June 13, 1933. M. E. POPKIN 1,914,290

PNEUMATIC MASSAGING AND CLEANSING MACHINE

Filed Aug. 26, 1930 5 Sheets-Sheet 1

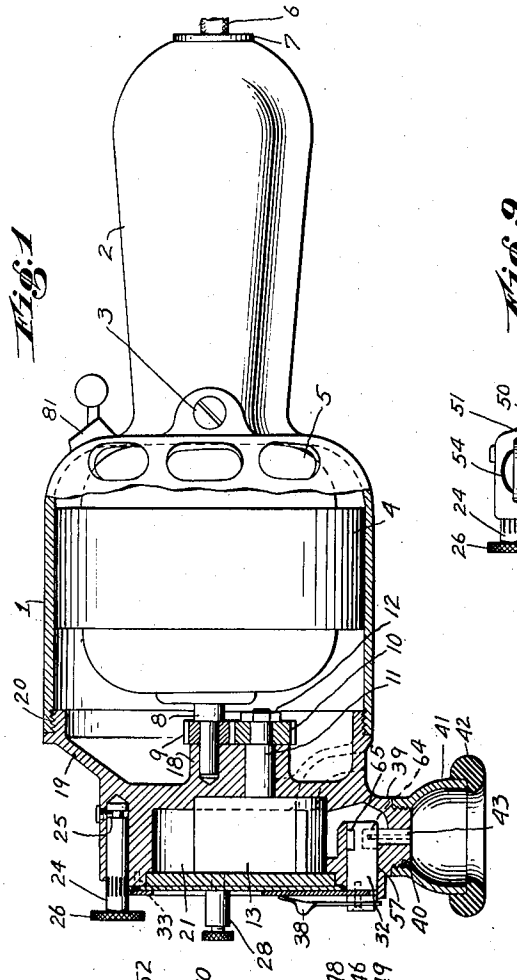


Fig. 1

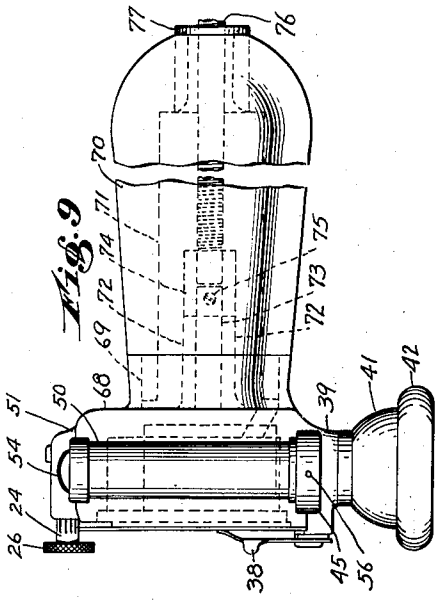


Fig. 9

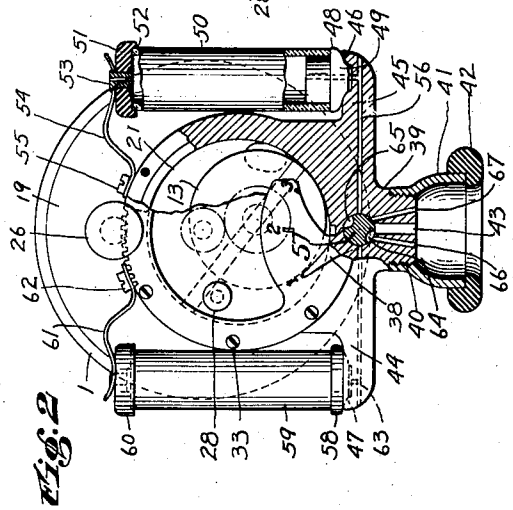


Fig. 2

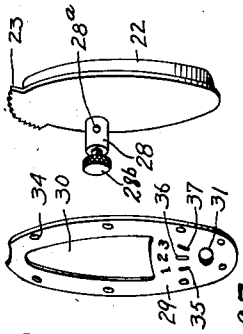


Fig. 3

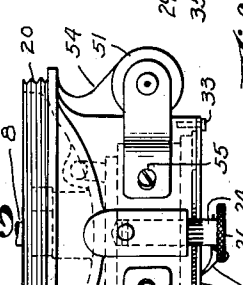


