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APPARATUS FOR ADMINISTERING THERAPEUTIC AGENTS

Original Filed March 8, 1947

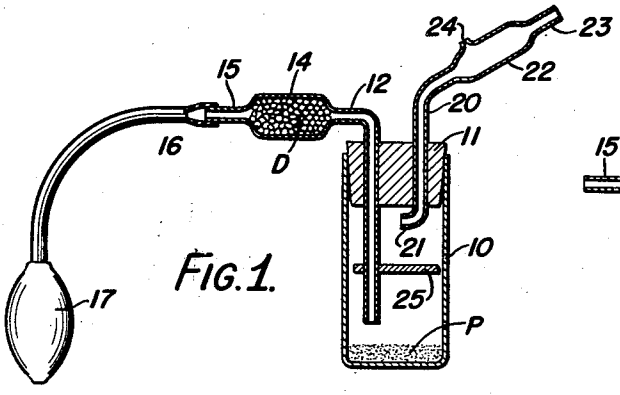


FIG. 1.

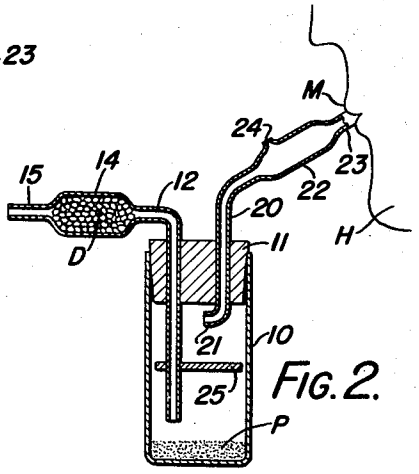


FIG. 2.

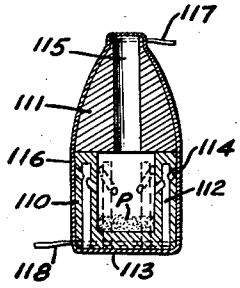


FIG. 5.

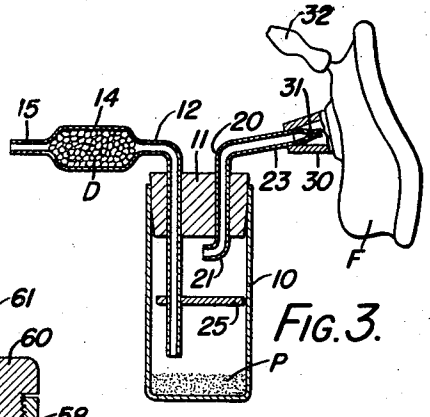


FIG. 3.

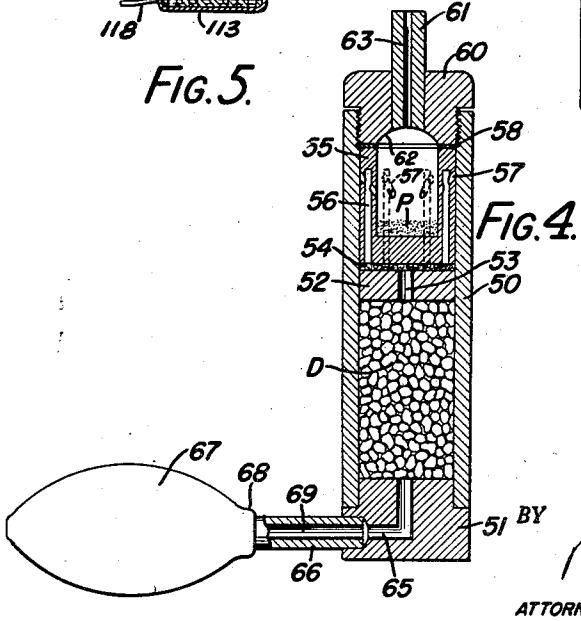


FIG. 4.

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APPARATUS FOR ADMINISTERING THERAPEUTIC AGENTS

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Original application March 8, 1947, Serial No. 733,280. Divided and this application November 26, 1949, Serial No. 129,624

8 Claims. (Cl. 128—266)

The present invention relates to apparatus for administering therapeutic agents and more particularly to apparatus for administering therapeutic agents in micropulverized powdered form. The present application is a division of our pending U. S. patent application Serial No. 733,280, filed March 8, 1947, now Patent No. 2,533,065, issued December 5, 1950.

