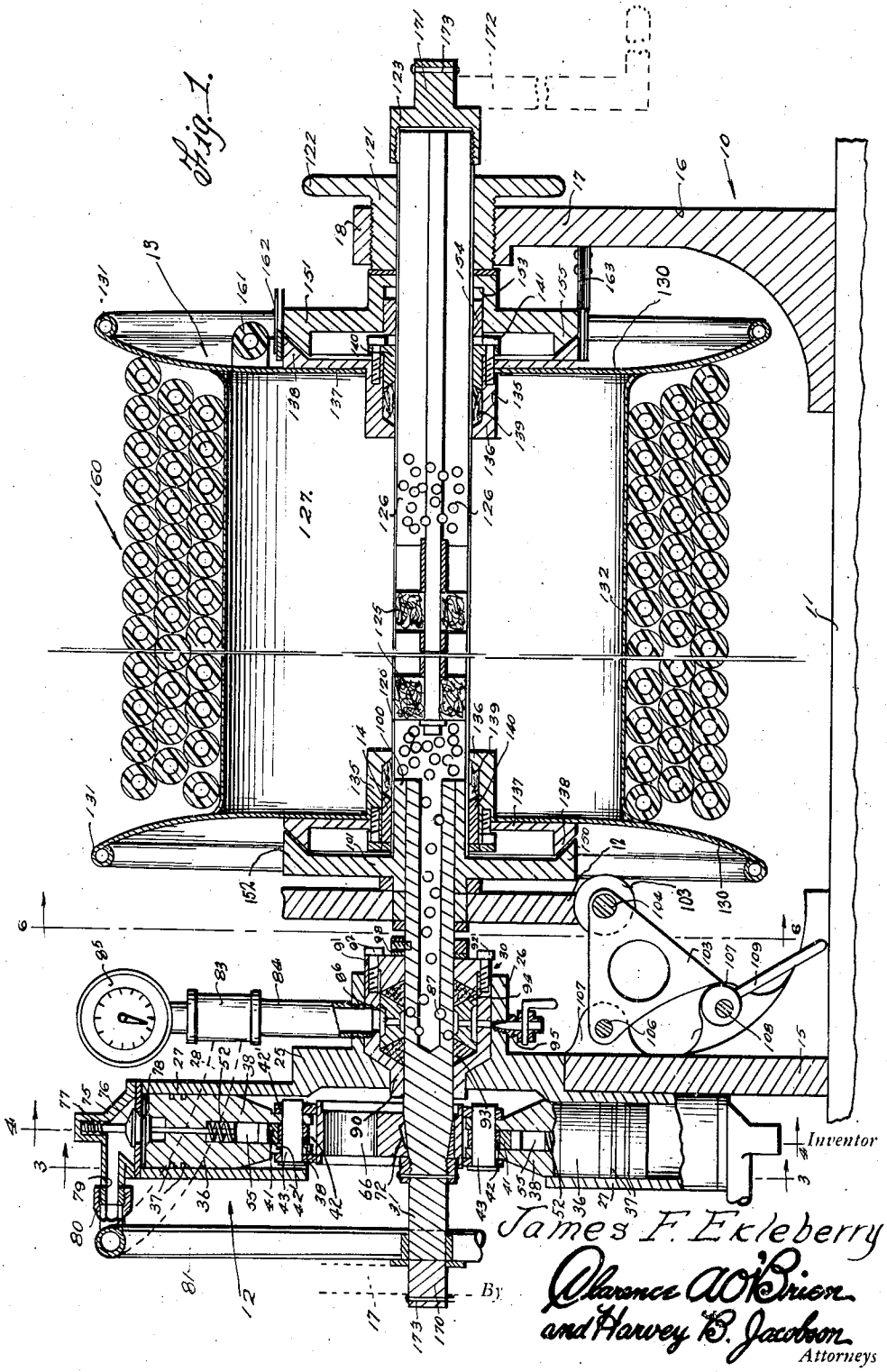
April 5, 1949. J. F. EKLEBERRY 2,466,215

RADIAL PUMP

Filed Aug. 17, 1944 4 Sheets-Sheet 1

Fig. 1.



Inventor
James F. Ekleberry
By Clarence A. O'Brien and Harvey B. Jacobson
Attorneys

April 5, 1949. J. F. EKLEBERRY 2,466,215

RADIAL PUMP

Filed Aug. 17, 1944 4 Sheets-Sheet 2

Fig. 3.

