

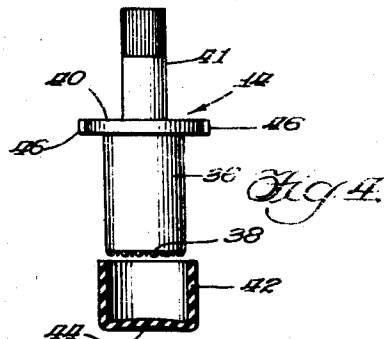
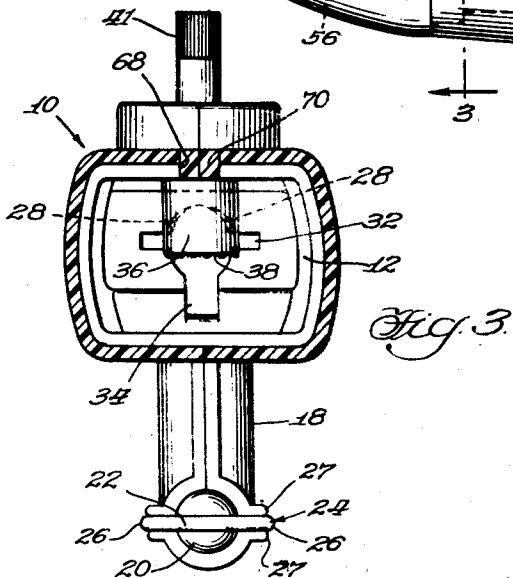
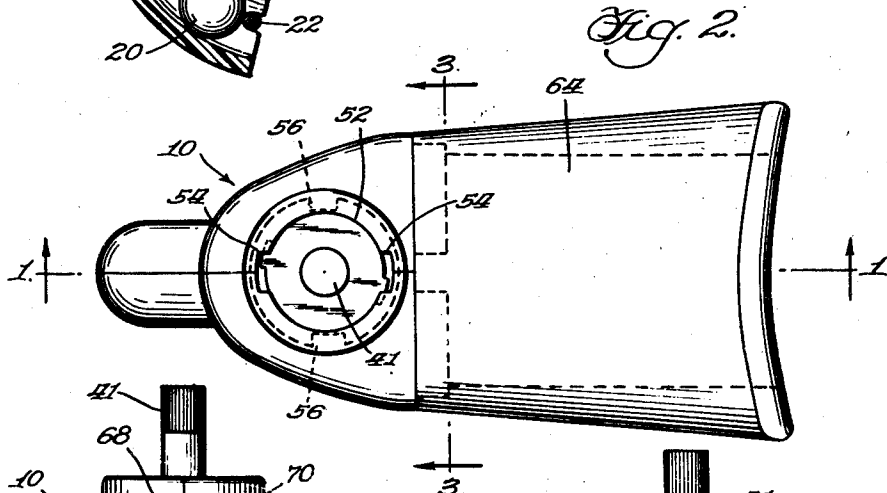
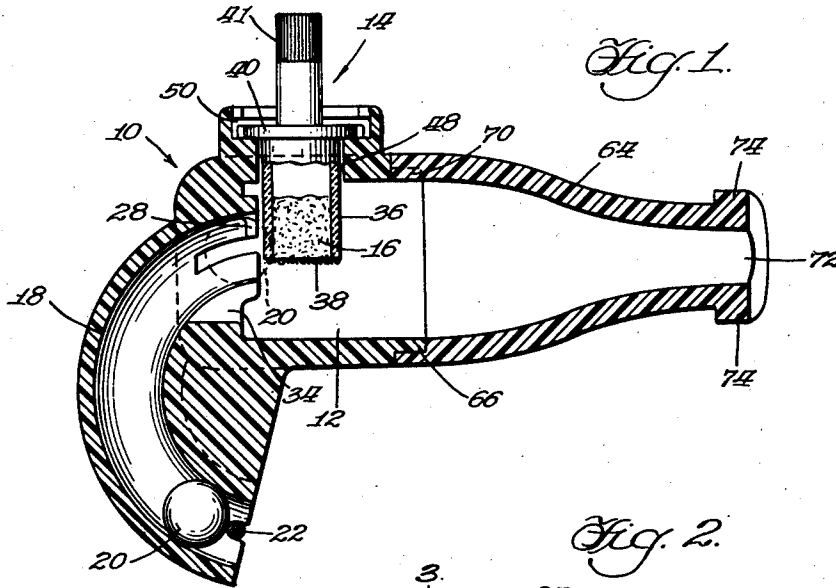
May 17, 1949.

M. R. FIELDS
INHALATOR

2,470,296

Filed April 30, 1948

2 Sheets-Sheet 1



INVENTOR.
Mack R. Fields
BY
Donald H. Sweet atty.

May 17, 1949.

