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VACUUM APPARATUS

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Fig. 1.

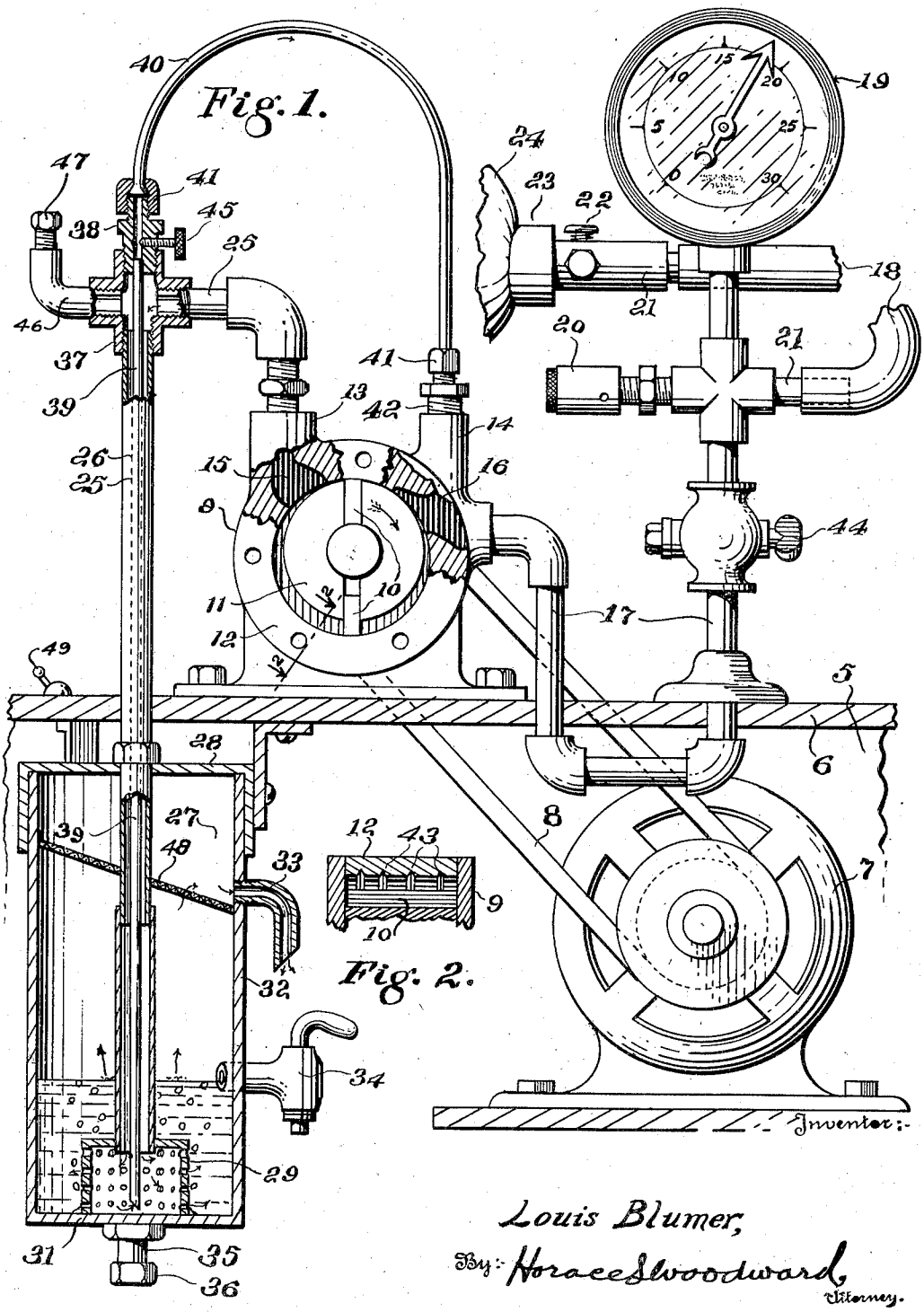

Fig. 2.

