To all whom it may concern:

Be it known that I, ROBERT WATSON, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Apparatus for Treating Diseases by Vacuum and Air Pressure, of which the following is a specification.

The purpose of the present invention is to provide an apparatus for the local treatment of disease by vacuum and air pressure; and it comprises a cylinder having an opening adapted to be closed by the part of the body to be treated and an air inlet and exit port, a valve adapted to open and close said port, a reciprocating piston and a tappet adjustable relatively to the valve and arranged to engage said valve and move it relatively to the port into the proper positions to cause the apparatus to successively compress, successively rarefy, or alternately compress and rarefy the air within the cylinder, the internal and external air-pressures being permitted to equalize at the completion of each operation of compression and rarefaction.

In the accompanying drawings, Figure 1 shows a pump embodying my improvements, the pump-cylinder being shown in central section and the valve-tappet being adjusted to cause compression of the air within the cylinder. Figs. 2 and 3 are views of the piston, piston-rod, valve, and tappet, showing the tappet in the same position as in Fig. 1 and illustrating the position of the valve at the end of each stroke. Figs. 4 and 5 are similar views showing the tappet arranged to adjust the valve for suction only. Figs. 6, 7, and 8 are similar views showing the tappet arranged to cause alternate compression and rarefaction of the air within the cylinder. Fig. 9 is a perspective view of the valve. Fig. 10 is a view showing the rear side of the valve and a portion of the piston-rod, having a guide-pin thereon for preventing the turning of the valve upon the rod. Fig. 11 is a perspective view of the end of the tappet-support. Fig. 12 is a similar view of the tappet; and Fig. 13 is a longitudinal section through a pump, in which the tappet is movable with the piston instead of being fixed relatively thereto.

Referring to Fig. 1 of the drawings, 1 indicates a cylinder having a tubular projection 2 at one end, to which may be connected a flexible tube 3 and a tubular part 4, adapted to be applied to and closed by the ear or other part of the body which is to be treated. A cap 5 is fitted to the opposite end of the cylinder and serves as a bearing for a tubular piston-rod 6. Openings 7 are formed in this cap in order to permit the air to circulate freely therethrough. The outer end of the piston-rod is closed by a head 8 which, as shown in the drawings, is suitably formed for attachment to a driving-crank. The inner end of the piston-rod is open and communicates with the space 9 in the forward part of the cylinder. A piston 10 is secured to the piston-rod, this piston being conveniently formed by arranging a pair of leather cups 11 back to back and securing them around the rod. An air inlet and exit port 12 is formed in the rod exteriorly to the cylinder 8. This vent is adapted to be opened and closed by a valve 11, which is arranged at different points in the movement of the piston-rod by means of an adjustable tappet 14. The valve, as shown in Figs. 9 and 10, consists of a sleeve having an internal bore of the same diameter as the piston-rod and having a slot 13 so extending longitudinally through it. The sleeve thus has sufficient elasticity to cause it to be frictionally held upon the rod in any position, and the sleeve is prevented from turning upon the rod by a pin 14, projecting 85 from the rod into the slot. Flanges or projections 15 and 16 are formed at the opposite ends of the sleeve and adapted to be engaged by the tappet, and the central part of the sleeve on the side opposite to the slot 13 is cut away, as shown at 17, in order that the air may escape or enter through the port 12 when said port is in register with the opening 17. The valve is a double one, having two valve portions 18 and 19 at the opposite ends of the opening 17, adapted to close the port 12. The piston-rod has a fixed range of movement, and the valve 11, which is arrested by
the tappet before the completion of the piston-stroke, has a shorter range of movement. If the stroke of the piston, for instance, is one inch, the length of the valve-sleeve between the flanges may be conveniently three-fourths of an inch, and by making the opening 17 one-fourth of an inch long the valve portions 18 and 19 of the sleeve will each be of the same length. The tappet T consists of a flat piece of metal having a part 20 adapted to seat against the under side of the end 21 of a tappet-arm 22, which, as shown, is secured to the cylinder. The part 20 has a rib 23, adapted to fit into any one of three grooves 24, 25, and 26 upon the end of the tappet-arm and radiating from an opening in said arm, through which a stud 28 passes into the tappet projects. This stud is provided at its upper end with a head 29, to which is attached a handle 30. A spring 31, arranged between the head and the tappet-arm, draws the tappet against the lower face of the arm and holds the rib 23 within any particular groove in the arm. The depending part 32 of the tappet projects downwardly between the flanges of the valve-sleeve and is adapted to engage said flanges, thereby arresting the movement of the sleeve. For a piston-rod having a movement of one inch and a valve-sleeve having valve portions of the dimensions above given the part 32 of the tappet should be approximately one-quarter of an inch wide, and the center of the stud 28 should be about one-eighth of an inch removed from the depending portion 32, so that the depending part of the tappet may be swung into two positions one-quarter of an inch apart, as shown in Figs. 1 and 4, and it may be turned so that its opposite sides 33 and 34 will be one-quarter of an inch apart longitudinally of the piston-rod, as shown in Figs. 6, 7, and 8. These dimensions are merely given for the purpose of illustration.