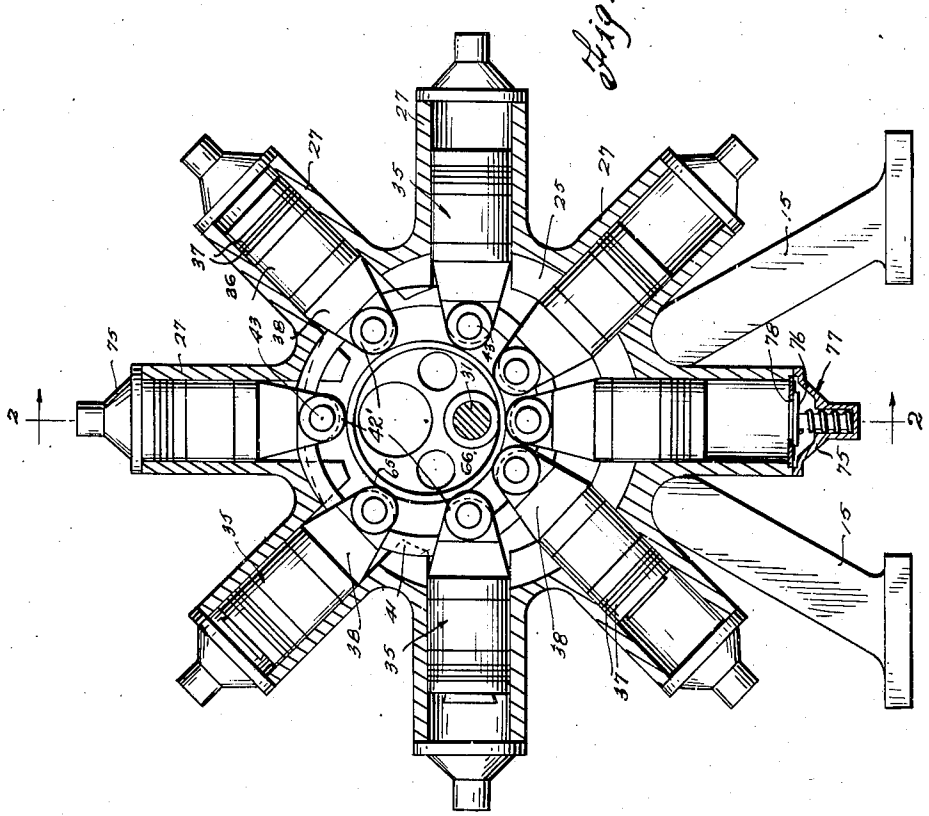
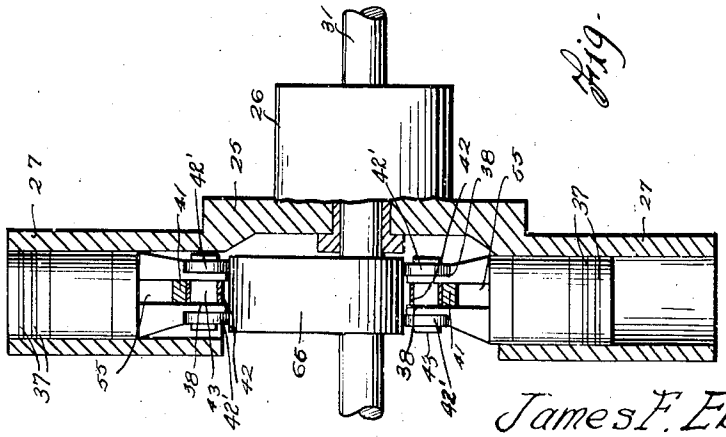


Fig. 2.



Inventor
James F. Ekleberry

By Clarence A. O'Brien and Harvey B. Jacobson
Attorneys

April 5, 1949. J. F. EKLEBERRY 2,466,215

RADIAL PUMP

Filed Aug. 17, 1944 4 Sheets-Sheet 3

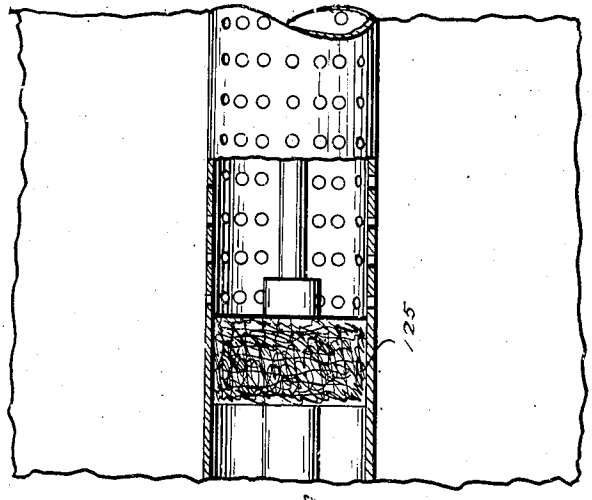


Fig. 5.