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VACUUM APPARATUS

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4 Claims. (Cl. 230—138)

The invention relates to means for treating pathologic conditions by external mechanical induction of vascular activity or improved blood circulation, through the production of local vacuous areas over congested or insufficiently active areas of the body.

It is a special aim of the invention to present a complete portable unit adapted to the uses of physicians and operators following mechanical remedial manipulations or other kinetic therapic treatments.

In one of the developments of the latter school of therapy it is a practice to use a vacuum pump connected to a cup adapted to be applied to the surface of the body of the patient, and it has been difficult heretofore to afford a safe regulation of the degree of vacuum so produced within the cup. I long ago originated a cup for such use which is now largely employed, this having a finger-released inlet valve by which the vacuum could be relieved at will. Still, the operator could not dependably control the degree of vacuum being utilized, and even if a gauge were used, a momentary inattention or carelessness on the part of the operator might have serious results by development of excessive suction.

It is therefore a purpose of my invention to provide a simple and inexpensive device which may be depended upon to automatically limit the vacuum within safe pressures. It is also an aim to perfect such a device which will maintain the vacuum in the appliance within a range of pressures which will avoid the disturbance of the arterial blood supply objectionably and enable the induction of activity in the venal fluids where such treatment is principally required. It is a specific object to evolve a novel construction of parts adapted to attain these purposes.

Another important aim of the invention is to present novel and efficient means to regulate the intake of a pump in such a system. Another important object is to present a novel means for separating oil and air about to be vented from such a system.

Additional objects, advantages and features of invention reside in the construction, arrangement and combination of parts, as will appear from the following description and accompanying drawing, wherein

Figure 1 is a vertical section of a system embodying the invention;

Figure 2 is a fragmentary section of the pump.

There is illustrated a system which is adapted to be embodied in a small portable unit weighing forty pounds, more or less, or which may be permanently installed in the same size for the purposes indicated. It is adapted to be operated by a motor of one-quarter (¼) horsepower, or less, from the usual electric light circuits. It has been embodied for actual use in a small case 5 measuring 12 x 16 inches in plan and 12 inches in height, having a motor and a reservoir within the case while a pump and its connections are disposed on the top plate 6 of the case.

In Figure 1 the parts are shown one-quarter actual size in the form, arrangement and proportions in which they have been used, except that the outlet and applicator connections were in practice extended laterally from the pump for compactness.

A motor 7 of any usual construction is shown, from which a belt drive 8 is carried to a rotary pump 9, which is preferably of the rotary piston type in which sliding radial pistons 10 are mounted eccentrically in a circular casing 12. From the casing a suitable discharge nipple 13 and two intake nipples 14 are extended from the outlet and inlet ports 15 and 16 formed in the casing 12. From one intake nipple a pipe line 17 is extended, from which leads a rubber hose 18 having at its outer end a coupling member 21 provided with a safety inlet valve 22, operable by a pressure of the finger to open. A vacuum gauge 19 is mounted on the pipe line 17, and a regulator valve 20 may be used here, if desired. Over the end of the coupling member 21 there is detachably engaged the coupling member 23 of an applicator or cup 24 of a suitable form to fit particular contours of the human body, and replaceable by cups adapted to contours of other parts, as required.

From the discharge side of the pump a pipe 25 is extended horizontally a distance, and thence at right angles downward as at 26, through the plate 6 to an oil reservoir 27, the pipe being soldered or welded in the top head 28 of the reservoir and projecting a distance within the reservoir. At the lower end of the pipe there is a small cage 29 of circular form larger than and receiving the discharge end of the pipe therein. The open lower side of the cage is set against the bottom 31 of the reservoir and secured in any approved manner. In the upper part of the reservoir a vent 33 is provided in the side of the reservoir, opening downwardly at its outer end. At an intermediate level, a drain cock 34 is provided on the side of the reservoir preferably a distance below the middle of the reservoir in this instance, to enable oil to be drained to establish an oil level at the cock. In the bottom

31 a central short drain pipe 35 is engaged, having a plug 36 at its lower end.