In our prior application, we have described how absorbable therapeutic agents such as, penicillin, streptomycin, etc. may be administered by inhalation of these agents in micropulverized powdered form. This method of administration has many advantages over prior conventional method of administering these therapeutic agents by injection or by nebulizing solutions of these agents.

One object of the present invention is to provide simple, inexpensive apparatus for administering therapeutic agents in powdered form which can readily be operated by the patient himself without effort.

Another object of the invention is to provide apparatus for administering therapeutic agents which will be light in weight and of a size than can be readily carried around in the pocket of the patient.

A further object of the invention is to provide an insufflator for administering a measured amount of a powdered therapeutic.

Still another object of the invention is to provide an insufflator for administering a powdered therapeutic which will insure easy and proper operation at all times.

Other objects of the invention will be apparent hereinafter from the specification and from the recital of the appended claims.

In the drawings:

Fig. 1 is a sectional view of a piece of apparatus built according to one embodiment of this invention for administering a therapeutic agent in powdered form, and having an air bulb for producing the air stream that picks up the therapeutic powder;

Fig. 2 is a sectional view of the apparatus shown in Fig. 1 but illustrating how, by removal of the air bulb, the apparatus may be employed for inhaling the therapeutic substance through the mouth;

Fig. 3 is a sectional view showing how the apparatus of Figs. 1 and 2 may be adapted for use with a face mask;

Fig. 4 is a sectional view of an air-bulb operated piece of apparatus built according to another embodiment of the invention; and

Fig. 5 is a sectional view of a further modification of the invention showing a disposable combined container and inhaler.

Fig. 1 shows a very simple form of apparatus constructed according to this invention for administering a powdered therapeutic agent. Here, **10** denotes a container that may be made of glass or of a suitable plastic. The open end of this container is closed by a rubber stopper **11**. This stopper has two holes in it. Through one of these holes there passes a tube **12**, which extends downwardly a considerable distance into the container. This tube is formed exteriorly of the container with an enlarged portion forming a chamber **14**, and beyond this chamber the tube terminates in a reduced end portion **15**. The tubular end **16** of a suitable rubber air pressure bulb **17** may be connected to the end **15** of the tube as shown in Fig. 1. Through the other hole in the stopper **11**, there passes a tube **20**, which has its end turned at an angle below the stopper **11**, as denoted at **21**. Exteriorly of the container, this tube **20** is formed with an enlarged portion **22**; and it terminates in a reduced end portion **23**. The enlarged portion **22** of the tube **20** has an opening **24** formed in one side thereof, to provide an air vent. The tubes **12** and **20** may be made of glass, or of plastic, or of a suitable metal, such as copper.

The insufflator described may be used for administering any powdered therapeutic agent, for instance, finely powdered penicillin. The powdered agent, which is to be administered, is placed in the container **10**. It is here denoted at P. A suitable dehydrating substance, such as anhydrous calcium sulfate, denoted at D, is placed in the chamber **14** of tube **12**. This preferably is employed in the commercial form in which it is mixed with a litmus agent so that it will turn from blue to pink, when it has picked up all the moisture which it can hold.

In use, if a person wants to administer the penicillin, or other therapeutic agent to a patient, or if the patient wishes to administer it to himself, the end **23** of tube **20** may be placed in one nostril of the patient, and the bulb **17** is alternately squeezed and released. Thus, a stream of air, is forced through the dehydrating substance D, down through the tube **12** into the container **10**. The pressure of this air, forces the powder D in the container up through the tube **20** and out through the end **23** of this tube in a form like smoke; and the patient inhales this therapeutic smoke.

A baffle **25** is secured in any suitable manner to the tube **12** some distance above the lower end thereof, so as to prevent the powder P from being expelled from the container in lumps or gobs. These might irritate the throat, and would be wasteful of the medicine. The baffle is circular and there is but a slight difference between the diameter of the baffle and the internal diameter of the container, so that the only way in which the particles of powdered penicillin can reach the tube **20** is around the periphery of the baffle.