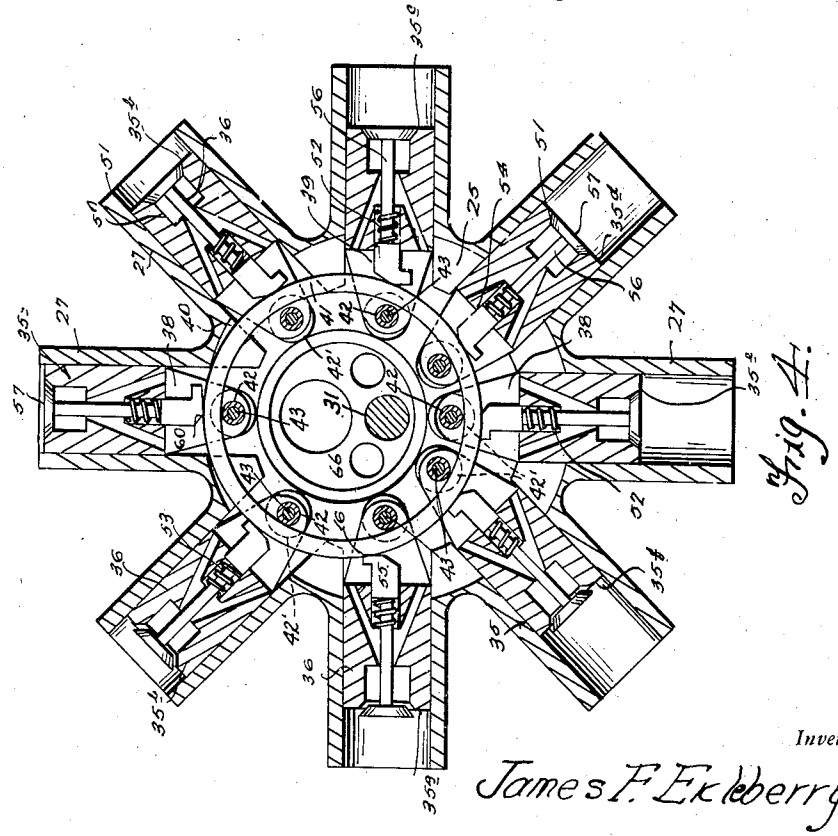


Fig. 4.