At the point where the pipe 25 turns downward, a T fitting 37 is connected as a continuation of the pipe with the part 26, and in the upper arm of this T, on the axis of the pipe 26, a bushing 38 is engaged, having a very small pipe 39 joined thereto and extended concentrically downward through the pipe 26 to near the bottom 31 or therebelow into the drain pipe 36 a distance if desired. From the upper side of the bushing a very small goose neck pipe 40 is extended to the pump, said pipe 40 having a coupling 41 thereon at each end, one engaged with the bushing 38 while the other is engaged with a simple bushing nipple 42 engaged in the wall of the pump and in communication with the inlet port 16. The pipes 39 and 40 are made small and of a diameter having a definite relation to the degree of vacuum which it is desired that the apparatus shall produce, as will be explained.

The pump is so constructed that its efficiency may be materially varied, extending through a desired range of pressures. For this purpose the perimetral cylinder wall may be formed with fine grooves 43, which may be termed by-pass grooves, the depth of which in the drawing has been exaggerated for the purpose of illustration, or other means provided by which when there is a very small quantity of oil in the pump, air is permitted to by-pass the pistons easily when the intake is closed, but when a larger amount is supplied, the leakage past the pistons is impeded and a greater amount of air is expelled and a higher vacuum produced in the closed intake. It has been found that this method produces a highly effective regulation, so that with an oil of low viscosity, the size of the pipe 39 shown and the pump operating at eleven hundred revolutions per minute, an evenly sustained vacuous condition modulated to the desire of the operator, may be obtained, but limited at all times to one that is safe. In this the quality of the oil is important as to its viscosity, and I have found that a very thin oil somewhat lighter or thinner than that used for lubricating sewing machines ordinarily, affords the desired condition.

The degree of vacuum may also be regulated by placing a hand valve 44 in the pipe 17, as in Figure 1. And a valve 45 is provided in the bushing 38 connecting the pipe 39 and goose neck 40, by which the rate of flow of oil to the pump may be varied to regulate the vacuum. If the valve 45 is utilized, the pipe 39 and goose neck may be of larger diameter, but in the present instance, with the valve 45 omitted or open, the inside diameter of the oil duct comprising the pipe 39 and goose neck 40 being somewhat less than $\frac{1}{16}$ of an inch, the maximum vacuum is within safe limits for use on human beings.

In this therapeutic method there is a critical line of division between the pressures permissible for acting on venous blood and those which would affect arterial blood, and by a proper regulation of the vacuum developed, I am able with the usual applicators to improve conditions peculiarly in venal blood flow to a marked degree. This enables me to benefit cases of high blood pressure, notably, and to improve conditions in many circulatory ailments, as well as other pathogenic conditions, especially those of a congestive nature, with more positive result than where the vacuum generator is not controlled with certainty and held to the same limit.

A filler spout 46 is provided on one arm of the T 37, closed by a plug 47, enabling replenishment of oil in the reservoir as required.

The cage 29 may be formed in various ways, but in the present instance is shown as a foraminate cylindrical wall having a top joined thereto, in which the pipe 26 is fixed. If desired, diagonal screens 48 may be extended across the reservoir below the vent 33 and above the end of the pipe 26, used with or without the cage 29, to prevent oil from passing to the vent. Oil particles reaching the screens will drain to the lower parts thereof and thence to the lower end of the reservoir. The interstices of the screens should be large enough to prevent the formation of oil films or bubbles thereacross. It will be noted that the apertures in the cage 29 are larger at the upper part than the apertures in the lower part of the cage.

A switch 49 may be provided on the case 5, by which the circuit to the motor may be opened or closed. The circuits are normal conventional wiring, which do not require illustration.