Fig. 4

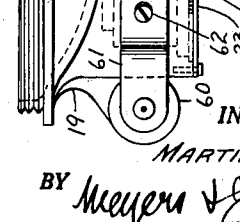


Fig. 5

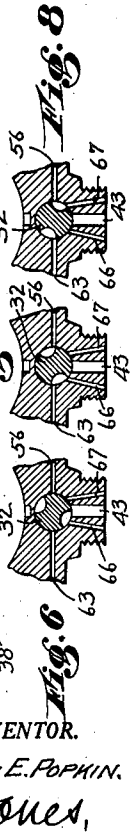


Fig. 8

Fig. 7

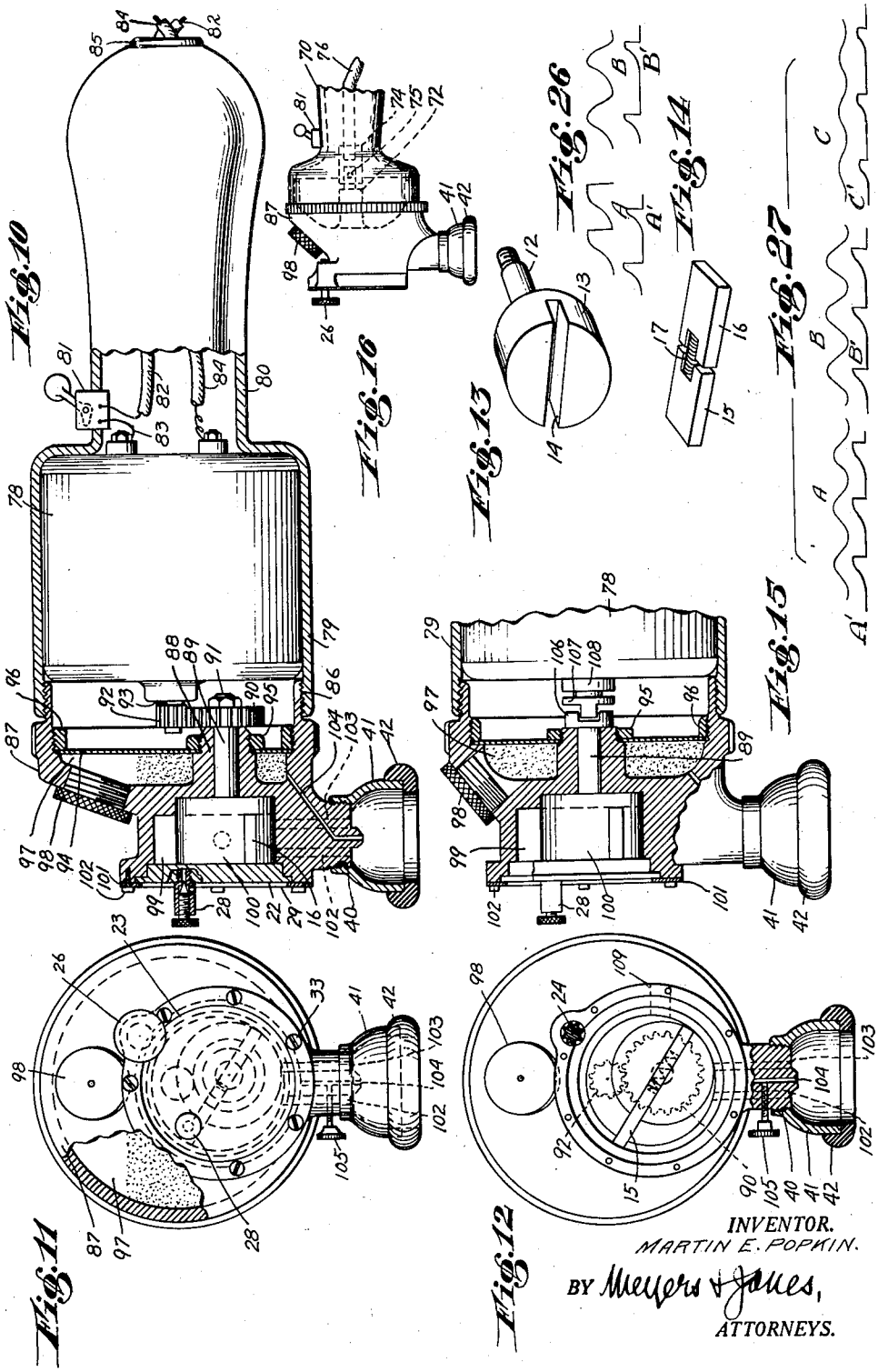
Fig. 6

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PNEUMATIC MASSAGING AND CLEANSING MACHINE

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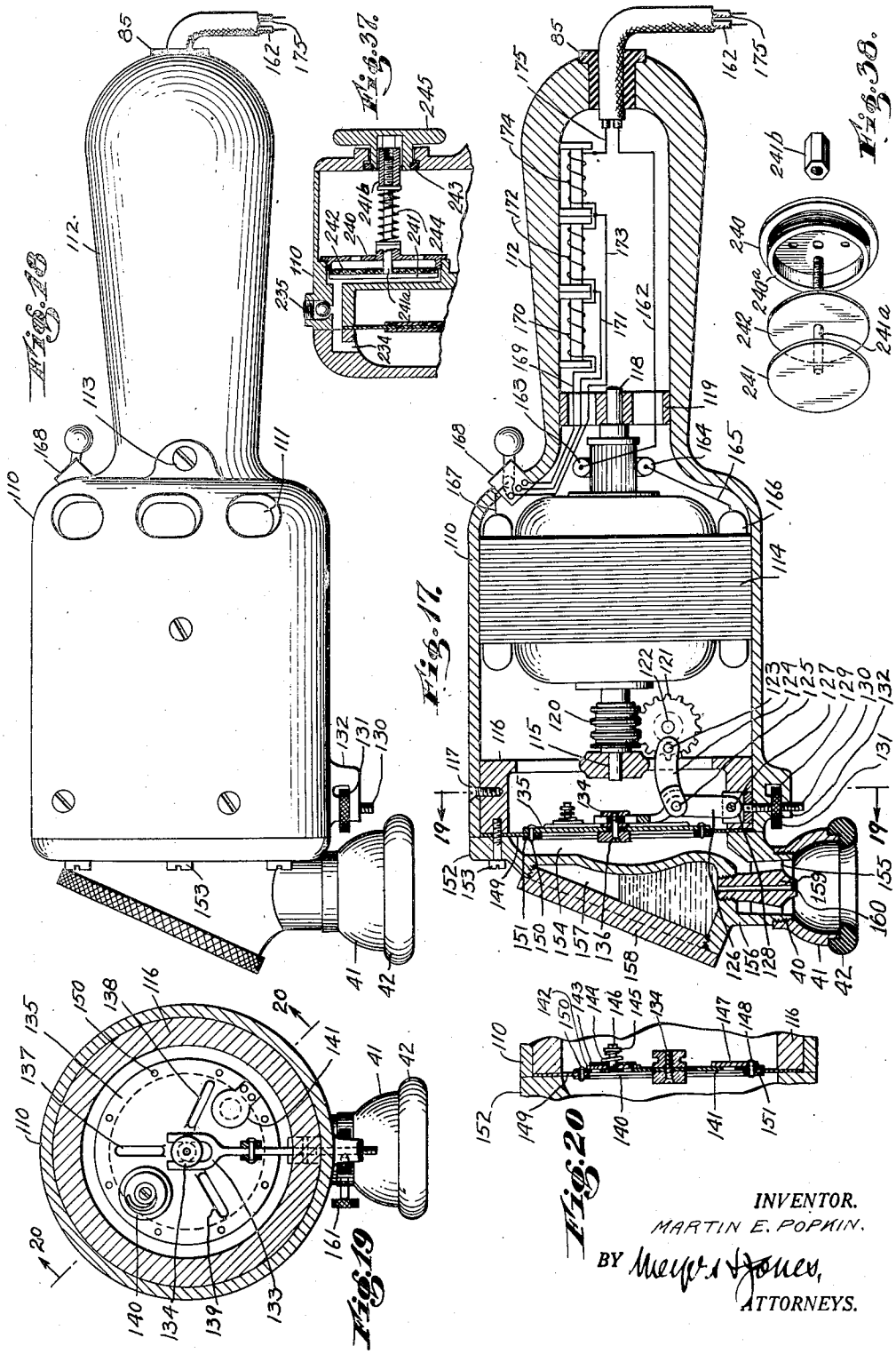


