A. J. TYLER.

PNEUMATIC PUMP.

APPLICATION FILED JULY 24, 1912.

1,139,930.

Patented May 18, 1915

3 SHEETS—SHEET 1.

Fig. 1.

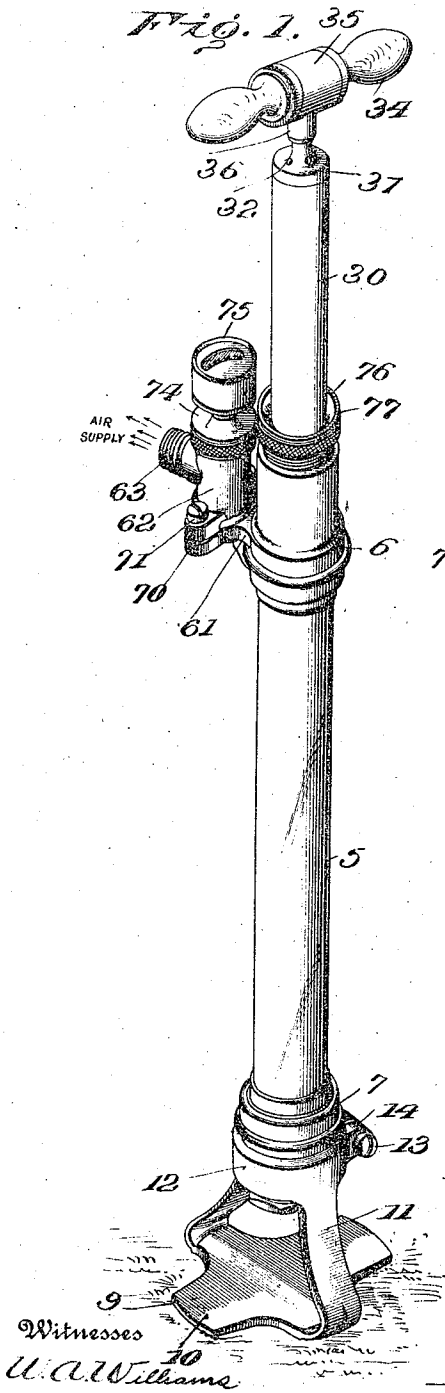


Fig. 2.

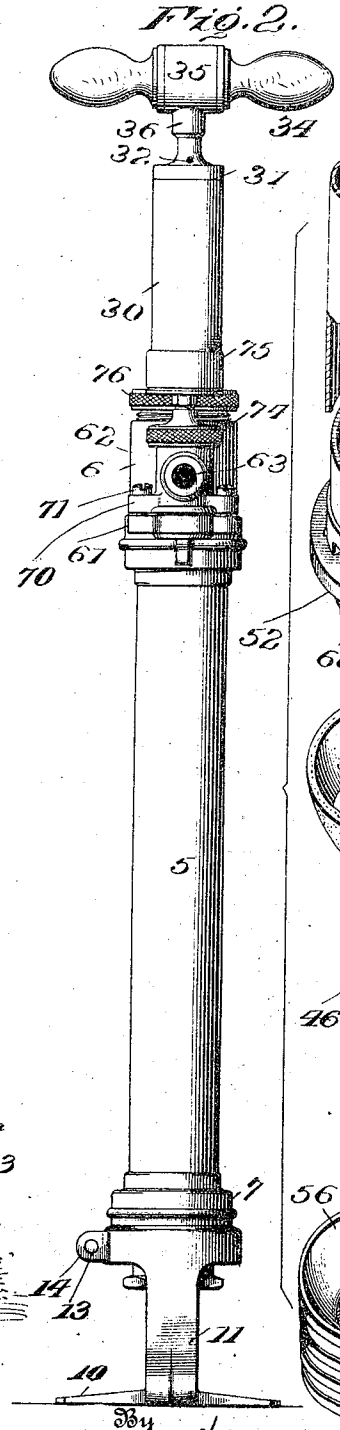
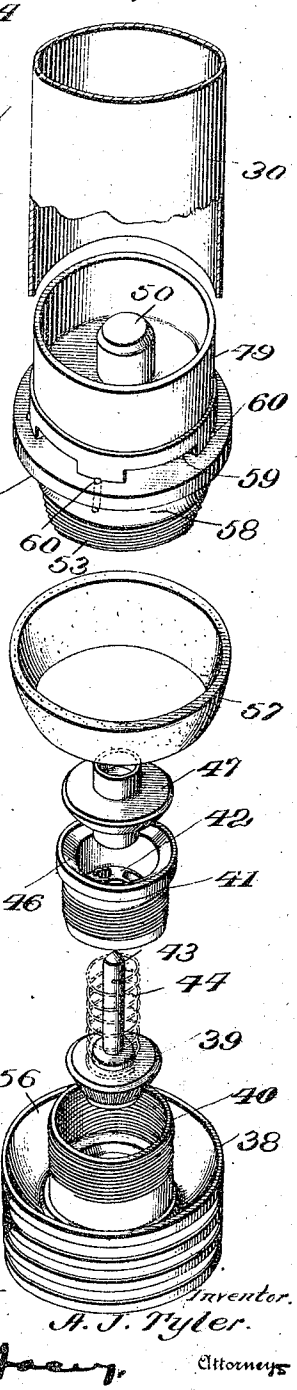