The operation of the pump illustrated in Figs. 1 to 12, inclusive, is as follows: When the tappet is turned into the position shown in Figs. 1, 2, and 3, the rib 23 upon the tappet enters the groove 24, and the tappet is thus located in position. While the piston-rod is moving outward, the port 12 registers with the opening 17 in the sleeve and air may freely enter through the tubular rod into the cylinder, thus preventing the formation of a partial vacuum therein. When the piston reaches the three-quarter stroke, the flange 15 upon the sleeve engages the tappet and is arrested thereby until the completion of the stroke. The port 12 therefore passes under the sleeve and is closed by the valve portion 19 of the sleeve, as shown in Fig. 2, and upon the ensuing inward stroke of the piston-rod compression takes place within the cylinder, assuming, of course, that the tubular end piece 4 is closed by application to the part of the body to be treated. When the piston-rod has completed three-quarters of its inward move-
its outer end. Finger-pieces 40 are arranged at the forward end of the cylinder, and the piston is reciprocated by placing the fingers upon the parts 40 and pressing the cap 39 with the thumb. A spring 41 within the cylinder forces the piston outward, as shown in dotted lines, when the pressure of the thumb is relieved from the cap-piece. The port for the cylinder consists of a transverse slot 42, and the sleeve Y, which serves as a valve, fits around the cylinder and is similar in construction to the valve-sleeve in the previously-described figures. The tappet also is constructed and arranged as in the previously-described figures; but the tappet-support 43, instead of being fixed relative to the piston, is connected to the cap-piece 39 of the piston and movable therewith. The tappet-support, as shown, has an offset portion 44, which when the piston is in its outermost position (shown in dotted lines) abuts against a stop 45 upon the side of the cylinder. The tappet-arm extends through an opening 46 in this stop projection. The inward movement of the piston is arrested by the abutment of the cap 39 against the end of the cylinder. The piston therefore has a fixed range of movement which is greater than the distance between the flanges upon the valve-sleeve, and the latter is so proportioned that the adjustment of the tappet into its three positions will close and open the port 42 in the proper manner to produce the three results desired—namely, compression only, suction only, or compression and suction alternately—according to the adjustment of the tappet.

The degree of compression or rarefaction of the air may be controlled by a suitable valve 47, as shown in Figs. 1 and 13. By pivoting the tappet at one side of its engaging end to the support and constructing the tappet so that the edges of said engaging end are separated from another by a distance approximately equal to the diameter of the cylinder, it will be seen that all functions of the apparatus may be performed by simply turning the tappet about its pivotal point into three positions.

Having described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In an apparatus for treating disease, the combination with an air-chamber having an opening adapted to be closed by the part of the body to be treated and having an air inlet and exit port, of a valve having two portions adapted to extend over and close said port and an intermediate opening adapted to register with said port, a piston for compressing and rarefying the air within the chamber, and a tappet arranged to engage and operate the valve when the piston is operated.

2. In an apparatus for treating disease by vacuum and air pressure, the combination with an air-chamber having an opening adapted to be closed by the part of the body to be treated and having an air inlet and exit port, of a valve having two portions adapted to extend over and close said port and an intermediate opening adapted to register with said port, a piston for compressing and rarefying the air within the chamber, and a tappet arranged to engage and operate the valve when the piston is operated.

3. In an apparatus for treating disease by vacuum and air pressure, the combination with an air-chamber having an opening adapted to be closed by the part of the body to be treated and having an air inlet and exit port, of a valve having two portions adapted to extend over and close said port and an intermediate opening adapted to register with said port, a piston for compressing and rarefying the air within the chamber, and a tappet adapted to operate the valve so as to close the port at the completion of one stroke of the piston and to open the port at the completion of the succeeding stroke.

4. In an apparatus for treating disease by vacuum and air pressure, the combination with an air-chamber having an opening adapted to be closed by the part of the body to be treated and having an air inlet and exit port, of a valve having two portions adapted to extend over and close said port and an intermediate opening adapted to register with said port, a piston for compressing and rarefying the air within the chamber, and a tappet adjustable relatively to the valve and adapted to operate the valve so as to close the port at the completion of either the inward or outward stroke of the piston and to open the port at the completion of the succeeding stroke.