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PNEUMATIC MASSAGING AND CLEANSING MACHINE

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PNEUMATIC MASSAGING AND CLEANSING MACHINE

Filed Aug. 26, 1930 5 Sheets-Sheet 4

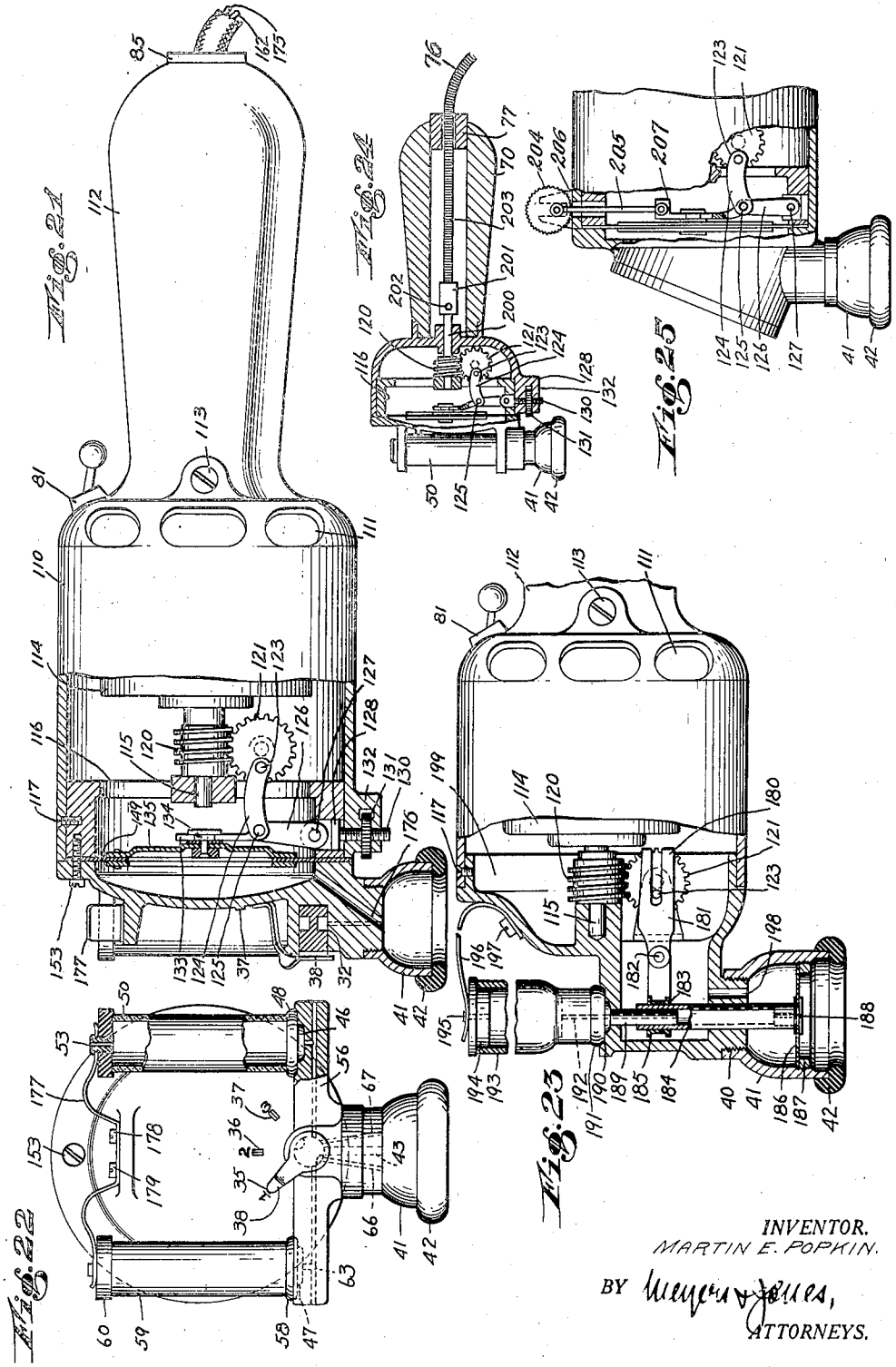


Fig. 21

Fig. 24

Fig. 25

Fig. 23

Fig. 22

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PNEUMATIC MASSAGING AND CLEANSING MACHINE

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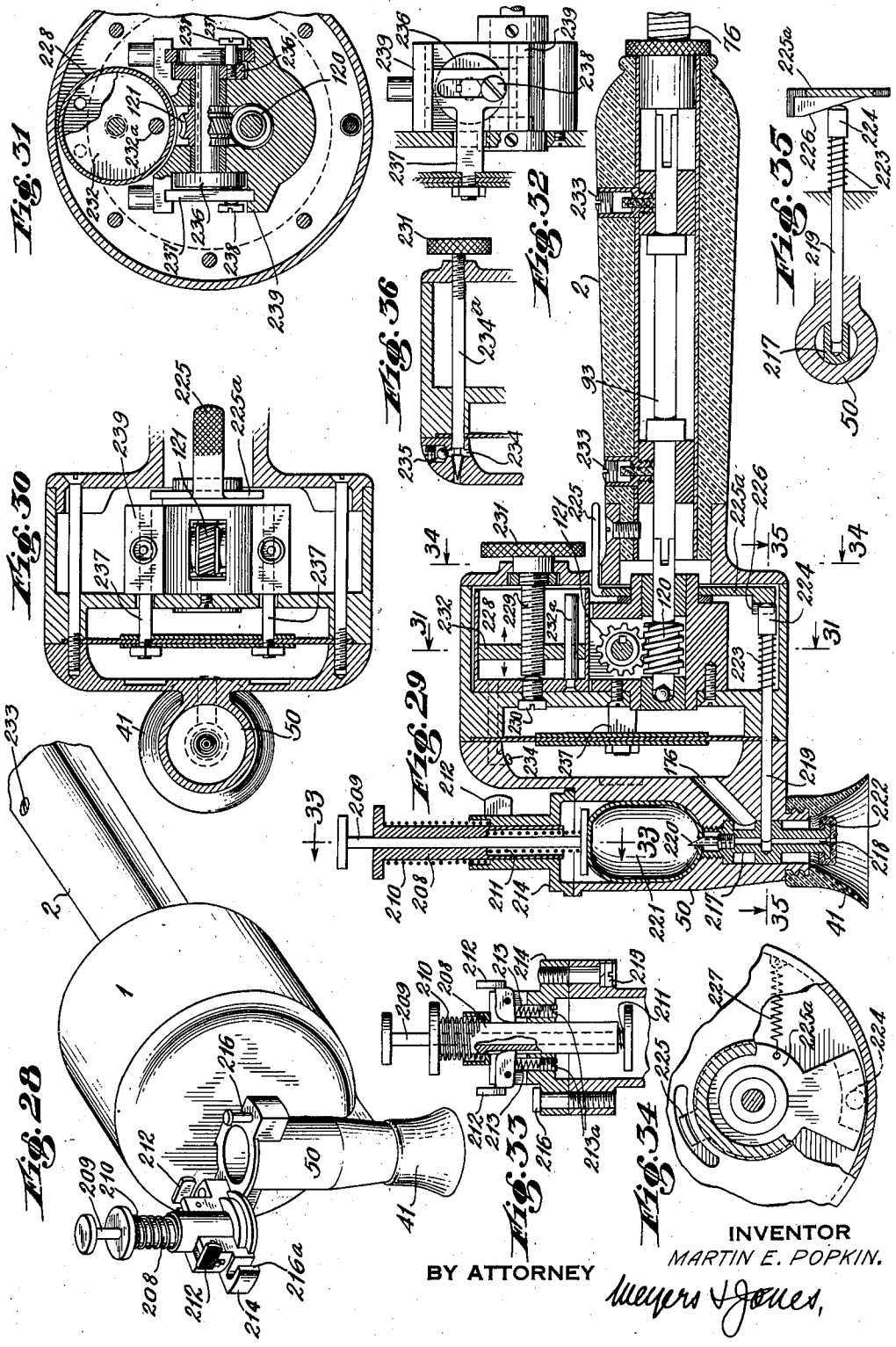


Fig. 28

Fig. 29

Fig. 30

Fig. 31

Fig. 32

Fig. 33

Fig. 34

Fig. 35

Fig. 36

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Patented June 13, 1933 1,914,290

UNITED STATES PATENT OFFICE

MARTIN E. POPKIN, OF NEW YORK, N. Y.