The vent **24** in the tube **20** admits of an additional current of air being drawn into the tube **20** as the stream of powder and air passes through that tube. This additional air stream serves to keep the powder stirred up and agitated and further insures that it will pass out of the end **23** of the tube **20** in the desired form of smoke. If the vent were not provided, too much powder might be expelled from the end **23** of the tube at one time; and this would be wasteful.

The same piece of apparatus shown in Fig. 1 can be used without change for inhaling the penicillin, or other therapeutic agent, through the mouth. Thus, after removing the tube **16** and air pressure bulb **17**, the patient, part of whose head is denoted at H in Fig. 2, can place the end **23** of the tube **20** in his mouth M and suck air through the end **15** of the tube **12**, through the dehydrating substance D, into the container **10**, and thence draw the powder suspended in air through the tube **20** into his mouth. In this case, an additional current of air is usually not required, and the patient can close the vent **24** with his thumb.

The same piece of apparatus can be used, also, without substantial change, in connection with a face mask where it is desirable to employ such a mask in the administration of a therapeutic substance to a patient. In this case, the end **23** of tube **20** is inserted into an opening formed on the projecting portion **30** of the face mask F (Fig. 3), and there is a rubber flap valve **31** applied over the end **23** of tube **20**. The face mask F itself, which is shaped to fit the contour of the face, has a further rubber flap valve **32** secured to it at any suitable point. The rubber flap valve **31** permits the powdered penicillin and air to be drawn into the face mask as the patient inhales. It closes when the patient exhales. The rubber flap valve **32** allows the air to be exhausted from the mask when the patient exhales.

Another form of apparatus built according to the invention is disclosed in Fig. 4. This comprises a tube **50** made of glass or plastic, one end of which is closed by a bottom cap piece **51**. If the tube **50** is made of plastic, this cap piece may be made of plastic, also, and it may be secured in the tube **50** simply by friction. Secured in the tube **50** by friction or in any other suitable manner, about midway of the height of the tube is a partition member **52**. This divides the tube **50** into a lower and

an upper chamber. The lower chamber is adapted to contain the dehydrating agent D. The partition member **52** has a central opening or duct **53** formed therein. On top of the partition member **52**, there is placed a thin layer of fine glass wool **54** which acts as a filter. On top of this layer of glass wool, within the tube **50**, there is mounted a cup-shaped powder receptacle or medicament vial **55** with the bottom of the receptacle or vial facing toward the air inlet **53**. This receptacle is adapted to hold the powdered therapeutic agent P. There are several equi-spaced holes or conduits **56** drilled longitudinally in the sidewall of the receptacle or vial **55** from the bottom of the receptacle or vial upwardly for the greater portion of the height thereof. These holes or ducts **56** communicate with short, helical or skew ducts **57**, which lead rearwardly into the interior of the receptacle. There is a gasket ring **58** placed on top of the receptacle or cup **55**, and the receptacle or vial is secured in the tube **50** by the upper cap or vial retainer member **60** which threads into the tube **50**. The cap or retainer member **60**, which forms a closure for the vial, has a central opening therein; and in this there is mounted a short tube **61** having a duct **63** extending axially therethrough. The bottoms of the cap or closure member **60** and of the tube **61** are made to spherical shape, as denoted at **62**, so as to provide a dome-like or spherical top for the chamber in which the powder P is contained.

There is a right angular duct **65** drilled or otherwise formed in the bottom end cap **51**; and there is a short tube **66** mounted at one side in this end cap and having a duct **69** therein which communicates with the duct **65**. An air pressure bulb **67**, having an engaging portion **68** may be secured to the tube **66**, by pushing the portion **68** over the outside of the tube **66**.

