ABSTRACT: A portable suction or vacuum pump system especially for medical use, which meets the requirements of pharyngeal and tracheal suctioning (high suction, low flow), gastric decompression or stomach pumping (moderate suction, low flow and cyclic operation), and pleural suctioning (low suction, high flow). Operation is by batteries, external DC or external AC by use of a power converter. A vacuum regulator and pump characteristics permit the various combinations of suction and flow.
PORTABLE SUCTION PUMP SYSTEM

BACKGROUND OF THE INVENTION

Hereafter, suction systems for medical purposes have been designed for hospital use where portability and sources of power for operating pump is no problem. Size, within reason, is no problem. However, there has been growing need for a unit for use in the field—one that is portable, one capable of providing various combinations of suction and air flow and one capable of operation from various power sources.

THE INVENTION

The pumping system herein designed is portable, and because of its component parts and their arrangement, is capable of providing various combinations of suction and flow, as required in medical use and especially in the field and is capable of operation from various power sources.

THE DRAWINGS

FIG. 1 is a diagrammatic illustration of the vacuum circuit of the system of this invention; and
FIG. 2 is an electrical schematic associated with the system.

THE PREFERRED EMBODIMENT

Looking at the drawings, there is diagrammatically illustrated the suction or vacuum part of the system in FIG. 1 and the electrical part of the system in FIG. 2. In the system, a DC motor 11 is coupled to a suction pump 12, preferably of the vane type in which the vanes and rotor are carbon and the remaining parts are constructed of corrosion resistant materials. In order to eliminate some servicing (except for periodic cleaning of the pump), the pump is preferably constructed with bearings which are grease lubricated for life. The carbon vanes also require no lubrication. While this general type of pump is preferred, other types of suction pumps can be used in the system if necessary or desirable. The motor 11 can be energized by battery or from an external power source, as will later be described.

The suction or vacuum part of the system includes, in addition to the pump 12, a noise muffler 13 connected to the outlet of the pump by a conduit 14, and a bottle or container 15 connected to the inlet of the pump by a conduit 16. A conduit 17 from the bottle 15 permits selective coupling of the bottle 15 to a pumping field. The bottle or container 15 acts as a suction or vacuum reservoir as well as a container for drain fluids, as will be described.

In the line 16, there are an air filter and trap 18, a check valve 19, a vacuum regulator 20, a vacuum gauge 21, a vacuum switch 22, a float valve 23, and a pressure vent valve 24.

The check valve 19 and the pressure vent valve 24 are of conventional construction, as for example a spring biased ball or member which when seated prohibits the passage of fluid there through and which when unseated permits the discharge of fluid in one direction.

The float valve 23 is also of conventional construction. For example, the valve may contain a float in a container which will block flow through a conduit when the fluid in the container reaches a certain level.

The vacuum regulator 20 is also of conventional construction in that it contains an adjustable orifice, as for example a biased ball and a seat with means to adjust the bias force.

Likewise, the vacuum switch 22 is of conventional construction and includes a diaphragm connected to a switch means, such that changes in the vacuum level in the system cause actuation of the switch means.

Because the various parts are of conventional construction, and well known in the art, no further detailed description is considered necessary, it being understood that various constructions other than that described above could be used if their functions are equivalent.

In operation, the motor 11 effects rotation of the rotor (not shown) of the pump 12 resulting in the exhaustion of air through the noise muffler 13. To permit both a preselected suction limit in the bottle or container 15, as well as cyclic operation when necessary or desirable, other elements are included in the flow line or conduit 16. The vacuum regulator 20 permits the selection of a vacuum level at the bottle 15 by bleeding outside air into the system at the selected level of vacuum, and thus vacuuming and then exhausting the vacuum. A vacuum switch 22 controls the energization of the motor 11 for cyclic operation, switching the motor on at a low value of vacuum and switching the motor off at the preset value, both values being factor set, while the vacuum gauge 21 indicates, for visual observation, the level of the vacuum in the bottle 15.

Accordingly, once the bottle 15 is evacuated to a selected level, and air is not permitted to enter the system through the line or conduit 17, the level of vacuum in the bottle 15 remains, even through air flows to the pump 12.