PNEUMATIC MASSAGING AND CLEANSING MACHINE

Application filed August 26, 1930. Serial No. 477,898.

My present invention relates to pneumatic massaging and skin cleansing machines, and has for its object to provide a new type of such machines having advantages over any known to me. The present application is a continuation in part, together with certain new parts, of my prior pending application No. 377,170, filed July 10th, 1929, which will be formally abandoned after the filing of this case.

While the novel features of this case will be more particularly defined and set out in the claims hereto appended, they may be succinctly stated as follows:—

The regulation in various respects of application of the massaging device to the skin is of great importance to physicians, and even to those who use these devices unprofessionally in "beauty" parlors, or the like. In the treatment of skin affections it is the purpose of the present constructions which I have devised to provide regulation of the ratio between lift and drop so that it may be varied from long suction and sharp drop to long suction and slow drop, or short suction and either sharp or slow drop, as the expert in charge may desire. This necessitates a regulation not only for both speed (or time) and intensity, which I believe to be new, and which certainly has not heretofore been appreciated, but also for the division of each cycle and assigning a desired part of it to suction, and another part to release thereof, as will be explained more at large in connection with curves of the actions.

I may employ somewhat different types of apparatus effecting the same purposes, one of which operates by the movement of a diaphragm, and the other by a pump. I provide a change of effective volume of air in the primary chamber in front of the diaphragm in one form, by means of some form of adjustable chamber (usually a cylinder) communicating with such primary chamber and which is auxiliary thereto, together with means for varying the volume of the auxiliary chamber such as an adjustable piston in the cylinder. In another form I provide a valve in connection with the chamber, the position of which may be regulated so as to control the effecting change of volume in the applicator in front of the diaphragm, thus changing the intensity of the suction.

As a variant of this form, I provide a valve communicating with the atmosphere and with the chamber in front of the diaphragm, with means for adjusting its stroke or area, or both, the valve controlled by a spring, so that by regulating the stroke or area of the valve the intensity of the suction may be adjusted as required, at the same time adjusting the character of the drop.

In the form of device in which a pump is employed I prefer a rotary pump with an impeller, as hereinafter more fully described, though other pumps may be used; and I provide a valve, the position of which may be adjusted to vary the length of the stroke, and thereby the intensity of the suction. If this valve is allowed to open freely so as to break the suction completely and instantly when the impeller passes, the drop is sharp; but means may be provided for retarding the stroke of the valve (as by adjusting the area of valve or inlet) so as to make the drop more deliberate, and this means may be adjustable. Thus in this form of device, both the character of the suction, the character of the drop and their ratio may be adjusted.

All of the requirements which I have thus described may be effected (as will be apparent after description of the mechanism) while the device is operating, which is to medical specialists in skin troubles a matter of the greatest importance. In prior devices, while in some of them there has been an intensity control and in others a speed control, in no type with which I am acquainted has there been variable speed and intensity embodied in a single apparatus, nor has this control adjustment been effected while the apparatus is operating; while in all forms of the types which I have just indicated, that is,—

A—Diaphragm type with variable stroke, to regulate the intensity of the vacuum or differential pressure; and a valve for regulating the time ratio of lift to drop;

B—Diaphragm type with variable volume provided by an auxiliary chamber communicating with the space in front of the dia-

phragm (or equivalent valve action), and a valve for regulating the time ratio of lift to release;

C—Pump or rotary impeller type, with a valve interposed between the intake and exhaust, movable in position to vary the intensity of the differential pressure or vacuum; the time ratio or lift to drop being variable by regulating the period of the valve, or the size of its opening.

It will be seen that the three different forms of adjustment are so combined as to give to the operator the closest possible control of intensity; of period, or speed; of the ratio of lift to drop; and the character of lift to drop. I believe that the embodying of all of these in a single apparatus has heretofore been unknown.

It is also new so far as I know not only to provide means for dividing the cycle of operation so as to change the ratio of lift to drop, but also to modify the character and period of each.

Also I combine with the apparatus, as thus constructed in its various substantially equivalent forms, means for supplying medicaments to the applicator of the apparatus, which I believe to be unknown in this art heretofore; medicaments have heretofore been applied to the skin independently, and then the apparatus has been used to procure the necessary or desirable massage. This is wasteful and not nearly so effective.

For this latter purpose I provide receptacles for medicament, one or more, each preferably adapted to contain a capsule which is itself insoluble, flexible and sterile, the capsule containing a suitable medicament which may be chemically pure and without preservative mixture of any kind, inasmuch as the capsule protects it from contamination or oxidation. These capsules are disposed in receptacles which may be placed in communication with the applicator at desired times, whereupon the capsule is punctured and its contents discharged; the puncture being small, when the needle or tube is removed, the capsule seals itself and the contents remains uncontaminated.

Other forms of the device apply medicament directly from a container, either fixed or removable, which does not contain a capsule and which may be brought into communication with the applicator at desired times, the medicament feeding for as long a time as may be desired, when the communication may be shut off and the supply preserved against unnecessary depletion. Supplying medicines directly through the applicator in this way has not heretofore been effected, so far as I know; and by regulating the supply by means of a valve, as shown hereinafter, by which material may be fed into the applicator to a desired amount, and then shut off, a precise dosage in application not heretofore attainable may be effected.

The various forms, generically similar though specifically different, are operated by a rotating shaft preferably driven by an electric motor; in some cases the motor is shown enclosed in the apparatus as held in the hand of the operator, which is convenient for domestic or other occasional use. For professional treatments, particularly in hospitals where the use is frequent and wearisome, it is preferred to use a flexible shaft driven from a motor more remote, as indicated in the drawings.

In the drawings:

Figure 1 is a partial longitudinal section of the device utilizing an electrically driven pump.

Figure 2 is a front elevation of Figure 1, partly in section, showing the removable sanitary medicament receptacles in place.

Figure 3 is an isometric view of the vacuum release valve.

Figure 4 is an isometric view of the vacuum release valve cap.

Figure 5 is a plan of the head of the device shown in Figure 1, and indicates means for regulating the vacuum.