Fig. 3.



Witnesses

U. A. Williams

Inventor.

A. J. Tyler.

By

Attorneys

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3 SHEETS—SHEET 2.

Fig. 4.

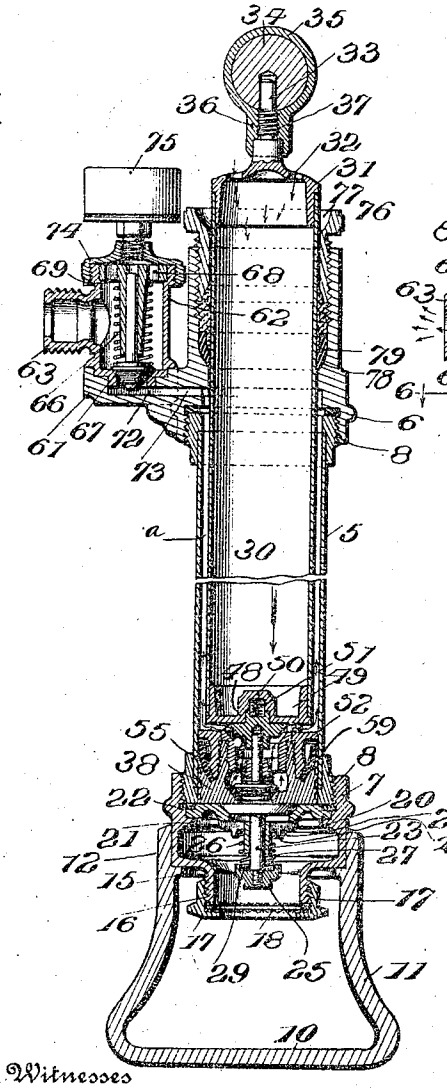
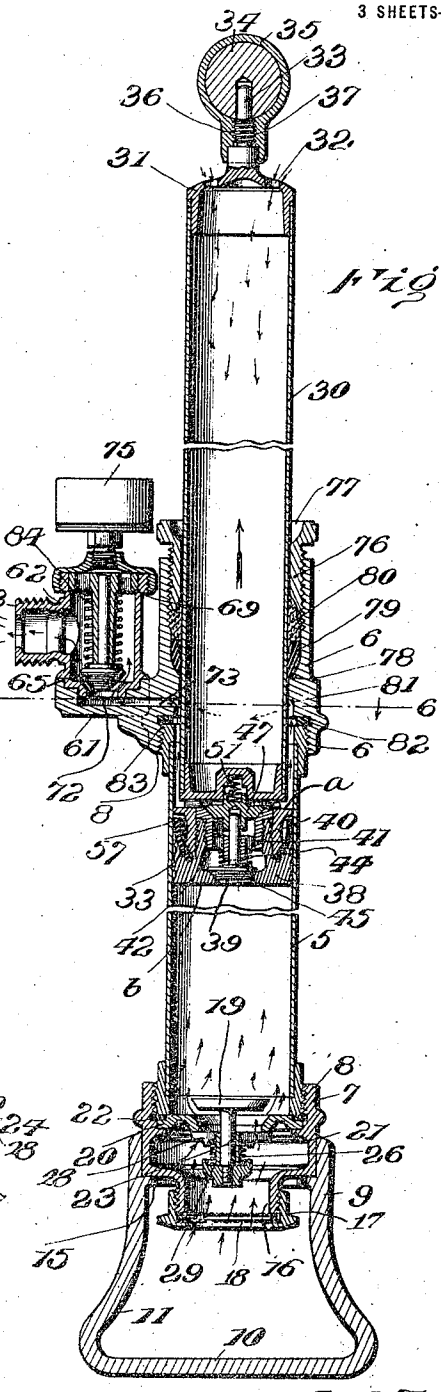


Fig. 5.