5. In an apparatus for treating disease by vacuum and air pressure, the combination with an air-chamber having an opening adapted to be closed by the part of the body to be treated and having an air inlet and exit port, of a valve having two portions adapted to extend over and close said port and an intermediate opening adapted to register with said port, a piston for compressing and rarefying the air within the chamber, and a tappet adapted to operate the valve so as to close the port at the completion of each stroke of the piston and to open the port at an intermediate portion of the stroke.

6. In an apparatus for treating disease by vacuum and air pressure, the combination with an air-chamber having an opening adapted to be closed by the part of the body to be treated and having an air inlet and exit port, of a valve having two portions adapted to extend over and close said port and an intermediate opening adapted to register with said port, a piston for compressing and rarefying the air within the chamber, and a tappet adjustable relatively to the valve and adapted to operate the valve so as to close the port at the completion of either the in-
ward or outward stroke of the piston and to
open the port at the completion of the suc-
cceeding stroke, and also to close the port at
the completion of each stroke of the piston
and to open the port at an intermediate por-
tion of the stroke.
7. In an apparatus for treating disease by
vacuum and air pressure, the combination
with an air-chamber having an opening
adapted to be closed by the part of the body
to be treated and having a lateral inlet and
exit port, of a valve comprising a sleeve hav-
ing end portions adapted to close said port
and having an intermediate opening, a pis-
ton adapted to rarefy and compress the air
within the chamber, and a tappet adjustable
into several positions relatively to the valve
and adapted to engage and operate the valve.
8. In an apparatus for treating disease by
vacuum and air pressure, the combination
with an air-chamber having an opening
adapted to be closed by the part of the body
to be treated and having an air inlet and exit
port, of a piston having a fixed range of
movement, a valve comprising a sleeve, hav-
ing end portions adapted to close said port
and having a central opening, said sleeve
also having flanges or projections thereon
separated from one another by a distance
shorter than the range of movement of the
piston, and a tappet arranged to engage said
projections alternately when the piston is re-
ciprocated.
9. In an apparatus for treating disease, the
combination with an air-chamber having an
opening adapted to be closed by the part of
the body to be treated, of a piston for rarefy-
ng or compressing the air within the cham-
ber, a tubular piston-rod to which said piston
is connected, said rod having a lateral port,
a valve slidingly mounted upon said rod and
adapted to open and close said port, and a
tappet arranged to engage and operate said
valve.
10. In an apparatus for treating disease by
vacuum and air pressure, the combination
with an air-chamber having an opening
adapted to be closed by the part of the body
to be treated, of a piston adapted to rarefy
and compress the air within the chamber, a
tubular rod to which said piston is connected,
said rod having a lateral port, a valve com-
prising a sleeve mounted upon the piston-rod
and having two portions adapted to extend
over and close said port and having an in-
termediate opening, and a tappet arranged
to engage and operate said valve.
11. In an apparatus for treating disease by
vacuum and air pressure, the combination
with an air-chamber having an opening
adapted to be closed by the part of the body
to be treated, of a piston adapted to rarefy
and compress the air within the chamber, a
tubular rod to which said piston is connected,
said rod having a lateral port, a valve com-
prising a sleeve mounted upon the piston-rod
and having two portions adapted to extend
over and close said port and an intermediate
opening and a tappet adjustable relatively to
the valve and adapted to engage and operate
said valve.
12. In an apparatus for treating disease by
vacuum and air pressure, the combination
with an air-chamber having an opening
adapted to be closed by the part of the body
to be treated and having a lateral inlet and
exit port, of a piston for rarefying and com-
pressing the air within the chamber, said pis-
ton having a fixed range of movement, a valve
having end portions adapted to extend over
and close said port and having an interme-
diate opening adapted to register with said
port and shoulders separated from one an-
other by a distance shorter than the range of
movement of the piston, and a tappet extend-
ing between and adapted to engage said
shoulders, said tappet and valve being rela-
tively adjustable.
13. In an apparatus for treating disease by
vacuum and air pressure, the combination
with an air-chamber having an opening
adapted to be closed by the part of the body
to be treated and having a lateral inlet and
exit port, of a piston for rarefying and com-
pressing the air within the chamber, said pis-
ton having a fixed range of movement, a valve
having end portions adapted to extend over
and close said port and having an interme-
diate opening adapted to register with said
port and shoulders separated from one an-
other by a distance shorter than the range of
movement of the piston, and a tappet extend-
ing between and adapted to engage said
shoulders, said tappet being pivotally con-
ected at one side of its engaging portion to
a suitable support, and the edges of said en-
gaging portion being separated from one an-
other by a distance approximately equal to
the diameter to the circle in which said tapp
swings.
In testimony whereof I affix my signature
in presence of two witnesses.

ROBERT WATSON.

Witnesses:
C. W. CLEMENT,
L. I. JONES.