Figure 6 is a partial section illustrating the cupping valve positioned to cut out the application of medicaments.

Figure 7 is a partial section illustrating the cupping and medicament valve positioned to connect one of the two medicament receptacles with the cup.

Figure 8 is a partial section illustrating the cupping and medicament valve positioned to connect another receptacle for medicaments.

Figure 9 is a partial side elevation of a device similar to that shown in Figure 1, except that it is driven by means of a flexible shaft.

Figure 10 is a partial longitudinal section of a device similar to the one shown in Figure 1, except that the medicament receptacle is fixed.

Figure 11 is an end elevation of the device of Figure 10, partly in section.

Figure 12 is an end elevation of Figure 10, with the vacuum release valve plate and vacuum pump cap removed and the applicator partly in section.

Figure 13 is an isometric view of the vacuum pump impeller.

Figure 14 is an isometric view of the vacuum pump impeller blades.

Figure 15 is a partial longitudinal section of an alternative form of device shown in Figure 12, wherein the vacuum pump is driven by means of a flexible coupling.

Figure 16 is a partial side elevation of the device shown in Figure 10 driven by a flexible shaft.

Figure 17 is a longitudinal section of another form of device that is driven by means

of an electric motor in series with a variable resistance and switch, said device illustrating the preferred means of adjustably oscillating a diaphragm vacuum pump with a fixed medicament chamber.

Figure 18 is a side elevation of parts shown in Figure 17.

Figure 19 is a section taken on lines 19—19 of Figure 17.

Figure 20 is a partial section taken on line 20—20 of Figure 19.

Figure 21 is a partial longitudinal section of an alternative form of the device shown in Figures 17, 18, 19 and 20, wherein removable medicament receptacles are utilized.

Figure 22 is a front elevation partly in section of Figure 21, showing removable medicament receptacles in place.

Figure 23 is a partial longitudinal section ilustrating a mechanism adapted to drive a diaphragm vacuum pump wherein the diaphragm is located within the applicator.

Figure 24 is a partial longitudinal section of the device shown in Figure 21, wherein the operating mechanism is driven by a means of a flexible shaft.

Figure 25 shows the device of Figure 24 with a cam for adjusting stroke and intensity.

Figure 26 shows two curves illustrating changes or ratio of lift to drop, as later explained, with pump operation.

Figure 27 shows changes in amplitude and character of operation of a diaphragm.

Figure 28 is a perspective showing the medicament receptacle with the cap displaced.

Figure 29 is a longitudinal section of the device shown in Figure 28.

Figure 30 is a plan partly in section of an alternative method of operating the diaphragm shown in Figure 29.

Figure 31 is a section on the line 31—31 of Figure 29.

Figure 32 is a detail of the connection between the diaphragm and the worm-gear of Figure 29.

Figure 33 is a section on the line 33—33 of the medicament receptacle and its cap, as shown in Figures 28 and 29.

Figures 34 and 35 are details of the control for the medicament, as shown in Figure 29.

Figure 36 is a detail of an alternative way of controlling the chamber in front of the diaphragm of Figure 29.

Figure 37 is a sectional view of another device to effect the purpose of the parts shown in Figure 29.

Figure 38 is a perspective sketch of parts shown in Figure 37.

In Figures 1 to 8 inclusive, the device shown is comprised of a body 1, having a handle 2 fixed thereto by means of screws like 3, one of which is shown.

This body 1 carries a motor 4, which is ventilated by means of the holes 5 and the motor leads 6 pass through the insulated bushing 7 on the handle 2.

The motor shaft 8 carries a pinion 9 meshing with a gear 10, attached to and held upon a shaft 11 by means of the nut 12, the other end of the shaft formed as shown in Figure 13 with a cylindrical hub 13, provided with a slot 14 holding the blades 15 and 16, normally held apart by means of the spring 17.

When the hub is rotated, the impeller blades inserted in the slot 14 are pressed against the sides of the cylinder by the spring 17, forming a good type of rotary suction blower.

The end of the motor shaft 8 is supported in a boss 18 which is a part of the cap 19, and so also is the shaft 11, the cap being screwed at 20 into the body 1.

The cap is provided with a chamber 21 eccentric with the shaft 11 and containing the hub 13.

Over this part 13, is arranged a vacuum release valve plate 22, see Figure 3, provided with a gear segment 23 engaging with a toothed shaft 24, provided with a slot for holding the shaft positioned in the cap 19 by means of the screw 25; to turn this shaft, a knurled head 26 is provided.

The plate 22 is also provided with an opening 27, terminating in a threaded pipe, with a screw 28^b controlling an opening 28^a; to hold this valve positioned the plate 29 (see Figure 4) having an opening 30 for the pipe or valve 28, and an opening 31 for a valve 32, is provided; the cap-plate 29 is held to the cap 19 by means of the screws 33, one of which is shown in Figure 1, which pass through the holes 34 in the cap 29.

There are also three indicating marks 35, 36 and 37, on this cap 29 with the indicia 1, 2 and 3 thereon, arranged to register with the handle 38 (Figure 2) of the valve 32.

The bottom part of the cap 19 is provided with a boss 39 threaded at 40, carrying a cup or applicator provided with a rubber ring 42, and this boss 39 has an opening 43 communicating with the chamber 21 and the interior of the applicator 41.

The cap 19 is provided with extensions 44 and 45 on each side, the extension 44 having a pocket 46 and the extension 45 a pocket 47, adapted to hold a rubber stopper 48, provided with a hole 49 and formed to fit a removable sanitary receptacle 50, utilized to hold medicaments. The other end of the receptacle has a cap 51 for carrying a rubber washer 52, the cap 51 provided with a vent 53, and being formed on the top to engage with and hold a spring 54, to hold the receptacle positioned, the spring fixed to the cap 19 by means of the screw 55.

Registering with the hole 49 in the cork 48 is a hole 56 which terminates in the opening 57, into which fits the valve 32.

The pocket 47 of the extension 44 holds the cork or stopper 58 in the removable receptacle 59 having a cap 60 like 51 and a spring 61 and a screw 62 like 54 and 55, all of which parts are for the same purpose as hereinbefore described for the removable receptacle.

Registering with the hole 49 in the cork 58 is the hole 63 which also terminates in the opening 57 on the side opposite to the hole 56.

The valve 32, Figures 2, 6, 7 and 8, is provided with two pockets 64 and 65; the pocket 64 when properly positioned registers with the hole 63 and hole 66 communicating with the interior of the applicator 41 and the opening or valve-seat 57.

The pocket 65 registers with the holes 56 and 67, which latter hole communicates with the interior of the applicator and the opening 57.

Figures 2 and 6 illustrate the relative position of the valve 32 and co-operating parts when both of the passages or holes 56 and 63 are cut off.

Figure 8 illustrates the relative position of the valve 32 and co-operating parts when the passage 56 registers with the passage 67 and the passage 63 is cut off.