Witnesses

W. A. Williams

Inventor

A. J. Tyler.

By Harness.

Attorneys

A. J. TYLER.

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3 SHEETS—SHEET 3.

Fig. 6.

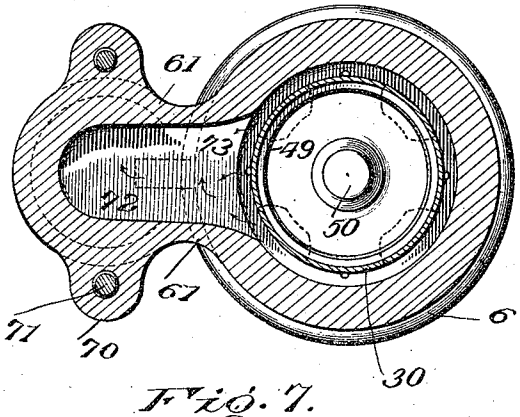


Fig. 8.

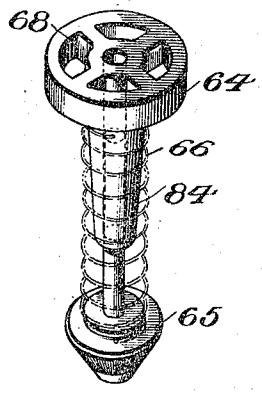


Fig. 7.

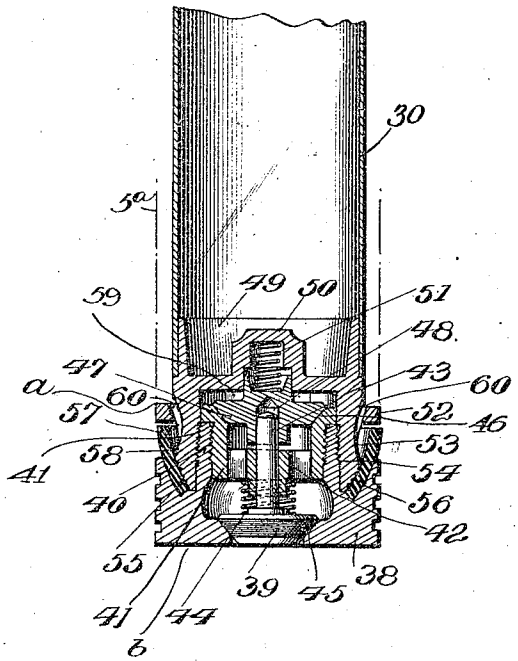
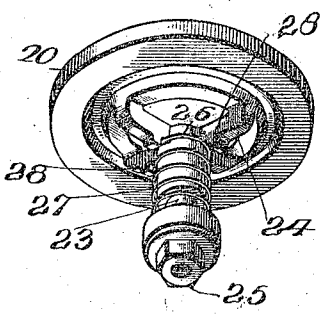


Fig. 9.



Inventor

A. J. Tyler.

Witnesses

W. A. Williams

By

Attorneys

UNITED STATES PATENT OFFICE.

AARON J. TYLER, OF ROCHESTER, NEW YORK, ASSIGNOR OF TWO-THIRDS TO HOWARD L. BIDELMAN, OF ROCHESTER, NEW YORK.

PNEUMATIC PUMP.

1,139,930. Specification of Letters Patent. **Patented May 18, 1915.**

Application filed July 24, 1912. Serial No. 711,296.

To all whom it may concern:

Be it known that I, AARON J. TYLER, citizen of the United States, residing at Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Pneumatic Pumps, of which the following is a specification.

This invention relates to pneumatic pumps and more particularly to that general class of pumps especially designed for inflating the tires of automobiles, bicycles and the like.

The primary object of the invention is the provision of a pneumatic pump of simple, compact and durable construction, capable of discharging a maximum volume of air and in which friction between the parts thereof is reduced to a minimum.

A further object of the invention is to provide a pump, the construction of which is such that the plunger will displace a full cylinder of air at each working stroke thereof.

A further object is to provide a double-acting pump having a differential plunger mounted for reciprocation in the cylinder thereof and provided with a novel form of valve for controlling the passage of air from the intake to the interior of the cylinder.