In operation, the circuit to the motor being closed and a suitable applicator 24 being fitted at the outer end of the hose, the applicator cup is applied to an area of the body to be treated so that the edges of the cup fit continuously to the surface of the skin as nearly as practicable. As the air is exhausted from within the cup, the tissues are raised within the cup rapidly, and a rapid flow of blood toward the surface at the same time induced. By operation of the valve 22 the vacuum may be abruptly or gradually relieved so that a massage of the tissues is effected at the same time that flow of blood away from the surface is permitted. The periods of relative vacuum and atmospheric pressure may thus be alternated more or less rapidly as the nature of the case requires, and a sustained period of suction may be maintained when desired.

To change the position of the cup on the patient, the valve 22 is operated so as to relieve the vacuum entirely, while the cup is readjusted. The valve 44 may be used as a cut-off is desired, and also has an important function when partly closed in reducing the rapidity with which the vacuum is developed. This may be utilized to avoid shock to painful areas or neuropathic cases. The valve 20 may be used to limit the maximum vacuum for a specific area, or patient. The valve 45 may also be used with like effect, but is specially intended to use as a safety device limiting the vacuum produced to guard against possibility of damage to tissues. The cock 34 may be used to drain off any excess of oil which may be introduced into the reservoir. The vent 33 is an ajutage for allowing escape of air only, as it is returned from the pump.

It will be apparent that various modifications and substitutions in the construction and combination disclosed may be made within the scope of the invention as set forth in the claims, and I do not regard the invention as limited to the exact construction disclosed.

I claim:—

1. Apparatus for external vacuum treatment of the human body, comprising a pump consisting of a cylinder and piston grooved on abutting faces so as to allow escape by the piston of compressed gases to such extent as to be ineffective in the absence of a lubricating liquid therein of predetermined viscosity and a quantity in excess of

that for lubrication, said pump having an inlet, means to connect a therapeutic appliance to said inlet, means to supply a leakage impeding liquid to said inlet in quantity variable at will, and means to restrict the maximum flow within limits short of retardance of said escape of gases producing a suction effect beyond the minimum pressure which may safely be established over external surfaces of the body as described, said pump having an outlet for gases and liquid, and means to operate the pump at a predetermined speed in relation to the viscosity of said liquid.

2. The structure of claim 1 including a reservoir, a connection between the outlet and the reservoir consisting of a vertical pipe within the reservoir, and a very small pipe within the first named pipe extending below the first named pipe and opening in the lower part of the reservoir and connected at its outer part with the intake of the pump, the diameter of said small pipe being such that it is capable of conducting less liquid than sufficient to cause the pump to produce a degree of vacuum exceeding the safe limits for external surfaces of the human body.

3. The structure of claim 1 in which said means to supply liquid consists of a small duct to the inlet of the pump and having an interior diameter proportioned to a suction efficiency in the pump related to the maximum degree of vacuum safe in applicator cups of therapeutic apparatus of the character described, materially less than the maximum capacity of the pump measured in degree of vacuum, and means adjustable at will to further restrict the flow of liquid through said duct.

4. A pump of the character described consisting of a chamber having a perimetral wall formed with gas by-pass grooves therein of such depth and width that normal lubricant supplied at the inlet in excess of mere lubricating requirement will oppose movement of gas through the groove and produce pressures proportional to the quantity of lubricant passing through the groove, a rotor therein rotatable on an axis eccentric to the chamber, a piston radially slidable in the rotor to engage said perimetral wall, means to rotate the rotor, inlet and outlet ports being formed in the chamber at respective sides of the minimum radius from the rotor axis to the said wall, a liquid supply, and means to feed said liquid to said inlet, said liquid being of a viscosity whereby when fed in excess of lubrication requirement it will pass through said grooves to impede movement of gases from the compression side of the piston through said grooves, and said means to feed said liquid to the inlet being constructed to restrict the maximum supply of liquid to less than that required to impede gas flow through said grooves to induce a vacuum greater than safe for local areas of the human body.

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