To use the apparatus of Fig. 4, the patient alternately squeezes, then releases the bulb **67**. This forces air through the tube **66**, and duct **65** into the lower chamber containing the dehydrating substance D. The dehydrating substance removes the moisture from the air. The dried air passes out of the lower chamber through the duct **53** in the partition member **52**, and through the filter **54** into the ducts **56** formed in the cup-shaped member **55**. Thence it flows through the ducts **57** rearwardly into the interior of this cup. The skew or helical inclination of the ducts **57** causes air flowing into the upper chamber to create a turbulence and force the powder into a spiral path. The spherical dome **62** of the upper chamber helps keep the powder agitated. From the receptacle the air-borne powder is therefore forced upwardly through the duct **63** in the tube **61** to the outer air where it emits in the form of smoke.

The upper chamber of the apparatus is of reduced area because of the use of the receptacle or cup **55**. The small surface area increases the emptying efficiency of the powder chamber. The outlet tube **61** is likewise made of small internal calibre to reduce the amount of precipitate on the walls of the tube. The threaded connection of the upper end cap **60** with the tube **50** prevents the powder from seeping out between the tube **50** and the end cap, the thread serving, therefore, as a seal.

The apparatus shown in Fig. 4 is adapted to all the various uses of the apparatus shown in Figs. 1 to 5 inclusive. Thus, on removing the bulb **67**, the outlet tube **61** can be placed in the mouth, and the powder drawn directly into the oral cavity. The outlet tube **61** can also be connected to a face mask, in a manner similar to the connection between the outlet tube **20** of Fig. 3 and the facemask of that figure, or, if desired, the outlet tube **61** can be replaced by a right angular tube for this purpose. Various adapters can also be fitted to the outlet tube, for nasal, oral, dental, vaginal use, etc., if so desired.

In some cases it may be desirable to provide an inhaler which contains a single dose of the therapeutic agent, which is to be administered, and which is disposable after use. Such an inhaler is shown in Fig. 5. This comprises a cylindrical-shaped cup or barrel **110**, and a cap **111**.

The cup or barrel is hollowed out to receive a measured dose of the therapeutic powder P. Ducts **112** are formed in the side-wall of the cup or barrel from the bottom **113** thereof to a point above the level of the powder P in the container. These ducts **112** communicate with inclined ducts **114** that lead rearwardly into the interior of the container above the level of the powder.

The cap **111**, which tapers externally upwardly, has a single axial duct **115** formed therein.

The barrel **110** and cap **111** may be made of papier-mâché or of a suitable plastic. A measured dose of the therapeutic is placed in the container **110** and the cap **111** sealed thereon. Then container and cap are dipped in some suitable sealing material or wrapped in a suitable cellulose cover so as to completely seal and cover the whole container. This sealing covering is designated at **116** in Fig. 8. Strings or wires **117** and **118** may be embedded in this covering so that when they are pulled, the part of the covering, which covers the outside end of duct **115**, and the part of the covering, which covers the bottom or outside ends of ducts **112**, are removed. Then the inhaler is ready for use.

In use, the patient simply puts the small end of the cap **111** into a nostril or into his mouth and inhales. Air is drawn through the ducts **112** and **114** into the powder chamber; the skew or helical shape of the ducts **114** creates a turbulence in the powder; and the powder in suspension is drawn up through the duct **115** into the nostril or mouth.

Apparatus constructed according to the present invention is simple to operate, inexpensive, efficient, foolproof, and with it measured doses of different therapeutic agents may be administered either in a hospital or at home in a period of a few minutes without any of the disadvantages or inconveniences of prior apparatus for administering therapeutics.

While the invention has been described in connection with the administration of penicillin, the device may be used, as already indicated, for the administration of any other absorbable therapeutic agent in powdered form, as described more particularly in our current application No. 733,280 above mentioned.

While the invention has been described, therefore, in connection with particular embodiments thereof and particular uses therefor, it will be understood that it is capable of various further modifications and uses; and this application is intended to cover any variations, uses, or adaptations of the invention following, in general, the principles of the invention and including such departures from the present disclosure as come within known or customary practice in the art to which the invention pertains and as may be applied to the essential features hereinbefore set forth and as fall within the scope of the invention or the limits of the appended claims.