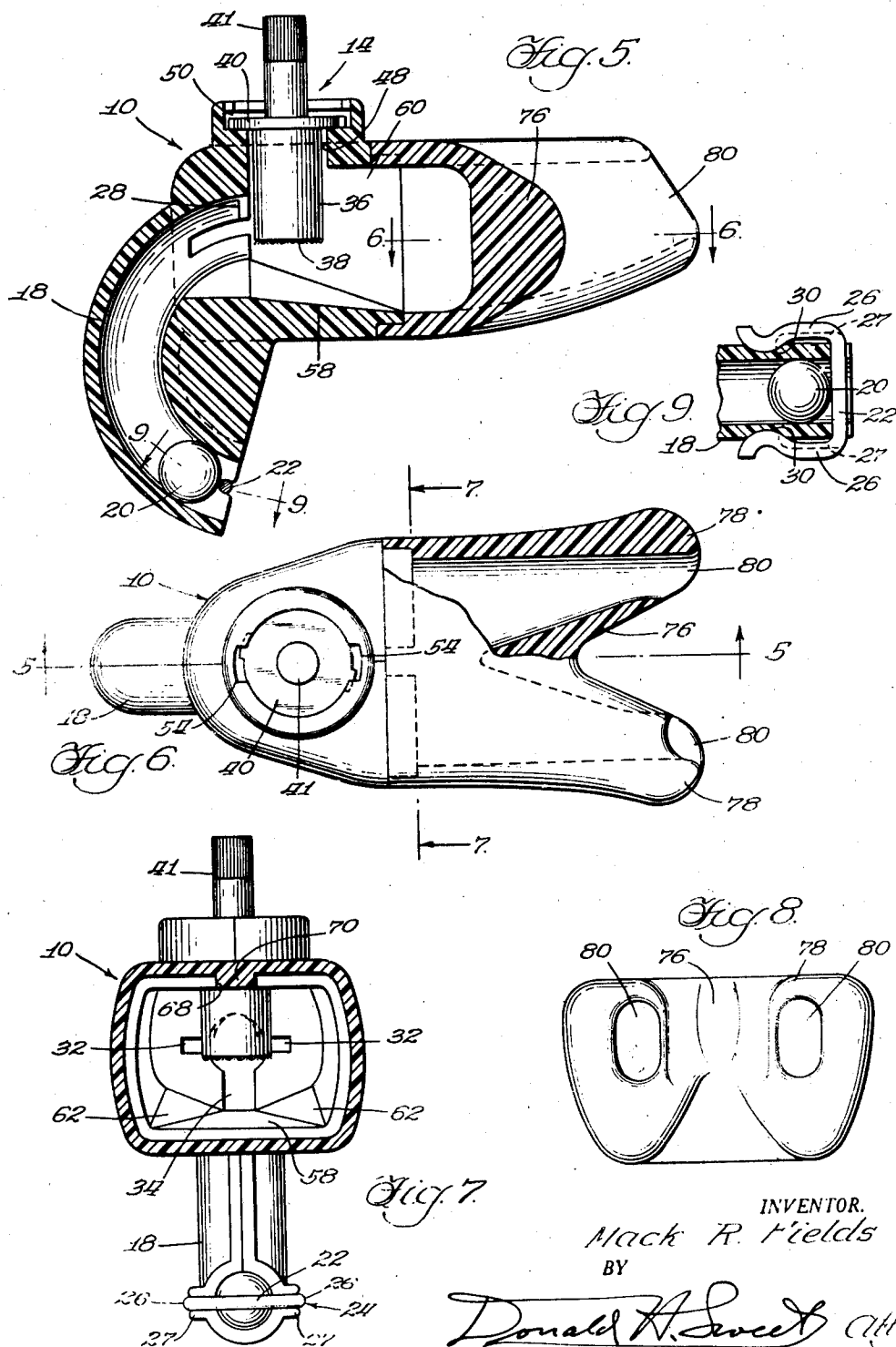
M. R. FIELDS

2,470,296

INHALATOR

Filed April 30, 1948

2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE

2,470,296

INHALATOR

Mack R. Fields, Libertyville, Ill., assignor to Abbott Laboratories, North Chicago, Ill., a corporation of Illinois

Application April 30, 1948, Serial No. 24,319

21 Claims. (Cl. 128—266)

1

My invention relates to therapeutic medication and includes among its objects and advantages increased convenience in medication with dry medicaments in powder form, especially with respect to accuracy of dosage and accurate placement of the material.

Many useful medicaments, and especially penicillin and related antibiotics, are subject to substantial or, in some instances, complete alteration by the stomach juices when administered orally. Different patients vary widely in the condition of the alimentary canal and the extent to which oral dosages will be impaired in effectiveness. In fact, the same patient will react differently to the same dosage at different times, because the condition of the patient's alimentary canal varies from time to time.

On this account, precision in treatment has only been attainable in the past with oral dosages supplemented by checking blood samples to ascertain how much medicament has found its way into the blood stream, or by parenteral administration.

It has been discovered that the air-born ingestion of powdered penicillin and other medicaments available in the form of fine powders, can be practised to cause therapeutic effects. It is also possible to combine the general treatment thus resulting with high local concentration of the same medicament in whatever body cavity is utilized.