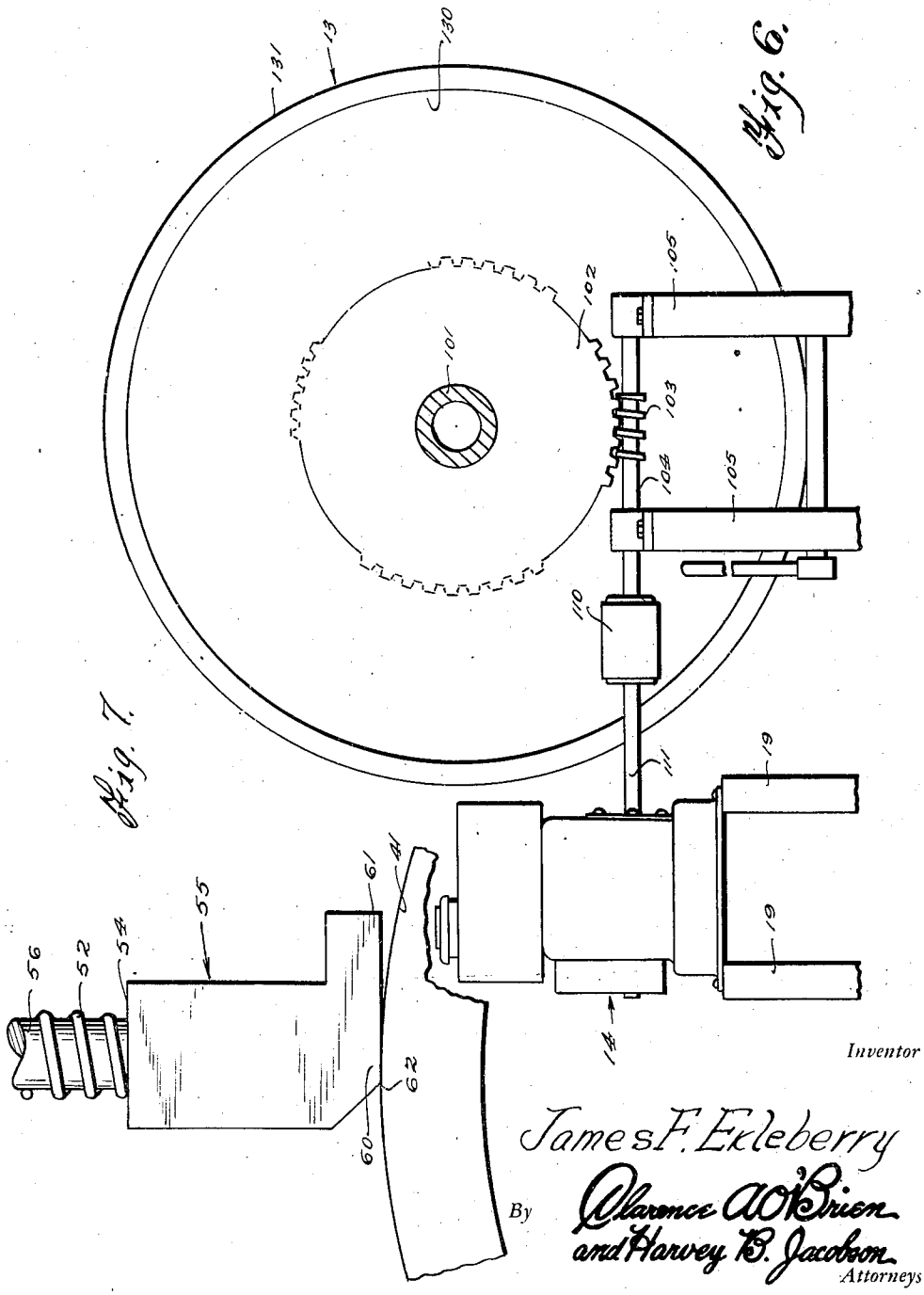
Inventor
James F. Ekleberry

By Clarence A. O'Brien and Harvey B. Jacobson
Attorneys

April 5, 1949. J. F. EKLEBERRY 2,466,215

RADIAL PUMP

Filed Aug. 17, 1944 4 Sheets-Sheet 4



Inventor

James F. Ekleberry

By Clarence A. O'Brien and Harvey B. Jacobson

Attorneys

Patented Apr. 5, 1949

2,466,215

UNITED STATES PATENT OFFICE

2,466,215

RADIAL PUMP

James F. Ekleberry, Miami, Fla., assignor of one-half to C. Roy Miller, Miami, Fla.

Application August 17, 1944, Serial No. 549,951

8 Claims. (Cl. 230—194)

1

This invention relates to apparatus for divers and more particularly to an improved apparatus for supplying air to a diver while below the surface of the water.

A primary object of this invention is the provision of an improved apparatus whereby air may be readily and continuously supplied to a diver with a minimum chance of supply failure.

An additional important object is the provision of an improved pump in association with such an apparatus designed to supply air in a continuous steady flow with a substantially complete absence of pulsation.

A further object is the provision of such a pump wherein the intake of air and a constant supply of the same to the diver is continuous, smooth and steady.

A still further object is the provision of a motor-driven pump for use in such an apparatus having provision whereby the same may be readily, and substantially immediately, shifted to manual operation in the event of power failure for any reason whatsoever.

A still further important object is the provision, in a pump having a plurality of radially disposed pistons and valves therein, of improved means for opening and closing the valves at desired intervals.

A further object is the provision in such a pump as described in the foregoing objects of a valve boot of novel form and configuration adapted to be continuously in contact with a free-floating ring, actuated by an eccentric, to open and close the valves as desired.

An additional important object is the provision of a pump of the character mentioned in the preceding objects wherein the above mentioned eccentric serves also to actuate the pistons of the pump.

A still further object is the provision in an apparatus for divers of an improved air filter so positioned and arranged as to completely cleanse the air supplied to the diver of foreign matter.

An additional object is the provision of a compression chamber in such an apparatus to which the air is fed from the pump which serves still further to minimize the possibility of any pulsation of air and the supply to the diver.

Still another object is the provision, in association with such an apparatus, of an improved hose reel adapted to be actuated by the pump to take up any slack in the hose to the diver.

A still further object is the provision of such hose reel, having a slip-friction driving connection with the pump whereby the exertion of undue tension on the diver's hose is precluded.

Still another object is the provision of such reel which may be readily engaged and disengaged from the operative effect of the pump as desired.

2

Other objects reside in the combinations of elements, arrangements of parts, and features of construction, all as will in part be obvious and in part described hereinafter and shown in the accompanying drawings, wherein there is disclosed a preferred embodiment of this inventive concept.

In the drawings—

Figure 1 is a side sectional view disclosing one form of apparatus embodying this invention.

Figure 2 is a sectional view taken substantially along the line 2—2 of Figure 3, as viewed in the direction indicated by the arrows.