A further object is to provide the cylinder head with a lateral extension having a valve casing mounted thereon and provided with a nozzle for attachment to an air hose, there being a gage disposed above the casing and a check valve arranged within said casing for controlling the flow of air to the hose and gage, respectively.

A still further object of the invention is generally to improve this class of devices so as to increase their utility, durability and efficiency.

Further objects and advantages will appear in the following description, it being understood that various changes in form, proportions and minor details of construction may be resorted to within the scope of the appended claims.

For a full understanding of the invention and the merits thereof, reference is to be had to the following description and accompanying drawings, in which:

Figure 1 is a perspective view of a pneumatic pump constructed in accordance with the present invention; Fig. 2 is a side elevation; Fig. 3 is a perspective view of the plunger valve with the different parts thereof separated in order to more clearly show the construction thereof; Fig. 4 is a vertical sectional view, showing the plunger at the end of its downward stroke; Fig. 5 is a similar view, showing the plunger near the end of its upward stroke; Fig. 6 is an enlarged transverse sectional view taken on the line 6—6 of Fig. 5 and looking in the direction of the arrow; Fig. 7 is an enlarged vertical sectional view of the lower end of the plunger, showing the construction of the plunger valve; Fig. 8 is a detail perspective view of the check valve for controlling the flow of air to the nozzle and gage, respectively, detached; Fig. 9 is a perspective view of the intake valve detached.

Corresponding and like parts are referred to in the following description and indicated in all the views of the drawings by the same reference characters.

The improved pump forming the subject matter of the present invention comprises a cylinder 5 having upper and lower heads 6 and 7, the interior walls of which are threaded at 8 for engagement with the correspondingly threaded ends of the cylinder, as shown. Secured to the lower head 7, is a supporting base 9 having a foot piece 10 adapted to rest on the ground or other suitable support and provided with spaced converging arms 11 terminating in a split ring 12 adapted to encircle the lower head 7 of the cylinder and in which position it is retained by means of a clamping screw 13, passing through outstanding ears 14 formed on the split ring, as best shown in Fig. 1 of the drawings. The split ring 12 is provided with an inwardly extending flange 15 adapted to receive the lower head 7, the latter being provided with a threaded extension 16 for engagement with a correspondingly threaded cap 17. The cap 17 is provided with one or more screens 18 which extend across the lower end of the head 7 and serve to prevent the entrance of dust, dirt and other foreign matter to the operating parts of the pump.

Arranged at the lower end of the cylinder 5, is an inlet valve 19, the seat of which is provided with an annular flange 20 which rests o shoulder extending inwardly from the lower head 7, there being a gasket 22 interposed between the flange 20 and the adjacent threaded end of the cylinder in

order to prevent leakage between the parts. The valve 19 may be of any suitable construction, but is preferably provided with a depending stem 23 which passes through a centering spider 24 for engagement with a stop nut 25. The valve 19 opens upwardly and is normally held to its seat by means of a coil spring 26 which encircles a tubular extension 27 formed on the valve seat and bears against the nut 25, as shown. It will here be noted that the ribs of the spider 24 are provided with depending lugs 28 which serve to center the upper end of the coil spring 26 on the valve, while the nut 25 is provided with a depression 29 which serves to center the lower end of said spring.

Mounted for reciprocation within the cylinder 5, is a differential plunger 30, preferably hollow as shown, and having its upper end closed by a cap piece 31 in which are formed one or more openings 32 to permit the escape of heated air within the plunger when the latter is in operation. The cap 31 is provided with an upstanding pin 33, the free end of which projects within a handle 34 and serves to prevent rotation of the handle within a socket member 35. The socket member 35 encircles the intermediate portion of the handle and is provided with a tubular extension 36. the interior walls of which are threaded for engagement with corresponding threads 37 formed on an intermediate portion of the pin 33. By such a construction, the handle 34 may be readily detached from the plunger when it is desired to withdraw the plunger from the cylinder, while the pin 33 serves to prevent rotation of the handle within the member 35, as before stated.

The lower end of the differential plunger 30 is closed by a piston head 38 in which is mounted a valve disk 39. The head 38 has an upper face *a* and a lower face *b*. These faces are of different area and constitute the plunger faces of the differential plunger. Upper and lower valve seats are formed within the plunger head about in the planes of the respective plunger faces *a* and *b* and coöperate with valves in a manner and for the purpose hereinafter more fully explained. The piston head 38 is provided with a tubular extension 40, the interior walls of which are threaded for engagement with a cup-shaped member 41, the latter being provided with a spider 42 in which is mounted for reciprocation the stem 43 of the valve 39. A coil spring 44 is preferably interposed between the valve disk 39 and the lower face of the spider 42 in order to normally retain the head of the valve on its seat 45.

