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[54] **FLUIDOTHERAPY APPARATUS UTILIZING GAS-FLUIDIZED SOLIDS**

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[52] **U.S. Cl.** **128/24.1,** 128/38

[51] **Int. Cl.** **A61h 29/00**

[58] **Field of Search** 128/24.1, 24.2, 33, 128/38–40, 65, 66, 369, 370

[56] **References Cited**

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[57] **ABSTRACT**

Apparatus and method for fluidotherapeutic treatment of parts of the human body, by the use of a gas-fluidized-solids bed in which the part is submerged and subjected to combined heat, massage and/or medication.

8 Claims, 3 Drawing Figures

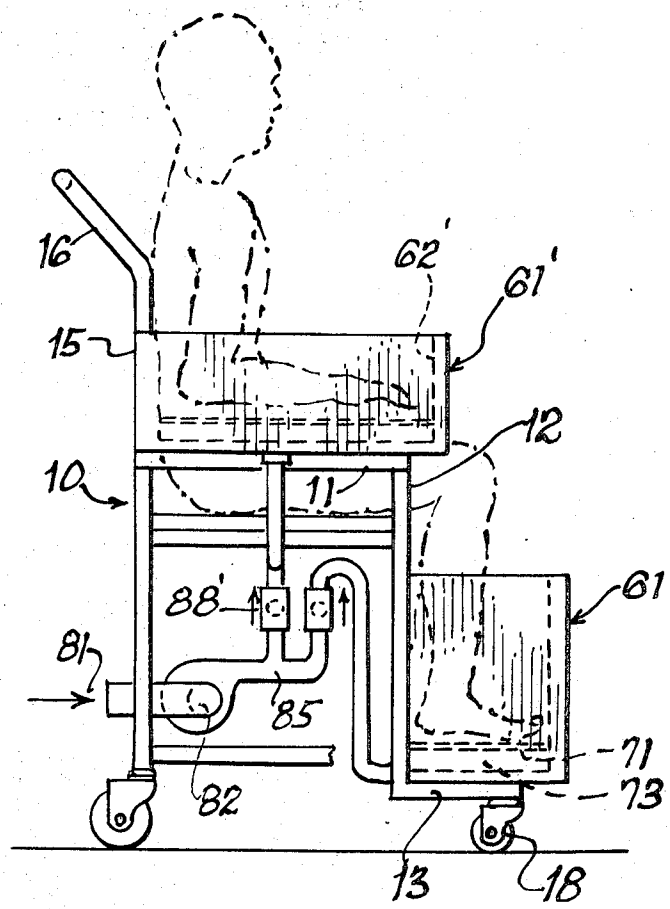


FIG. 1

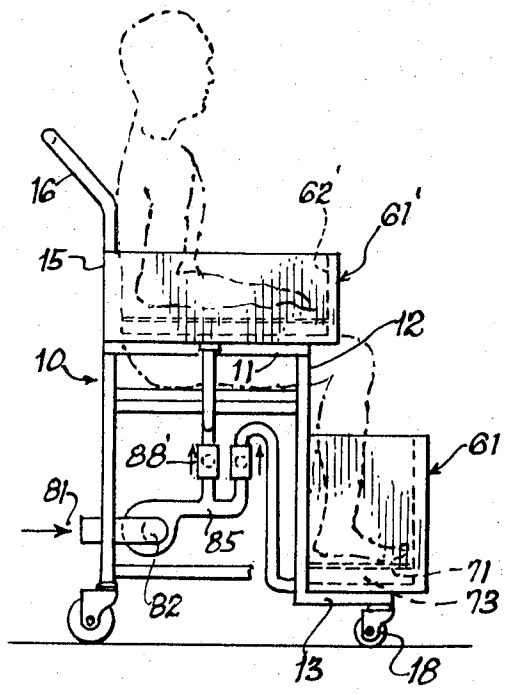


FIG. 2

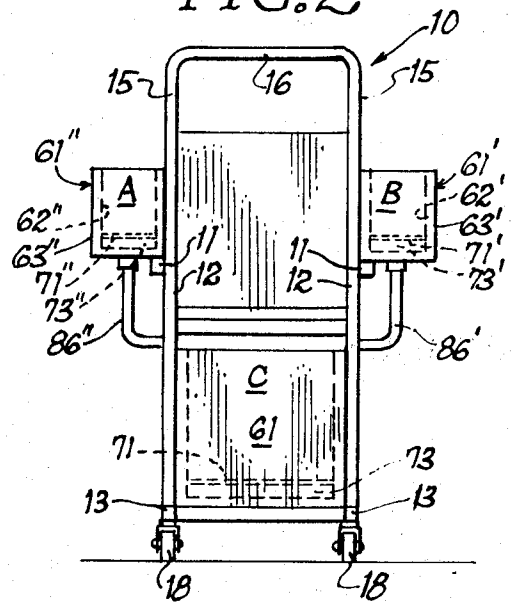
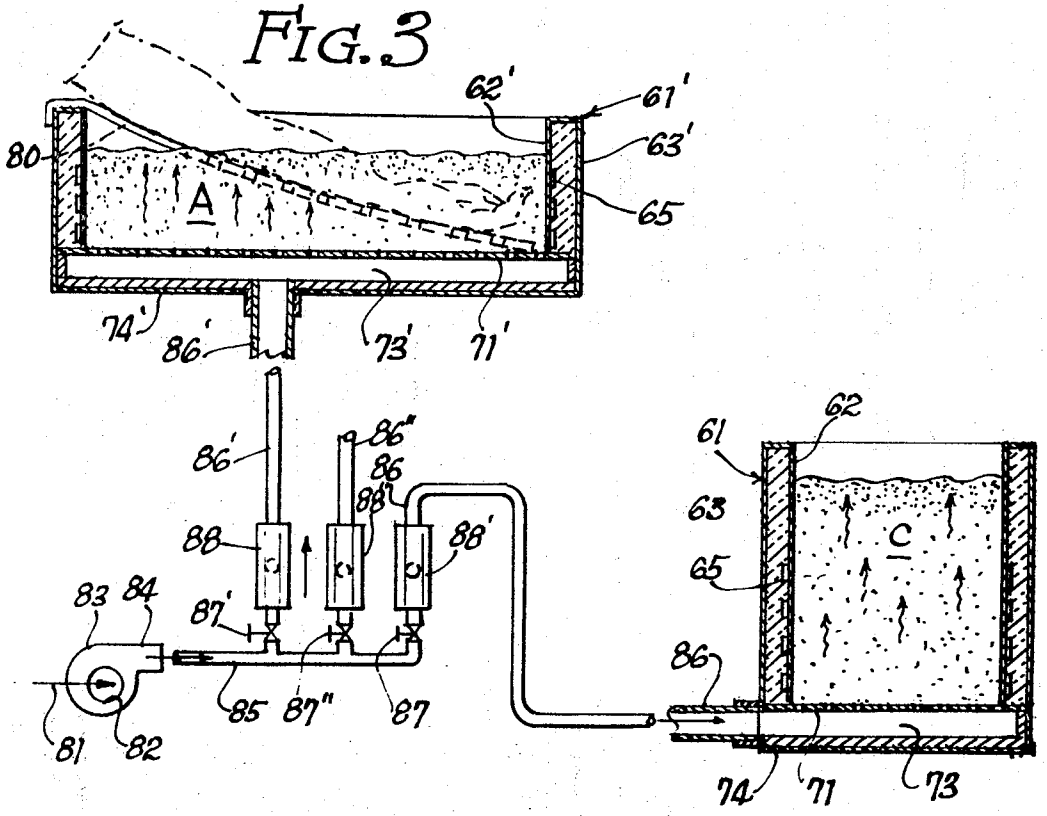


FIG. 3



FLUIDOTHERAPY APPARATUS UTILIZING GAS-FLUIDIZED SOLIDS

BACKGROUND OF THE INVENTION

A fluidized solids bed per se is well known. Essentially, it comprises a receptacle containing a quantity of finely divided, refractory material e. g., sand, aluminum oxide and the like which is agitated by passing air or other gas under pressure upwardly through the particulate mass. Under these circumstances, the mass of particles acts as a pseudo-fluid and exhibits many of the characteristics of a true fluid, e. g., agitated movement and ability to conform to an object submerged therein. For many applications, the body of particles is arranged to be heated, for example, by electrical heating elements carried on the exterior of the receptacle. Inasmuch as a fluidized solids bed can be readily controlled as to its physical behaviour in passing the gas therethrough and as to its temperature, there is provided apparatus utilizing a bed of this nature to function hydrotherapeutically on the human body. For example, the bed may be cooled to a temperature lower than ambient by a suitable refrigerant circulated in coils in, or surrounding the bed.