Figure 3 is a sectional view taken substantially on the line 3—3 of Figure 1, as viewed in the direction indicated by the arrows.

Figure 4 is a sectional view taken substantially on the line 4—4 of Figure 1, as viewed in the direction indicated by the arrows.

Figure 5 is an enlarged detail view partially in section and partially in elevation, of certain constructional details.

Figure 6 is a sectional view taken along the line 6—6 of Figure 1 as viewed in the direction indicated by the arrows, and

Figure 7 is an enlarged elevational view of still another detail of construction.

Like reference characters refer to like parts throughout the several views of the drawings.

Having reference now to the drawings and more particularly to Figure 1, there is generally indicated at 10 a supporting frame which may be contained in a box or like container, a fragment of which is indicated at 11, which frame is adapted to support the apparatus which is comprised broadly of a pump, generally indicated at 12, a hose reel generally indicated at 13 and a motor for driving the pump generally indicated at 14 (see Figure 6).

Frame 10 may be of any desired configuration or arrangement of parts, but in the application shown is comprised of oppositely disposed pairs of legs 15 and 16, adapted to be secured in any desired manner to the box or other supporting surface 11. Legs 15 have secured thereto, as by welding or the like, pump 12, while legs 16 terminate in a unitary central upper portion 17 provided with a centrally disposed aperture threaded as at 18, for a purpose to be described hereinafter, and serve to support the opposite end of the assembly. Additional supporting members 19 (see Figure 6) may be provided, if desired, to support motor 14.

Having reference now to pump 12 it will be seen that the same is comprised of a substantially circular central portion 25 provided with a central aperture, and a rearwardly extending annulus 26. Portion 25 has integral therewith a

plurality, illustratively eight, of radially disposed cylinders generically indicated by the reference character 27.

Positioned within annulus 26 and extending into the central recess of member 25 is a stuffing box generally indicated at 30, to be more fully described hereinafter. A drive shaft 31 extends through pump 12 and stuffing box 30 rearwardly into association with reel 13.

Positioned within each of cylinders 27 is a piston generically indicated at 35 comprised of a piston body 36 and the customary piston rings 37. The inner portions of piston bodies 36 are bifurcated and tapered to provide pairs of extending members 38 having a groove 39 therebetween. The inner ends of the juncture point of the cylinders are also grooved as at 40 (see Figure 4) to provide a path of travel for a ring 41 positioned between the bifurcations 38 of the pistons. Ring 41 is held in position in grooves 39 by rollers 42 revolubly mounted on pins 43 passes through suitable apertures and bifurcations 38 and headed to retain the same in position. Thus it will be seen that the ring 41 is free to rotate in an eccentric fashion. When actuated in a manner to be described hereinafter, within the groove formed as above described. Each of piston bodies 36 is provided with an internal bore 50 (see Figure 4) one end of which is formed into a valve seat 51 and the other end of which is recessed as at 52 to provide accommodation for a compression spring 53 normally abutting a shoulder 54 of a valve boot, generally indicated at 55. Valve boots 55 have attached to their outer ends valve stems 56 on which are mounted valves 57 adapted to seat in valve seats 51.

As best shown in Figures 7 and 4, valve boots 55, which are biased by springs 52 into engagement with ring 41, are provided with a relatively flat follower surface 60 terminating at one end in a right angled toe 61 and at the other end in angular portion 62 from which the rear of the boot extends at an angle to the body of the valve boot. As rings 41 are rotated past, or forced inwardly with respect to, various valve boots, these various portions are engaged by the rings, for a purpose and in a manner to be described more fully hereinafter.

Referring back to bifurcations 38 of pistons 35 it will be seen that these terminate in arcuate portions 65 and rollers 42' are applied thereadjacent which are adapted to abut and ride against an eccentric cam 66. (See Figure 2.) The cam 66 is fixedly secured, as by splines 70 and grooves to drive shaft 31. The rollers 42' may be attached in any suitable manner preferably to the said pins 43 and adjacent the ends thereof.