The upper end of the cup-shaped member 41 is beveled as indicated at 46 to form a seat for a second valve disk 47. The lower portion of the upper valve disk 47 is provided with a socket 48 adapted to receive the upper end of the stem 43 which projects upward from the lower valve disk, thus to assist in guiding said upper disk when the latter is moved to open position. Arranged above the disk 47, is a cylindrical member 49, which fits within the lower portion of the plunger and is provided with a central boss 50 having a socket formed therein for the reception of a spring 51, which latter fits within a similar socket formed in the disk 47 and serves to retain said valve on its seat. Extending laterally from the cylindrical member 49, is a flange 52 and arranged below said flange, is a depending nipple 53, the interior walls of which are threaded at 54 for engagement with corresponding threads formed on the exterior walls of the tubular member 40. The lower end of the nipple 53 is curved inwardly and downwardly at 55 in parallel relation to a correspondingly curved wall 56 formed on the piston head 38. The wall 56 forms a seat for a washer 57, preferably formed of leather and which, by contact with the interior wall of the cylinder 5, serves to prevent leakage of air during the operation of the plunger. The nipple 53 is provided with an exterior circumferential groove 58 adapted to receive a quantity of lubricating oil so as to keep the leather washer soft and pliable at all times. It will thus be seen that when the washer 57 is placed on its seat and the piston head 38 screwed home, said washer will be effectually held against accidental displacement, while at the same time the members 38, 53 and 40 will be securely clamped in assembled position.

Formed in the outer wall of the cylindrical member 49, are a series of horizontal slots or openings 59 which communicate with the valve seat 46 so as to permit the passage of air from the intake through the valves 39 and 47 to the interior of the cylinder, on the down stroke of the plunger. The flange 52 is provided with a series of spaced ducts or passages 60 which communicate with the circumferential groove 58 so that when the pump is in operation, air will pass through said ducts and force the oil in the groove in contact with the washer 57, thus to cause the latter to bear against the interior wall of the cylinder and form a tight joint.

The head 6 is provided with a lateral extension 61 on which is mounted a valve casing 62 having a laterally extending nipple 63, the exterior walls of which are threaded for detachable connection with an ordinary air hose (not shown). Arranged within the casing 62, is a spring pressed valve, preferably formed in two sections 64 and 65 between which is interposed a coil spring 66. The valve proper 65 is normally held to its seat 67 in the valve casing by the spring 66,

while the section 64 of the valve is provided with a series of openings 68 and normally rest on a shoulder 69 formed in the inner wall of the valve casing, as best shown in Fig. 4 of the drawings. The valve casing 62 is provided with laterally extending perforated ears 70 which register with corresponding ears formed on the extension 61, the parts being clamped together by screws or similar fastening devices 71. The extension 61 is formed with a recess 72 arranged directly below the check valve 65 and with which communicates a duct or passage 73 leading to the interior of the cylinder 5. The upper end of the casing 62 is closed by a cap piece 74 having a threaded opening therein to permit the attachment of a pressure gage 75 of any suitable construction.

Threaded in the upper end of the head 6, is a gland 76 having a cup-shaped depression 77 formed therein which surrounds the plunger 30 and serves to receive a quantity of oil for lubricating the plunger. The interior of the head 6 is provided with a curved wall 78 which forms a seat for a gasket or washer 79 and interposed between said washer and the gland 76, is a suitable packing 80. Thus it will be seen that when the gland 76 is rotated to compress the packing 80, the washer 79 will be expanded into contact with the walls of the plunger 30 and thus form a tight joint between the parts. The inner wall of the head 6 is also preferably provided with spaced shoulders 81 and 82, one of which forms a stop for limiting the upward movement of the plunger 30, while the other forms a seat for a gasket 83 interposed between said shoulder and the adjacent end of the cylinder, as best shown in Fig. 5 of the drawings.