Although the present specification might, for want of more apt terms, employ the terms "hydrotherapy" and "hydrotherapeutic" with reference to treatment by utilization of a fluidized-solids bed, it will be apparent that the root "hydro" ("water") results in misnomers. Since "fluidotherapy" and "fluidotherapeutic" are more descriptive within the present context, they will be employed.

SUMMARY OF THE INVENTION

By way of example, the invention will be described with reference to fluidotherapeutic treatment of the legs, feet and/or arms of a patient. However, it will become apparent that the entire body of the patient may be treated in accordance with the principles of the invention. By way of example, we provide a structure in the nature of an armchair in which the "arms" are each constituted as a fluidized-solids bed together with the receptacle therefor, gas circulating means and heating means. Desirably the chair is mobile, so that it may be brought into the room of a non-ambulatory patient. The chair carries a receptacle at the front and at a lower level than the seat for treatment of the legs and feet of the patient. The size and proportions of all the receptacles are as desired. Means are provided for heating each of the several beds together with thermostatic controls therefor. Gas is fed to the beds under pressure by means of a blower.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a view from the right side of the apparatus;

FIG. 2 is a rear elevational view thereof;

FIG. 3 is a combined medial cross sectional view of a lateral receptacle and the lower receptacle, together with a somewhat schematic representation of the gas-feeding means.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Adverting to FIG. 1, there is shown a chair-like structure **10**, comprising a suitable framework to support the several components to be described. Since the framework may take a multiplicity of adequate structural forms, e.g., tubular members, further elucidation is regarded as non-essential. Front-to-back members **11—11** continue as vertical members **12—12** which, at the lower end, continue forwardly as members **13—13**. A handle bar **16** joins vertical members **15—15** so that the apparatus is rendered mobile on swivel casters **18**.

The several fluidized-solids beds are similar in construction and are referred to by the same reference numerals, but primed. Each comprises an open-top receptacle or box **61, 61', 61''**, formed of spaced-apart, inner and outer lateral walls **62, 62', 62''** and **63, 63', 63''** between which are housed electrical heating elements **65**, arranged in good heat-transfer relation with the inner wall of each box. An acceptable heater comprises a metal sheath housing an electrical resistance wire, e.g., Nichrome, this latter being embedded in a dense matrix of a refractory such as powdered magnesium oxide. Desirably, the heater sheath has a flat side for intimate, extended contact with the wall to which it is contiguous. If desired, the box **61** may be divided by a front-to-back partition in order that each foot may be treated under an individual set of conditions. In such case separate controls are provided.

Each of the spaces in which electric heating elements are housed are preferably lagged with asbestos, as shown.

The bottom wall of each box comprises a perforate plate **71, 71'** and **71''** of material which is not likely to be attacked under the operating conditions to which it is exposed. Since, for treatment of the human body, the temperature is not likely to exceed 150° F., the selection of a suitable material for the indicated environment presents no problem. As is customary for hospital equipment, stainless steel may be employed. In the example, the plates **71, 71'** and **71''** are the upper wall of a plenum chamber **73, 73'** and **73''**. The bottom wall **74, 74'** and **74''** thereof, is desirably sheet metal appropriately joined to the outer lateral walls.

Each box is charged with sand or other particulate solid capable of developing the "fluid" phenomenon. Gas under pressure, e. g., air, nitrogen or other non-toxic and non-corrosive gas is delivered to one or more of the plenum chambers **73, 73', 73''**, as required for the particular body part involved. The source of supply is indicated by the numeral **81** and is connected to the inlet **82** of a blower **83** which has an outlet **84** feeding a manifold **85**. Branches **86, 86', 86''** from the manifold each include an on-off valve **87, 87', 87''** and a flow meter **88, 88', 88''**. Each of these branches **86, 86', 86''** is in communication with the respective chambers **73, 73', 73''**. Accordingly, flow of gas to each of the chambers may be controlled selectively and at independent rates. The flow meters **88, 88', 88''** are of any well-known type providing visual indication of the rate of flow of gas.