From the foregoing it will be seen that as drive shaft 31 is rotated, in a manner to be described hereinafter, the corresponding rotation of eccentric cam 66 abutting the arcuate inner surfaces of pistons 35 causes the same to move successively inwardly and outwardly in the cylinder 27. Simultaneously the valves 57 are successively opened to permit the passage of air into the cylinders. It should here be pointed out that the unique configuration of the valve boot is so arranged as to preclude opening of the valve on the down stroke of the piston, such opening occurring normally after the piston has started its upward stroke and hence obviating the possibility of back leakage of air. A consideration of Figure 4 will disclose piston 35*a* in its uppermost position at which time flat surface 60 of the associated valve boot 55 is in abutting relation with ring 41 and the valves 57 completely closed. As the ring rotates the position of the valve boots is changed respectively so that shoulder or angle 62 is in abutting relation with the rings as shown in the position of pistons 35*b*. As the relative position continues to change the angular surface to the rear of angle 62 is successively juxtaposed to ring 41 as shown by the position by pistons 35*c* and 35*d*. As the piston assumes its innermost position on the bottom of the down-strike as shown at 35*e* flat portion 60 is again juxtaposed to ring 41. Then as the valves assume the positions indicated at 35*f* and 35*g* the angle or toe 61 is brought into contact with the ring occasioning the opening of the associated valve, the valve at 35*g* being shown in its fully opened position. As the cam continues to rotate on the up-stroke the parts assume the position shown by piston 35*h* at which time the angular relation of surface 60 tends toward the flat and the valve begins to close, until finally the position originally indicated by piston 35*a* is resumed and surface 60 becomes tangential to the arc of cam 66. It is to be understood, of course, that each of the valves assumes successively the various positions shown as well as an infinity of intermediate positions, in such manner that there is a continuous flow of air from the inlet, at the lower open end of the cylinders 37 through the inlet passages and bores 50 of the pistons to the opposite ends of the cylinders.

As best shown in Figures 1 and 3, each of cylinders 27 is provided with a cylinder head 75 within which is positioned a one-way valve 76 spring-loaded as by a spring 77 to bias the same into closing position with the outlet 78 of the cylinder, in the absence of air pressure exerted by the associated piston 35. As shown in Figure 1, each of cylinder heads 75 is provided with an outlet 79 leading to a nipple 80 and thence into communication with a ring-shaped collector 81 from which a conduit 82 leads to a fitting 83 in communication with an inlet pipe 84 to collect and deliver all the air supplied by the various pistons. A pressure gauge 85 of any desired conventional type is secured in fitting 83 to indicate the pressure of the air being delivered. The opposite end of inlet pipe 84 is threadedly engaged in a suitable aperture in annulus 26 and communicates through an aperture in stuffing box 30 through grooves 86 and through apertures 87 in drive shaft 31 with a bore 88 in the interior of the inner portion of the drive shaft 31.

Referring back now to stuffing box or packing gland 30 it will be seen (Figure 1), that the same is comprised of a body 90 and an end cap 91 secured in position as by bolts 92. Positioned within casing 90 is a pair of packing rings 93 separated by a packing spacer 94, through grooves 86 in which latter, air passes from inlet pipes 84 to bore 88. A drain valve, or petcock 95 is provided for the purpose of draining off any accumulation of moisture within packing gland 30. An end play collar 96 is secured in position as by a set screw 97, and provided with a washer 98 to hold drive shaft 31 securely in rotative related assembly with packing gland 30.

The inner end of drive shaft 31 extends into a fitting 100 and is fixedly secured thereto. Fitting 100 is formed with a flange 101 to which is secured a gear 102 adapted to be engaged by a worm gear 103 rotatably mounted on a shaft 104 the ends of which are mounted in a frame 105

pivotally secured, as on a pivot 106, to lugs 107 extending in a frame 10. Frame 105 is comprised of two relatively triangular plates the inner surface of which is arcuate in configuration and adapted to abut an eccentric 107 mounted on a shaft 108 and provided with an operating handle 109. It will thus be seen that movement of eccentric 107 moves worm gear 103 into and out of engagement with gear 102 to provide a drive for pump 12. Shaft 104 is connected in any suitable manner as by gearing 110, or alternatively a drive belt (not shown) with the drive shaft 111 of motor 14, it here being pointed out that while motor 14 is shown in the drawings as a gasoline motor of any desired type, any other source of power, such as an electric motor or the like, may be utilized if desired.

Fitting 100 has secured peripherally thereabout one end of a tubular member or sleeve 120 which comprises the axle about which reel 13 is adapted to rotate. The opposite end of sleeve 120 is journaled for rotation in a centrally disposed aperture in a circular nut-like member 121 provided with an extending circular hand grasp 122 threadedly engaging the threads 18 of frame member 16. The outer end of sleeve 120 is closed by an end cap 123 in which is mounted a rod 124 extending inwardly within the sleeve and having mounted thereon a plurality of filters 125 of any suitable material adapted for the filtering and cleansing of air fed from bore 88 into sleeve 120. A plurality of apertures 126 positioned outwardly with respect to filters 125 pass through sleeve 120 to permit the escape of air into a storage and compression chamber 127 comprising the interior of reel 13.