In practice, the operator either inserts his foot between the walls 11 of the foot piece or stirrup and operates the plunger by reciprocating the handle 34, or straddles the pump with one foot on each end of the plate 10. On the downward stroke of the plunger, the intake valve 19 will be closed, and the air below the plunger will pass out through the valve formed by the disks 39 and 47 to the interior of the cylinder. On the upward stroke of the plunger, the intake valve 19 will be automatically moved to open position, while the valve disks 39 and 47 will be retained in closed position by the tension of the springs 44 and 51, the air in the cylinder being forced upwardly and laterally through the duct 73 to the nozzle 63 and gage 75, respectively. It will of course be understood that prior to operating the pump, the usual air hose, leading to the inflation valve on an automobile or bicycle, will be attached to the nipple 63 so that as the plunger is reciprocated, air will be forced through said hose to the tire, and at the same time, the pressure of the air will be indicated on the gage. It will here be noted that the openings 68 in the member 64 of the check valve permit the flow of air through said member 64 to the gage, while the depending extension 84 forms a guide for the stem of the valve 65.

The particular construction of the plunger head and the double valve formed by the valve disks 39 and 47 and the particular construction of the inlet valve 19 and its seat is of great importance to the efficiency of my pneumatic pump. It will be noted from Figs. 4 and 5 that the upper face of the head 7 is formed with an annular flange 20 and that the inner face of the head thus formed by the wall of the valve seat is flat except where centrally bent to form the seat proper for the valve 19. It will also be seen from Fig. 4 that when the valve 19 is closed its upper face is flush with the upper face of the head closing the lower end of the cylinder. The construction of the plunger head 38 is such that the lower face of the valve disk 39 is practically flush with the lower face *b* of the plunger head when the disk 39 is closed and the upper face of the valve disk 47 is flush with the upper face *a* of the plunger head when this valve is closed, as shown clearly in Fig. 5. Now upon a downward movement of the plunger from its uppermost position the air in the lower portion of the cylinder is compressed and passes through the plunger head into the upper portion of the cylinder and when the plunger reaches its lowermost position, shown in Fig. 4, the flat under face *b* of the plunger head will fit closely against the flat upper face of the closed end of the cylinder and against the flat upper face of the valve 19, and, inasmuch as all air has been forced out between the plunger head and the lower end of the cylinder, the valve 39 will close from the force of its spring, thus preventing any trapping of air within the hollow plunger head. Upon the upward movement of the plunger, the upper valve 47 will close and the air contained in the upper portion 5^a of the cylinder above the head *a* and between the body 30 of the plunger and the cylinder will be compressed and forced out through the port 73. It will be seen that no air is left between the lower end of the plunger head and the closed lower end of the cylinder upon the full downward movement of the piston, and this is due to the fact that the valve 19 when closed is flush with the face of the plunger head and that the valve 39 when closed is flush with the lower face *b* of the plunger head.

The reason for having a double valve within the plunger head controlling the passage of air therethrough is as follows: In the pistons or plungers of air pumps, it is particularly necessary that the plunger

head should be thoroughly packed so as to prevent the leakage of air around the plunger head. In order to provide for this packing the plunger head must be relatively deep or thick, it being impossible to properly pack a plunger head which is shallow or thin. Where packing rings are used, provision must be made for a plurality of these rings, and where a packing cup is used, such as the cup 57, it is necessary that this cup should have considerable surface in contact with the cylinder and with the exterior of the head. Furthermore, where a packing cup is used, it is necessary to provide for properly placing the cup in position and removing the cup. Therefore, the plunger head must be sectional and it is practically impossible to use a sectional head unless it is relatively deep.