Each of the fluidized beds A, B, C is provided with a temperature-sensing probe, a temperature indicator and adjustable thermostatic control means interconnected in a well-known manner to maintain a set temperature or temperatures for each of the masses A, B, C, it being understood that the apparatus is intended to treat the body parts at an established temperature. A high-temperature alarm and/or overload relay may be included in each of the circuits to the heating elements, having in mind that, in many cases, the patient may be incapacitated and incapable of removing his arm from the hot bed in the absence of an attendant.

For specific applications, the temperature and/or rate of gas flow of a bed may be program-controlled, e. g., a selected low temperature and flow rate increasing at some predetermined rate to a plateau and then a decreasing temperature. Each stage may be differently timed and the pattern may be repetitive.

A suitable fluidized-solids regimen is established within the bed or beds when the rate of gas flow is typically three standard cubic feet per minute per horizontal square foot of bed area.

FIG. 3 illustrates a typical use of a bed wherein a perforated support plate **80** is suitably mounted on one of the boxes **61, 61', 61''**, e.g., at an angle to the horizontal in order to dispose the patient's arm with the hand and lower part of the forearm submerged in the bed. Various other configurations of the plate **80** may be made available in the form of interchangeable adjuncts, having in mind relaxation of the patient and submersion of the portion of the body to be subjected to treatment. The support plate must have open area and size of holes sufficient to insure that it does not adversely affect the quality of fluidization in the vicinity of, and particularly on top of the plate. For example, the plate may have 65 percent open area and circular perforations of ½ inches diameter.

An important technique inherent in the inventive concept is the painless application of substances which are liquid or a gel at room temperature and above, but solid at temperatures below 60°F. In this case, the treatment solids are the fluidizing medium which is maintained at temperatures below 60°F. When the body portion is submerged or floated and gradually submerged, the heat of the patient's body will melt the solids in its vicinity and will deposit a uniform coating of the gel over that portion.

As an example of the use of the apparatus may be mentioned the treatment of foot ailments and infections, such as dermatophytosis, using ozonized air, preferably saturated with a remedial agent, e. g., vapor of pinene. In this example, the fluidizing gas is the ozonized air. The temperature of the fluidized solids is adjusted to realize optimum treatment. The higher the temperature, the higher the concentration of remedial agent in the ozonized air. Adjustment of the temperature level, including comparatively low temperatures, could be made dependent on alleviating discomfort of the patient. The invention contemplates the attainment of low temperatures by any conventional cooling means. In addition, the patient's members may be treated by other kinds of medicinal vapors.

We claim

1. The method of treating a part of the human body by fluid therapy which comprises the steps of:

a. providing a receptacle having a top opening, said receptacle containing a bed of particulate solid material,

b. admitting a gas under pressure to the lower part of the bed to induce fluidized-solids behaviour of the bed, and

c. submerging the body part in the bed for a preselected period of time.

2. The method in accordance with claim **1** characterized by the additional step of maintaining the bed at a predetermined temperature.

3. The method in accordance with claim **1**, characterized by the additional step of supporting the weight of the body part in its submerged position during treatment.

4. The method in accordance with claim **1** characterized in that the bed is heated in a cycle which begins at some low temperature, rises at some predetermined rate to a maximum temperature, is maintained at that level for a predetermined second interval and declines to said low temperature at some predetermined rate and so on cyclically over the total treatment period.

5. Apparatus for use in fluid therapy treatment of parts of the human body comprising a framework, a seat carried on said framework to support the subject, a receptacle disposed on at least one side of said seat, each receptacle containing a bed of particles of solid material capable of acting as a fluidized bed, means to deliver a gas under pressure to the bottom of the bed, the relative positions of the seat and bed being so arranged that the hand and/or arm of the subject may be submerged in whole or in part in said fluidized-solids bed.

6. Apparatus in accordance with claim **5** further characterized by means to heat said bed.

7. Apparatus in accordance with claim **5** further characterized by a receptacle positioned forwardly and downwardly of the seat and containing a bed of particles of solid material capable of acting as a fluidized-solids bed and means to deliver gas under pressure to the bottom of the bed, the depth of the bed being such as to receive the foot and leg portion of the subject.

8. Apparatus in accordance with claim **7** further characterized by means to heat said bed.

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