From the foregoing it will now be apparent that when motor 14 is driving pump 12 drive shaft 31 and hence sleeve 120 are continuously rotated. Reel 13 is mounted for free rotation on sleeve 120 which serves as an axle therefor. The reel is comprised of a pair of circular end plates 130 provided, adjacent their peripheries, with hand grasp rails 131, the end plates being secured in sealed relation to a cylinder 132 which, in conjunction with end plate 130, forms air chamber 127. End plates 130 are provided with centrally disposed apertures within which are positioned fittings 135, each comprised of an annulus having an inwardly turned flange 136 positioned interiorly of plate 130 and closely engaging shaft 120 and an external flange 137 terminating in a beveled edge 138. Packing 139 is positioned within the fitting and held in position by packing glands 40 secured to fittings 135 as by screws 141. Thus it will be seen that reel 13 may be rotated freely about shaft 120 when such action is desired.

Means are likewise provided for rotating the reel in conjunction with the rotation of sleeve 120 and drive shaft 31. Such means take the form of clutch disks 150 and 151, respectively. Clutch disk 150 may comprise a portion of fitting 100 and is provided with a bevel 152 adapted to conform to the bevel 138 of the corresponding flange 137. Clutch disk 151 is provided of an interior annular recess 153 within which is positioned a clutch collar 154 on which the clutch disk is adapted to slide inwardly and outwardly with respect to reel 13. Clutch disk 151 is also provided with a beveled surface 155 adapted to conform to the beveled surface 138 of the associated flange 137 of fitting 135. Such movement of clutch disk 151 is effected by rotation of nut-like member 121 threadedly engaged with threads 18 in frame 10. It will be readily understood that as threaded member 121 is rotated clutch 151 will be forced inwardly thus engaging the clutch surfaces 152—138 and 155—138, it being understood that clutch member 150 continuously rotates with the drive shaft 31. It will be readily apparent that the firmness of the engagement of the clutch portion may be varied according to the position of threaded member 121. That is to say, that when the clutch is entirely disengaged reel 13 may rotate freely independently of sleeve 120, and that when the engagement is tight the reel will rotate in fixed relation with the rotation of drive shaft 31 and then, when there is engagement between the opposed portions of the clutches, but such engagement is relatively light, the reel will rotate with the drive shaft but such rotation may be stopped as desired by the exertion of any pressure whatsoever upon the reel, as for example, by grasping hand grip 131, or by the exertion of the hose connection with diver.

This connection with the diver comprises a length of hose generally indicated at 160 adapted to be wound about cylinder 132 between extending portions of end plates 130 and having one end connected to the diver's helmet and the other end connected to a fitting 161 in communication with the air in air chamber 127.

If desired suitable telephone wires or similar conductors of current may be provided for the diver extending through the interior of hose 160, electrical contacts for such wires being established through a collector ring 162 attached to flange 137 and adapted to engage a suitable wiring plug 163.

From the foregoing the operation of the device should now be readily understandable. When it is desired to supply air to a diver beneath the surface of the water, for example, motor 14 is started, worm gear 103 thrown into engagement with gear 102 by appropriate movement of lever 109. This action causes rotation of the drive shaft 31 which operates the pump 12 in the manner previously described forcing air through intake 94 into the bore 88 and thence through filters 125 outwardly through holes 126 in the chamber 127. It may here be pointed out that the continuous steady action of the pump with its multiplicity of cylinders substantially preclude pulsation of air fed to the diver. Any such pulsation as might exist is effectively dampened in chamber 127. From chamber 127 the air passes outwardly through fitting 161 and hose 160 to the diver. Normally, reel 13 is set by means of threaded member 121 in slip-friction position, in such manner that the normal tension on the hose precludes movement of the reel. However, when any slack occurs in the hose for any reason as the slack is hauled in the clutch engages and causes the same to wind about reel 13, thus preventing the entanglements of hose lying about the deck, which have, hitherto, been a material hazard to the work of the deck crew assisting a diver.

It is possible under certain conditions, for a source of power to fail while a diver is below the surface of the water, which failure may, unless compensating means are provided, result fatally to the diver. In the instant invention the end of drive shaft 31 is squared as shown at 170 as is a projection 171 extending from end cap 123. Cranks 172 are adapted to be placed on the squared portions as desired and held in place by cotter pins 173, whereby the pump may be operated manually in the event of power failure.

From the foregoing it will now be seen that there is herein provided an apparatus for divers which is compact and may be contained in a relatively small space, which is exceptionally reliable and efficient in operation, and provided with safety features in the event of power failure, which is sturdy and durable in construction, and which may be operated and adjusted with relative ease and simplicity.