This valve 32 can place either of the receptacles 50 or 59 in communication with the interior of the applicator 41; when the pinion 25 is revolved the position of the valve 28 can be adjusted at will, so that the vacuum created within the applicator 41 will be released sooner or later, depending upon the position in which this valve is set.

In Figure 9 the head or cap of the device is the same as in Figures 1, 2 and 5, except that this head has no body part intermediate between the handle and cap, being solid at 68 and provided with a boss 69 into which fits the handle 70 provided with a recess 71 into which projects the bearing boss 72, providing a bearing for a shaft 73 like 11 in Figure 1; this shaft is longer and carries on the end the coupling 74, fixed thereto by the screw 75, the other end of the coupling being fixed to a flexible shaft 76 which passes out of the handle to some suitable driving means through the bushing 77.

In Figures 10, 11 and 12, the device is similar to that shown in Figures 1 to 9 inclusive, except that this device has a fixed receptacle for the medicament, formed in the head.

In Figure 10, the motor 78 is held within a body 79 formed at 80 to provide a handle in which is held the toggle switch 81 connected in series with the motor by the wires 82 and 83, the other wire 84, directly connected to the motor and both of these wires 82 and 84 pass out of the handle through the bushing 85.

The end of this body 79 is threaded at 86 to carry the cap 87 having a bearing boss 88 carrying the shaft 89 which is part of the element shown in Figure 13, one end of said shaft holding a gear 90 by means of the nut 91, which gear meshes with the pinion 92, on the shaft 93 of the motor 78.

This boss also carries a plate 94 held positioned by the nuts 95 and 96, providing one of the walls for the medicament holding space 97, access to which is had by means of the screw-cap 98.

The extension of the cap 87 is formed to provide an opening 99 similar to the eccentric opening 21 shown in Figures 1 and 2, for the element 100 shaped like 13, the parts 15, 16, 17, 22 and 28 being the same.

The part 22 is held in position by a ring 101 which is held to the cup 87 by the screws 102*a*; the eccentric cylindrical opening 99 communicates with the interior of the applicator 41 by means of the passages 102 and 103, the medicament holding space 97 communicating with the interior of the applicator 41 by means of the hole 104 provided with the adjustable needle valve 105 (see Fig. 11), and an opening in 99 may also be provided for a differential pressure releasing vent 109; see Fig. 12.

Figures 13 and 14 have been sufficiently described in connection with the description of Figures 1 to 8.

Figure 15 illustrates an alternative driving means between the motor 75 and element 100, wherein the end of the shaft 89 is formed to provide one of the elements 106 by a flexible coupling connected to the middle element 107, and the other element 108 is fixed to the motor shaft.

The device shown in Figure 16 is similar to that shown in Figure 9, using similar parts, but providing a flexible shaft drive. The cap 87 in this device provides for the use of a fixed medicament chamber, whereas the cap 68 in Figure 9 provides for removable receptacles.

In Figures 17, 18, 19 and 20 the arrangement of the mechanism for producing the vacuum suction is somewhat different, this device utilizing a vibrating diaphragm for producing the vacuum. It is comprised of a body 110, having air vents 111 therein connected to a handle 112 by means of the screw 113. The body 110 carries a motor 114 therein, with one end of the motor shaft 115 positioned in the spider 116, held in the body by the screws 117; and the other or commutator end 118 fixed within the handle 112.

The motor shaft carries a worm 120 meshing with a gear 121 on the shaft 122 supported in the body 110; the gear has a pin 123 engaging with a link 124 forked to engage with a pin 125 in the lever 126 pivoted by the pivot 127 in the sliding bearing yoke 128 connected to a threaded extension 130 carrying a knurled nut 131 which is held positioned within the part 132 so that when this wheel

is turned, the bearing yoke 128 will move up and down.

The end of the lever 126 is provided with a fork 133, shown in Figure 19, which engages with a suitably formed stud 134 fixed to the diaphragm 135 by the screw 136.

This diaphragm is provided with a plurality of reinforcing ribs 137, 138 and 139, and carries the valves 140 and 141, the valve 140 composed of a rubber disc 142, a metallic disc 143, a spring 144, a washer 145, and a holding screw 146; and the valve 141, made of a resilient material 147 pinned to the disc at 148 so that when the disc is moved in one direction (away from the motor) these valves will open and when moved toward the motor the valves will remain closed.

On the outside of the diaphragm is a resilient ring 149 preferably made of rubber, fixed to the diaphragm 135 by rivets 150 and metallic ring 151; the outside of this element 149 is fixed between the body 110 and the cap 152 by means of the screws 153, which also hold the cap in place.

This cap is formed with a space 154 within which the diaphragm operates which space is connected by the passage 155 to the interior of the applicator 41 screwed to the boss 156 at 40.

The front portion of this cap is provided with a medicament holding space 157 having a cover 158 and the cap carries a projecting stud 159 with a hole 160 therein, communicating with the space 157 and the inside of the applicator 41 and the amount of material passing through this hole is controlled by means of the needle valve 161, shown in Figure 19, omitted for clarity in Figures 17 and 18.

To control the speed of the motor 114, one of the line leads 162 is connected with one of the brushes 163 and the other brush 164 is connected by the line 165 to the field coils 166.

The other end of the field coil is connected by the wire 167 to the regulating switch 168, and by the wire 169 to resistances 170, 171, 172, and thence to the other line lead 175, so that either one, two, or three of these resistances 170, 172, and 174, can be placed in series with the motor, thus changing its speed.

In Figures 21 and 22 the device is similar to the device shown in Figures 17, 18, 19 and 20, except that this device is provided with removable medicament feeding receptacles. The head is provided with the same parts as shown in Figures 1, 2 and 3, with the following exceptions:

The passage 155 in the head or cap shown in Figure 17 is somewhat different in shape from the passages 176 in the head shown in Figure 21, but both serve the same purpose, and the medicament holding tubes and parts associated therewith are held by means of the single spring 177 and screws 178 and 179, instead of two separate springs like 54 and 61.

In Figure 23 the device shown is of somewhat different construction, it providing for only one removable tube of medicament and is vacuum diaphragm being placed in a different position. In this device the same motor 114 is mounted in the same body 110 with the same handle 112, and switch 81 having the same worm 120 and worm gear 121 with its pin 123.

This pin 123 engages with the slot 180 in the lever 181, pivoted at 182 with its end engaging with a collar 183, fixed to a tube 184, sliding in the head extension 185; the end of this tube is fixed in any suitable way to a diaphragm 186, held within the applicator 41 by the nut 187, a hole 188 communicating with the interior of this tube and the interior of the applicator 41.

Within this tube 184 is a fixed tube 189 communicating with a recess 190 in the upper part of the extension 185 formed to hold a stopper 191 provided with a hole 192, the stopper fitting within the medicament holding tube 193, provided at the upper end with a suitably formed cap 194, having a vent 195; to hold this tube and parts positioned, the spring 196 fixed to the cap by the screw 197 is employed.