Having thus described our invention, what we claim is:

1. Apparatus for administering a therapeutic agent having a chamber adapted to contain a dehydrating agent, a second chamber adapted to contain a powdered therapeutic agent, an intake duct for conducting air to one end of the first chamber, a ported partition between the two chambers, a filter in the second chamber seated against said partition, said apparatus having a plurality of ducts therein, each of which terminates at one end of the opposite side of the filter and each of which at its opposite end is directed rearwardly of the second chamber, whereby air is conducted into the second chamber to create a turbulence in the powder, and an outlet duct leading from the second chamber for conducting the powder suspended in air therefrom, said second chamber having a relatively small surface area, and said outlet duct having a relatively small internal diameter.

2. A disposable article comprising a hollow cup-like receptacle closed at its bottom and open at its top, a cap for closing the top of said receptacle, said hollow receptacle having a chamber therein adapted to contain a measured quantity of a powdered therapeutic agent and having conduits for conducting air formed in its side wall which extend from its bottom upwardly for the major portion of its height, and having other conduits formed therein which are directed rearwardly into said chamber and which communicate both with the first-named conduits and with the interior of the hollow member, said cap member having an axially extending outlet conduit extending therethrough and communicating with the top of said chamber, a cover enclosing the whole of said article and sealing the outer ends of all said conduits, and means operable to break said cover so as to unseal the first and third-named conduits.

3. In a powder blower of the type described, a tubular body, a ported transverse partition dividing the interior of the body into two cylindrical chambers, said body

having an air inlet at one end, air drying material in the chamber adjoining said end, said body having an air and powder outlet at the other end, a powder receptacle in the chamber adjoining the latter end, the bottom of the receptacle facing toward the air inlet and the receptacle opening facing toward the air and powder outlet, and means for conducting air forwardly to a point beyond the bottom of the receptacle and thence rearwardly of the receptacle into the interior of the receptacle.

4. In a powder blower of the type described, a tubular body having an air inlet at one end and an air and powder outlet at the other end, a receptacle for powder within the body, the bottom of the receptacle facing toward the air inlet and the receptacle opening facing toward the air and powder outlet, and means for conducting air forwardly beyond the bottom of the receptacle and thence rearwardly of the receptacle into the receptacle.

5. In a powder blower of the type described, a tubular body having an air inlet at one end and an air and powder outlet at the other end, a medicament vial fitting within the tubular body with its bottom toward the air inlet and its open end toward the air and powder outlet, and a vial retainer member having a central bore therethrough communicating with the outlet, said blower being provided with means for conducting air from the inlet forwardly of the vial, said blower being provided with ducts communicating with said conducting means which are shaped to turn the air rearwardly of the vial into the interior of the vial.

6. Apparatus for administration of a powdered therapeutic agent comprising a cup-like receptacle, and a closure for said receptacle, said receptacle forming a powder-receiving chamber which is closed at its bottom and open at its top, and said closure covering the top of said chamber and having an air and powder outlet duct extending through it and communicating with the top of said chamber, and said receptacle having air conducting means in its peripheral wall extending from the bottom of the receptacle toward the top thereof, and air-conducting means for directing air from the first-named air-conducting means rearwardly into said chamber.

7. Apparatus for administration of a powder therapeutic agent comprising a cup-like receptacle, and a closure for said receptacle, said receptacle forming a powder-receiving chamber which is closed at its bottom and open at its top, and said closure covering the top of said chamber and having an air and powder outlet conduit extending through it and communicating with the top of said chamber, and said receptacle having an air inlet passage in its peripheral wall open at its bottom and extending from the bottom of the receptacle toward the top thereof and a conduit communicating with said air inlet passage and with said chamber and extending rearwardly from said air inlet passage into said chamber to direct air rearwardly into said chamber.

8. Apparatus for administration of a powdered therapeutic agent having a hollow cup-like receptacle having a chamber formed therein for holding a finely powdered therapeutic agent, said chamber being open at its top and closed at its bottom, said receptacle having air-conducting means in its peripheral wall extending from the bottom of the receptacle toward the top thereof, and air-conducting means for directing air from the first-named air-conducting means rearwardly into said chamber, a closure for said receptacle covering the open top end of said receptacle and having a gas and powder outlet conduit extending through it and communicating with the open top end of said chamber, said closure being shaped to be inserted in a body cavity, and a rupturable covering sealing the outer ends of both said inlet and outlet conduits.

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