It will also be seen that there is herein provided a construction accomplishing all the objects of this invention and many others including advantages of great practical utility. As many embodiments may be made of this inventive concept, and as many modifications may be made in the embodiment hereindescribed and shown in the accompanying drawings, it is to be understood that all matter hereinbefore described or illustrated is to be interpreted merely as illustrative and not in a limiting sense.

I claim:

1. A pump comprising a casing, a drive shaft, means mounting said shaft in said casing, an eccentric secured to said shaft, cylinders extending radially from said casing, pistons in said cylinders and having bifurcations formed at their inner end portions to form grooves, outlet valve means associated with said cylinders and inlet valves in said pistons, valve boots connected to said inlet valves, a ring encircling said eccentric and seated in said grooves engaging said valve boots, rollers secured between the bifurcations of each piston and positioned between said eccentric and said ring, means secured to each piston engaging said eccentric for transmitting rotative movement of the eccentric to reciprocatory movement of each piston, spring means seated on said boots and reacting on said pistons for urging said valves to the closed position, the boots being shaped so as to produce a differential in the amount of movement of each inlet valve relative to the movement of each piston during a cycle of operation of the eccentric and ring.

2. A pump comprising a casing, a drive shaft means mounting said shaft in said casing, an eccentric secured to said shaft, cylinders extending radially from said casing, pistons in said cylinders and having bifurcations formed at their inner end portions to form grooves, outlet valve means associated with said cylinders and inlet valves in said pistons, valve boots connected to said inlet valves, a ring encircling said eccentric and seated in said grooves engaging said valve boots, rollers secured between the bifurcations of each piston and positioned between said eccentric and said ring, means secured to each piston engaging said eccentric for transmitting rotative movement of the eccentric to reciprocatory movement of each piston, spring means seated on said boots and reacting on said pistons for urging said valves to the closed position, said boots being substantially L-shaped and having a substantially flat cam surface for producing a differential in the amount of movement of each inlet valve relative to the movement of each piston during a cycle of operation of the eccentric and ring.

3. A pump comprising a casing, a drive shaft journalled in said casing, an eccentric secured to said drive shaft, radial cylinders in said casing, pistons slidably received in said cylinders and having bifurcations at the inner ends thereof to

form grooves, outlet valves associated with said cylinders, inlet valves in said pistons, valve boots secured to said inlet valves, means seated on said valve boots and reacting on said pistons for resiliently biasing said inlet valves to the closed position, a ring contacting said boots seated in said grooves, means secured to the bifurcations for maintaining the ring in said grooves, an eccentric secured to said drive shaft and positioned within said ring, means secured to said bifurcations and engaging said eccentric transmitting movement from said eccentric to said pistons, said boots having a cam surface thereon for producing differential relative movements of each inlet valve and its associated piston during a cycle of operation for opening and closing the inlet valves.

4. The combination of claim 3, said resilient biasing means comprising a spring associated with each piston and its associated inlet valve.

5. The combination of claim 3, each of said boots including a pair of integral arms connected in L-shape, and a cam flat at the junction of the arms.

6. A pump comprising a casing, a drive shaft journalled in said casing, an eccentric secured to said drive shaft, cylinders formed radially in said casing, pistons slidably received in said cylinders and outlet valve means associated with said cylinders, bifurcations on the inner ends of each piston forming a groove, a ring in said grooves and positioned around said eccentric, means secured within said bifurcations for maintaining said ring in said grooves, inlet valves in said pistons, means secured to each of said inlet valves and abutting said ring for opening said inlet valves during the compression stroke of said pistons, and resilient means associated with said inlet valve opening means closing said inlet valves during the exhaust stroke of said pistons, and means secured to said bifurcations and engaging said eccentric for transmitting rotative movement of said eccentric to reciprocatory movement of said pistons.

7. The combination of claim 6, and said inlet valve opening means comprising boots of substantially L-shaped configuration and having a cam formed thereon.

8. The combination of claim 7, and said resilient means being seated on said boots and reacting on said pistons for resiliently biasing said inlet valves to the closed position.

JAMES F. EKLEBERRY.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
699,570	Rhine	May 6, 1902
989,534	Macduffee	Apr. 11, 1911
1,096,828	Conrad	May 19, 1914
1,274,955	Sundh	Aug. 6, 1918
1,350,205	Anderson	Aug. 17, 1920
1,654,893	Meyers et al.	Jan. 3, 1928
1,867,470	Ponthieu	July 12, 1932
1,894,701	Paul	Jan. 17, 1933
1,914,248	Gallerani	June 13, 1933
1,982,610	Harris	Nov. 27, 1934
1,997,149	Lake	Apr. 9, 1935
2,220,926	Weigel	Nov. 12, 1940
2,310,520	Esnault-Pelterie	Feb. 9, 1943