The float valve 23 prevents fluid which has been collected or is collecting in the bottle 15 from travelling from the bottle to the pump 12. Thus, even if the container 15 is overfilled with fluids, and fluid reaches the float valve, the valve prevents flow of these fluids to the pump 12 by closing the conduit 16 to the pump.

Under certain circumstances, for example in pleural cavity suctioning, a pressure can be developed in the pumping field when a person breathes if the vacuum pump is not operating, which pressure must be vented to the atmosphere. Also, in the event of sudden reduced atmospheric pressure, as in the case of an aircraft pressurized cabin rupture, fluids may be forced back into the patient if the pressure differential is not relieved. For these functions, the pressure vent valve 24 is provided.

Attention now directed to FIG. 2 of the drawings showing the electrical part of the system being described. This part includes the motor 11 connected through a three-position engaged selector switch 25 to alternative power sources, i.e., an internal battery 26 or to an external source (not shown) through a case plug 27. Between the positive side of the power source and the motor is an off-on switch 28. Preferably, the internal battery is rechargeable, as for example of the silver cadmium type. The external power supply unit, one which can be operated from an AC source but which will supply DC to the motor 11 and regulated charging power to the battery. External power can also be any source of DC of correct voltage.

As is illustrated, the selector switch 25 has three positions. When in the No. 1 position, current is supplied from the external power source and also the battery is charged if connected to a combination battery charger power supply unit.

When in the No. 2 position, current is supplied by the battery 26. This circuit includes an elapsed time timer 29 which indicates the length of time the system has been operating on the battery 26 and which indicates to the operator a need for battery recharging. The battery circuit includes a low voltage cutoff switch 30 which is responsive to battery voltage and which will cut off the motor 11 when the voltage is below a predetermined level, to prevent damage to the battery 26. During startup when using the battery, a switch 28A is momentarily closed to activate the low voltage switch. A mode switch 31, movable between open and closed positions included in the various circuits, permits the selection of steady or cyclic operation. When in closed position, operation is steady, because the vacuum switch 22 is shorted out. When in open position, the vacuum switch operates between two preset limits of vacuum.

Like Position 2 of the selector switch is a battery recharge circuit and connects the battery 26 to the external battery charger/power supply unit which is not shown.

In order to indicate to the observer whether or not the unit is in operation, a pilot light 32 is connected in parallel to the motor 11.

Attention is given to the portability of a unit incorporating the various parts enumerated, a self-contained, battery operated unit is housed in a shock-resistant aluminum case which is water
tight when closed. Typical dimensions of such a case are 9 inches \( \times \) 9 3/4 inches \( \times \) 13 inches. Using a 20 volt battery pack of six 3.3 volt silver-cadmium batteries, rated 5.0 ampere hours, new batteries will provide about seven hours operation at a 5 inch suction value. In the cased system, the collection container is capable of holding about 1600 cc of fluid. Such a unit weighs about 17 pounds.

I claim:

1. A suction pump system especially adaptable for medical use comprising a suction pump having an inlet and an outlet, said inlet being connected to a fitting for use with a patient; means to drive said pump; means including a power source for energizing said driving means; a fluid collection and suction container connected between said pump inlet and to said fitting; a check valve connected between said container and said inlet to permit air flow to said inlet and to prevent air flow to said container; a regulator connected between said check valve and said container to regulate the degree of suction in said container; a gauge connected between said check valve and said container to indicate the degree of suction in said container; a vacuum switch connected between said check valve and said container for controlling the operation of said driving means;

2. A suction pump system as recited in claim 1 wherein said power source comprises battery means.

3. A suction pump system as recited in claim 2 wherein said battery means is rechargeable and said power source further comprises means to recharge said battery means.

4. A suction pump system as recited in claim 1 wherein said power means is external and comprises a source of DC current.

5. A suction pump system as recited in claim 1 wherein said power source is external and comprises a source of AC current.

6. A suction pump system as recited in claim 1 wherein said power source is internal and comprises a battery means, and said system further comprises a timer for indicating the length of time said battery means is operated.

7. A suction pump system as recited in claim 1 wherein said power source is internal and comprises a battery means, and said system further comprises a voltage cutout for stopping said motor when the voltage of said battery means reaches a predetermined level.