With a relatively deep head, a relatively long passage must be provided through the head and this passage, if only one valve is used to control the flow of air therethrough, will contain air under compression, which will act to cushion the stroke of the plunger and will very greatly reduce the efficiency of the pump. If no lower valve, as 39, were provided in this plunger, then upon a descent of the plunger, air would be compressed within the plunger head to the same degree as it is below the head and the space in the plunger under the upper valve disk, would contain compressed air. On the return stroke of the plunger this air would expand back and fill the bottom of the cylinder and the pressure would have to be reduced to normal before any more air could be gotten into the cylinder from the outside. This would not only serve to shorten the working stroke of the pump, but, at the same time, a portion of the energy used to compress the air contained within the plunger would be lost. If no upper valve, as 47, were provided in this plunger, loss of stroke and power would result, this being due to the fact that the air above the plunger face *a* and contained in the space 5^a is compressed to a much higher degree upon the upstroke of the plunger than the air in the lower portion of the cylinder below the plunger face *b* upon the down stroke of the plunger. In order to compress the air and do it effectively, without loss of plunger stroke and energy, every bit of the air must be forced out on each and every stroke of the plunger. This result is secured, as before stated, by the fact that the upper valve disk seats flush with the upper end of the plunger head while the lower valve disk seats flush with the lower face of the plunger head. The whole object of the valve construction, therefore, is to prevent trapping of air under compression within the relatively long passage formed in the piston head. While it would be theoretically possible to make a piston head with only one valve which would not trap air within the piston head, either on the up stroke or down stroke, yet it is not practically possible so to do, as before stated, because of the necessity of providing space for the packing. If a single valve was provided having a depth equal to the depth or thickness of a relatively deep or thick head, the valve could not be guided properly and it would be of such weight as would prevent its necessarily delicate operation. In order to reduce this weight, the valve might be cut away at its middle to provide two valve disks connected by an integral stem, but in this case it would be very difficult, if not impossible, to put such a valve in place and, therefore, it is necessary to form the valve controlling the passage of air through the plunger of two sections or parts, each being formed with a valve disk coacting with its own proper seat. This permits the valve to be readily set in place and as readily removed and adjusted, and this further permits of the slightly independent operation of the two valve disks so that one disk can close before or after the other disk. A further reason for forming the valve in two sections, each having its own valve disk and each being independently closable and operable by an independent spring is that the lower valve disk 39 must not be retarded in its closing movement by the upper valve disk 47. Upon the downward movement of the plunger the lower valve disk opens as does the upper valve disk. Now, when the plunger arrives at the lower end of its stroke, it is necessary that the valve 39 shall immediately close. Air under compression will be contained within the space surrounding the valve stem and this air will, to a certain extent, resist the movement of the upper valve 47. It does not matter, at this time, whether the upper valve 47 closes or not, but it is most essential that the lower valve shall close. In order for the upper valve to close, it must slightly compress the air within the passage through the head and even this slight compression of air, will tend to retard the closing of the upper valve, and therefore, check the closing of the lower valve disk, were the two disks connected integrally so as to move together. It will, therefore, be seen that it is essential to the complete and perfect operation of my pump that it should have the peculiar structure shown.

It will of course be understood that the size and shape of the foot piece may be varied, and that any style of valve may be employed for controlling the intake of air to the lower end of the cylinder. While the pump is principally designed for inflating the pneumatic tires of automobiles, it will be

ciprocation within the cylinder and including a plunger head having a passage therethrough formed with a valve seat at its upper end and a valve seat at its lower end, and a double valve including an upper and a lower valve disk and a stem, said double valve opening inward, one of said valve disks seating against the upper seat, the other of said valve disks seating against the lower seat, the upper valve disk when seated having its upper face lying flush with the upper face of the head and the lower valve disk when seated having its lower face lying flush with the under face of the head.

9. A pneumatic pump including a cylinder having an outlet at one end, the other end of the cylinder being closed by a cylinder head having an inlet passage and a valve surrounding the passage, the inner face of said head being flat, an inwardly opening valve controlling said passage and having a flat inner face adapted when the valve is closed to lie flush with the inner face of the head, and a differential plunger mounted for reciprocation within the cylinder and including a plunger head having a passage therethrough formed with a valve seat at its upper end and a valve seat at its lower end, and a double valve including an upper and a lower valve disk and a stem, said double valve opening inward, one of said valve disks seating against the upper seat, the other of said valve disks seating against the lower seat, the upper valve disk when seated having its upper face lying flush with the upper face of the head and the lower valve disk when seated having its lower face lying flush with the under face of the head.

10. In a pneumatic pump, the combination with a cylinder having an outlet opening in one end, an inlet opening at the other end, and an inwardly opening valve controlling said inlet opening, of a plunger working in said cylinder, a head at the lower end of the plunger, a connecting member secured within the lower end of the plunger around the head and provided with radial openings establishing communication between the bore of the head and the interior of the cylinder, a spider within the head constructed with a valve seat immediately adjacent the openings through the connecting member, a valve guided by said spider and seating in the lower end of the head, and a second valve guided by the first-mentioned valve and seating upon the spider.

11. In a pneumatic pump, the combination with a cylinder having an outlet opening in one end, an inlet opening at the other end, and an inwardly opening valve controlling said inlet opening, of a plunger working in said cylinder, a cylindrical member secured in and closing the lower end of the plunger and provided with radial openings forming a communication between the interior of said member and the space between the plunger and the cylinder, a head having an upwardly extending cylindrical portion secured within the lower end of said cylindrical connecting member, a spider secured in the upper end of said extension and having a valve seat formed on its upper end, a valve seating in the lower end of the head and provided with a stem extending upwardly through the spider, a second valve fitting over the said stem of the first-mentioned valve and seating upon the spider, a spring disposed between the connecting member and the said second valve, and a spring disposed between the spider and the first-mentioned valve.