A vent hole 198 communicates with the upper portion of the applicator 41 and the inner part 199 of the motor casing or body 110, so that the diaphragm will be free to operate.

The device shown in Figure 24 is the same as that shown in Figures 21 and 22, except that the worm 120 is carried on a shaft 200 connected to one end of a sleeve 201 by the screw 202, the other end being fixed to a flexible shaft 203, like the shaft 76 of Figure 9.

Figure 25 shows the substitution of a cam 204 operating a link 205 pivoted at one end to the bracket 207 of the forked link 126 and rotating in the slotted bracket 206 thus adjusting the effective length of the link 126, as in Figure 24, and so changing the amplitude of the stroke.

In Figure 26, the curves illustrate changes made in the character of the suction by altering the ratio between lift and drop without changing the speed of the pump shown in Figure 1, for example. These changes are effected by regulating the position and area of the valve 28, see Figure 3. The proportion between lift and drop is changed by rotating the cap 22 so as to advance or retard the point at which the blades 15—16 (see Figures 13 and 14) pass the valve 28; while the area of opening is regulated by means of the screw 28^b, which opens and closes the opening 28^a to a desired extent. Long suction is secured by turning the cap 22 to the left, thus prolonging the time during which the suction is maintained; while by opening the valve hole 28^a to its fullest extent the

suction is instantly relieved when the blade passes, thus giving the sharp drop illustrated at A, Figure 26; and by partly closing the valve-hole, the modified drop shown at B will be produced. By preference there may be a flap or ball-valve on the inner end of the tube or elbow 28, but I have not thought it necessary to illustrate it.

Figure 27 shows similar curves A, B, and C, for a diaphragm, of varying amplitudes; they will be better understood after the description of the remaining figures.

Figures 28, 29, 33, 34 and 35 should be read together. They show a form of the device particularly adapted to regulation of a diaphragm type of instrument. I will describe first the means for applying medicaments, especially Figures 28 and 29. Here 50 is a tube or receptacle shaped to hold a capsule 221, containing the liquid or ointment which is to be applied to the skin from within the cup or applicator, 41. This capsule is composed of a suitable soft material capable of collapsing under pressure such as a gelatin compound of suitable hardness, and is completely filled with the medicine. At the bottom of the chamber is a hollow needle 220, removably secured in a plug 217, having a bore 218 communicaing with the needle and the applicator. The plug is removably seated in the bottom of the part 50, in a bore which it does not entirely fill, as shown in Figure 35, and having circumferential grooves, one of which communicates with the diaphragm chamber by a bore 176, so that suction may be applied to the cup or applicator, 41.

The means for closing the top of the receptacle embraces the cap 214, pivoting upon the stud 215 and held by the stud 216. A sleeve 208 is co-axial with the cap, and is pressed up by the spring 210; clutch-arms 212, 212, hold the sleeve down against the pressure of the spring, being pressed up by the springs 213, 213, held in place by the screws 213a. Passing through the sleeve is a rod 209, pressed down by a spring 211, and provided with discs at the top and bottom. The sleeve 208 forms a movable abutment for this rod 209.

Obviously the container need not be entirely of gelatin, casein or cellulose, or similar flexible materials, but may be partly of other substances provided the needle can puncture the bottom readily.

The operation of these parts is as follows: When the capsule 221 is placed in the chamber, the sleeve 208 and rod 209 are at their highest points, and the cap is as shown in Figure 28. The cap is then swung on the stud 214 until the slotted bracket 216a engages the stud 216. The sleeve 208 is then pressed down, compressing both of the springs 210 and 211. The clutch arms 212 engage the sleeve and hold it in place, forming a fixed abutment against which the spring 211 bears to press down the rod 209. The pressure forces the needle 220 to puncture the capsule 221; as the capsule collapses, the spring expands and weakens, whereupon the operator may press the sleeve further down, renewing the tension of the spring 211. When it is desired to replace the capsule, the thumb and finger press in the clutch-levers 212, both springs are released, and the rod 209 and sleeve 208 spring up, so that the cup may be swung aside.

The capsule being soft is easily removed by the thumb and finger, in which event the puncture made by the needle 220 closes and seals the capsule.

In Figures 29, 34 and 35, I show the means for controlling the flow of the medicine. A rod 219 having a head 224 is pressed outward by the spring 223; the end of the rod crosses the bore 218 in the plug 217 through which medicine is pumped by the suction into the applicator 41. A lever 225a has a thumbpiece 225, and rotates against the pull of the spring 227. A cam-surface 226 on the lever controlls the position of the rod 219. As shown the bore 218 is normally open, the action of the springs 223 and 227 holding back the rod until the thumbpiece 225 is moved; but it may obviously be reversed, if desired.

When a sufficient amount of the lotion or ointment has been applied, the bore 218 may be closed, and the alternating differential pressure be applied to massage the medicine into the skin for as long as may be desired.

Referring again to Figure 29, I show means for changing the volume of air affected by the motion of the diaphragm. Most of the parts are as before, and bear the same reference characters. The shaft 93 is driven by the flexible shaft 76, is carried in suitable bearings having oil-cups 233 of well-known type, and has a ball thrust-bearing at one end.

The means for changing the volume of air as shown in the upper part of the figure, consists of a cylinder 228 (see also Figure 21) in which is a piston 232, with a guide-rod 232a, preventing tilting and rotation. A screw 229 is threaded through the piston, and its end bears against the stud 230 holding the cylinder-shell in place, the end of the stud being rounded for the purpose. The screw is rotated by the milled head 231. A perforation 234 in the casing effects communication between the cylinder and the front chamber of the diaphragm.

The operation is as follows: When it is desired to increase the volume of air displaced, thus lessening its tension, the screw 229 is rotated by the milled head 231, retracting the piston 232, thus increasing the part of the cylinder communicating with the diaphragm, increasing the amount of air to be moved, as already described. Of course

reversing the movement diminishes the air, and increases the tension, as already briefly explained in connection with Figure 27, in which curve B represents the effect when the piston is at the inner end of the cylinder, curve C when at the outer end, and curve A an intermediate position.

I have employed a cylinder and piston as a convenient form, but the chamber may obviously be of any desired shape. The proportions indicated are good ones.

In Figure 24 and others the diaphragm is attached to the vibrator at its center; but in Figures 30 to 32, I show how a greater power may be applied to the diaphragm by attaching it to a plurality of movers, in this case two. Here the worm-gear 121 rotates a shaft carrying discs 236 upon its ends, each disc carrying a stud 238 acting as a crank in a slot in the extended end of the rod 237, which slides in the ways 239. This arrangement gives considerable more power to the diaphragm.