In testimony whereof I affix my signature in presence of two witnesses.

AARON J. TYLER. [L. S.]

Witnesses:
SAMUEL N. ACKER,
W. N. WOODSON.

understood that the pump may be used with equally good results for attachment to air compressors and the like without departing from the spirit of the invention. When the pump is used in connection with an air compressor, the usual packing rings will be used in lieu of the cup-shaped leather washer 57.

From the foregoing description, it will be seen that the pump is so constructed that the several parts thereof may be readily detached to permit of repairs or replacement of any part when necessary, and that the differential plunger permits displacement of a full cylinder of air at each working stroke thereof with the least possible friction between the parts.

Having thus described the invention, what is claimed as new is:

1. In a double acting air pump, a plunger having spaced plunger faces of different area and formed with inner valve seats about in the planes of the respective plunger faces, and spaced valves arranged within the plunger and adapted to close upon the respective valve seats in the same direction.

2. A pneumatic pump including a cylinder, a differential plunger operating within the cylinder, an intake valve arranged at one end of the cylinder, an outlet arranged near the other end of the cylinder, and coacting independently moving valve disks disposed one above the other in the lower end of the plunger and movable to open position upon a down stroke of the plunger.

3. A pneumatic pump including a cylinder, an intake valve disposed at one end of the cylinder, a differential plunger operating within the cylinder and including a relatively thick head having a passage therethrough, and coacting valve disks disposed one above the other in the said head and movable to open position upon the down stroke of the piston and to closed position upon the up stroke of the piston.

4. A pneumatic pump including a cylinder having an outlet at one end, the other end of the cylinder being closed by a cylinder-head having an inlet passage, an inwardly opening valve controlling said passage, a differential plunger mounted for reciprocation within the cylinder and including a plunger head having a passage therethrough formed with a valve seat at its outer end and at its inner end, and a double valve comprising an upper and a lower valve disk, and a stem operatively connecting the valve disks, said double valve opening inward, and one of said valve disks seating against the seat at one end of the passage, the other of said valve disks seating against the seat formed at the other end of the passage.

5. A pneumatic pump including a cylinder having an outlet at one end, the other end of the cylinder having an inlet passage, an inwardly opening valve controlling said passage, a differential plunger mounted for reciprocation within the cylinder and including a plunger head having a passage therethrough, the outer end of the passage being formed with a valve seat and the inner end of the passage being also formed with a valve seat, and a double valve controlling said passage comprising an upper disk and a lower disk seating respectively against said upper and lower seats, said valve disks being independently movable with relation to each other but connected, and springs urging said valve disks to their respective seats.

6. A pneumatic pump including a cylinder having an outlet at one end and an inlet port at the other end, a valve controlling the inlet opening, a plunger mounted for reciprocation within the cylinder and including a plunger head having a passage therethrough, a valve controlling the flow of air through said passage, said valve being formed in two sections, each of said sections having a valve disk, each of said disks coacting with one of the valve seats formed in said passage, the lower disk when seated having its lower face flush with the lower face of the plunger, the upper disk when seated having its upper face flush with the upper face of the plunger, and means yieldably forcing each of said disks to its seat.

7. A pneumatic pump including a cylinder having an outlet at one end, the other end of the cylinder being closed by a cylinder head having an inlet passage, said cylinder head upon its inside face being flat, an inwardly opening valve controlling said passage, the inner face of said valve being flat and lying flush with the flat inner face of the head when the valve is seated, and a differential plunger mounted for reciprocation upon the cylinder and including a plunger head having a passage therethrough, and spaced valve seats at the ends of the passage about in line with the respective plunger faces, and valve means closing in the same direction upon the said valve seats and embodying an upper face lying about flush with the upper face of the head, and a lower face lying about flush with the lower face of the head to thereby prevent trapping of air within the plunger head and expansion of the trapped air upon a movement of the head.

8. A pneumatic pump including a cylinder having an outlet at one end, the other end of the cylinder being closed by a cylinder head having an inlet passage and a valve surrounding the passage, the inner face of said head being flat, an inwardly opening valve controlling said passage and having a flat inner face adapted when the valve is closed to lie flush with the inner face of the head, a differential plunger mounted for re-