In Figure 36, I show a valve 235, in the casing of the diaphragm chamber, with a needle-cock 234[a] controlled by the head 231, to be used in place of the piston and cylinder of Figure 29. This is fairly effective since by controlling the area of the inlet by the needle a regulation of the tension of the air may be accomplished. The piston and cylinder are to be preferred.

In the diaphragm type provided with valve 140, as shown in Figures 17 to 20, for example, it will be apparent that the suction will increase progressively (as it will with the rotary pump type when the valve 28 of Figure 1 is entirely closed) until the operator considers it sufficient.

In Figures 37 and 38, I show a spring valve which is a modified form of Figure 29. Here 240 is a perforated cap which screws into a threaded seat in the casing 110, the latter having the duct 234 and ball-valve 235, as before. A disc-valve 241 has a threaded stem 241*a*, and is provided with a rubber washer 242 sealing the opening between the valve 241 and the inner edge 240*a* of the screw-threaded part of the cap 240, forming a valve seat. A nut 241*b* on the stem 241*a* puts under compression a spring 244 for holding the valve against its seat. The tension of the spring is regulated by turning the nut 241*b* by a milled head 245, held in the case 110 by a nut 243. By turning the nut the pressure necessary to open the valve may be increased or diminished at will; I thus may regulate the character of the break, making the curve of diaphragm action resemble the curves of Figure 26 when so desired. The valve opens upon the suction stroke and closes with greater or less speed according to the tension of the spring, thus varying the ratio of lift to drop, as already explained, and also the quickness of the drop. The valve being in the duct between the applicator and the atmosphere controls the movement of air therethrough, and thus regulates the character of the suction, as just described.

Changes which may be made which preserve the advantages of the invention are intended to be covered by the claims.

What is claimed is:

1. An apparatus for pneumatic massage, embracing means for creating suction, a valve for releasing the suction; and means for changing the effective location of the valve relative to the cycle of suction and release, thereby changing their ratio.

2. In apparatus for pneumatic massage, embracing means for creating suction, a valve for releasing the suction, means for changing the effective location of the valve relative to the cycle to regulate the ratio of suction to that of release, and means for varying the opening thereof to regulate the character of the suction-drop, as described.

3. In apparatus of the character described, an applicator, means for producing suction therein, and means for regulating intensity of the suction while the apparatus is operating; the said means comprising means for altering the volume of air between the skin and the suction means, thereby changing its tension, as described.

4. In apparatus of the character described, an applicator, means for producing suction therein, and means for regulating intensity of the suction; such means comprising an auxiliary chamber communicating with the applicator, and means for altering the effective dimensions of the auxiliary chamber, thereby varying the volume of air affected by the suction means and changing its tension.

5. In apparatus of the character described, an applicator, means for producing suction therein, and means for regulating the intensity of the suction; such means comprising an auxiliary cylinder communicating with the applicator, an adjustable piston in the cylinder, and means for positioning the piston to vary the effective content of the cylinder, thereby changing the volume of air between the piston and the applicator which is acted upon by the suction means.

6. In apparatus of the character described, an applicator, diaphragm means for producing alternate suction and release thereof in the applicator in successive cycles, a valve operated in synchronism with the said cycles and forming the said releasing means, a spring controlling the valve, and means for changing the tension of the spring.

7. In apparatus of the character described, an applicator, means for generating therein successive cycles of partial vacuum, means for automatically releasing the said partial vacuum in each cycle, the releasing means comprising a spring-pressed valve; means for changing the pressure of the spring to con-

trol the intensity of the vacuum, and means for changing the area of the passage controlled by the valve to change the character of vacuum within each cycle, independently of the frequency, as described.

8. In apparatus for pneumatic massage, an applicator, a pump for creating a suction therein to lift the skin; means for releasing the suction and dropping the skin; and means for controlling the ratio of lift to drop in each impulse; such means embracing a valve, means for changing the position of the valve relative to the initial point of the cycle of suction and release to vary the relation of lift to drop, and means for changing the area of the vent controlled by the valve to change the character of the drop.

9. In apparatus for pneumatic massage, an applicator, a pump for creating a suction therein to lift the skin; means for releasing the suction and dropping the skin; and means for controlling the ratio of lift to drop in each impulse, a valve for releasing the suction, means for changing the area of the vent controlled by the valve; and means for changing the position thereof relative to the initial point of the cycle of suction; such last-named means comprising a movable plate closing the pump-chamber, a valve-opening carried by the plate, means for moving the plate to adjust the position of the valve, and means for adjusting the size of the valve-opening, as described.

10. In apparatus for pneumatic massage, an applicator, a pump for creating a suction therein to lift the skin; means for releasing the suction and dropping the skin; and means for controlling the ratio of lift to drop in each impulse wherein the pump is of the rotary impeller type, a rotatable plate closing one side of the impeller chamber, a valve-opening carried by the plate, means for rotating the plate to vary the position of the valve-opening and an adjusting device for controlling the area of the valve opening.

11. In apparatus for pneumatic massage, an applicator; means for creating a suction therein to lift the skin; means for releasing the suction to drop the skin at desired times; means for controlling the ratio of lift to drop in each cycle of suction and release; and means for controlling the character of the drop from gradual to sharp at will.

12. In apparatus for pneumatic massage, an applicator; means for creating a suction therein to lift the skin; means for releasing the suction to drop the skin at desired times; means for controlling the intensity of the suction; means for controlling the ratio of lift to drop in each impulse of the cycle, and means for controlling the frequency of the cycle, the said several means being controllable while the apparatus is operating, as described.

13. In apparatus for pneumatic massage, an applicator; means for creating a suction therein to lift the skin; means for releasing the suction to drop the skin; means for varying the ratio of lift to drop in each impulse; means for varying the character of the drop to produce at will a sharp drop or a gradual one; all of the said several means under control of the operator while the apparatus is in action.

14. In apparatus for pneumatic massage, an applicator; means for creating a suction therein to lift the skin; means for releasing the suction to drop the skin; means for controlling the frequency of the impulses; means for varying the point of release of the suction in each impulse to regulate the ratio of lift to drop; and means for controlling the speed of release to change the character of the drop; said several means being controllable by the operator while the apparatus is running.

15. In apparatus of the character described, an applicator; means for producing, releasing and varying the character of suction therein; means for regulating the intensity and period of the suction; and means for applying materials to the skin within the applicator for a desired time while the said changes are occurring; a plurality of receptacles for medicaments to be applied to the skin; and means for selecting material from any receptacle for application to the skin within the applicator, or for excluding all of them.

16. In apparatus of the character described, an applicator; means for producing, releasing and varying suction therein; means for regulating the intensity and period of the suction, and means for applying materials to the skin within the applicator for a desired time, a receptacle containing a capsule of skin-treating materials, means for puncturing and pressing upon the capsule at desired times.

Signed at New York in the county of New York and State of New York this 25th day of August, A. D. 1930.

MARTIN E. POPKIN.