In addition to water-soluble anti-biotics, solid inhalation therapy is of value in connection with other therapeutic agents, including antiseptics, bronchiolytics, and vaso-constrictors, and is indicated for at least some of the known anti-histamine drugs. Illustrative examples of vaso-constrictors are: epinephrine hydrochloride, isopropyl epinephrin and 2-amino-heptane. Illustrative examples of anti-histamine agents are: N-(alpha-pyridyl)-N-(alphathenyl)-N',N'-dimethylethylenediamine hydrochloride, and N-(alpha-pyridyl)-N-(benzyl)-N',N'-dimethylethylenediamine hydrochloride.

Data available so far does not support any reliable generalizations. More particularly, the mere fact that a drug is ineffective or toxic when administered orally affords no indication whether or no it is suitable for solid inhalation therapy. Many such therapeutic agents which are water soluble, will be found effective by solid inhalation, but both the effect and the degree of effectiveness need to be established by specific test in connection with each substance.

However, especially when the local application is in the lungs, a wide variability in the proportion of powdered material that comes to rest in the nose and in the bronchial tubes and in the actual lung itself can only be avoided by a substantial constancy in the method of inhalation.

2

According to the invention, I succeed in obtaining such constancy by providing apparatus which is to be utilized by the patient by breathing in and out in a simple, substantially normal way.

I utilize the energy of the air flowing through the device to deliver into each charge of air inhaled, a small substantially constant charge of powdered medicament, which charge is delivered quickly, shortly after inhalation begins, and finds its way to its resting place long before inhalation is finished. Thus the apparatus itself and the body passages first receiving the stream of air are thoroughly swept and scavenged with pure air during a major portion of the breathing-in process. I have found that administration in this way not only contributes to deep penetration of the medicament, but that it becomes unnecessary to pulverize or micronize the medicament into a true smoke. The use of larger particles tends to increase the reliability with which a uniform fraction of the material will pass on through the body passages first receiving the stream without getting caught on the moist walls.

According to the invention, a jolting means is actuated by the air flow to jolt the parts at the beginning of each movement of air through the device, and is thereafter kept inoperative until the movement is completed. After the movement is completed the jolting means must be restored to operative condition, ready for the next movement of air. And a source for piecemeal delivery of limited increments of powder must be activated by the jolting.

In its simplest form, this calls for an air passage, an element movable in the passage, and a stop to arrest the element and cause a jolt. The continued flow of air can be relied on to hold the element against the stop and inoperative until the air movement ends, and if the passage has a suitable inclination, gravity can be relied on to return the movable element. The jolting causes powder to be dislodged into the initial portion of the stream of air, and the parts remain quiescent during the remainder of the movement of air. This remaining movement dilutes the powder-laden air already delivered and scavenges the device and at least the initial portions of the body passage receiving the air.

In the accompanying drawings:

Figure 1 is a section of an inhalator according to the invention, on line 1—1 of Figure 2;

Figure 2 is a plan view of the same inhalator from above;

Figure 3 is a section on line 3—3 of Figure 2; Figure 4 is a side view of the capsule with the cover removed;

Figure 5 is a section similar to Figure 1, on line 5—5 of Figure 6, indicating a modified construction;

60

Figure 6 is a plan view partly in section on line 6—6 of Figure 5;

Figure 7 is a section on line 7—7 of Figure 6;

Figure 8 is an end view of the nose end of the modified form; and

Figure 9 is a section on line 9—9 of Figure 5.

In the drawings as filed, the parts were substantially to scale and twice normal size. Accordingly, in the printed patent, they are about 140% actual size.

In the embodiment of apparatus selected for illustration, the main housing 10 is of transparent plastic molded in two halves and sealed together on the plane of the section of Figure 1. The body defines a chamber 12 in the general shape of an open cup. The upper wall of the body is apertured to receive a capsule 14, containing the medicament 16.

The arcuate air inlet tube 18 enters the cup close beside the capsule 14. Outside the cup it curves downwardly and back toward the user to reduce the overall length of the device. The impact ball 20 normally lies in the position of Figure 1, being restrained from falling out by the ball 22 of a retaining clip 24. The clip has resilient side arms 26 that set in place between ribs 27 on the tube 18 and curve into shallow pockets 30. A simple steel ball functions very well in this connection, but with a ball of aluminum the parts may be designed to secure a slightly better mechanical action. When the capsule is in place the ball 20 is restrained from leaving the inlet tube 18 by the capsule itself, but to insure against loss I provide also lips 28 extending in from upper quadrants of the edge of the tube at its inner end. The inner end of the tube is also provided with side slots 32 and a bottom slot 34 extending back along the tube far enough so that the ball will pass the rear ends of the slots at the end of its inward movement and thus open inlet apertures for the entrance of air into the cup 12.

The capsule 14 includes the barrel 36 which houses the medicament 16 retained by a mesh screen 38, the top flange 40 and the knurled operating handle 41. It is filled at the factory and then covered with the cap 42, the bottom 44 of which bulges up slightly in undistorted position so that when the cap is pushed in place over the capsule the bottom will press snugly against the screen 38. The flange 40 has opposite ears 46 so that the capsule can be assembled with the body by a bayonet joint connection. As clearly indicated in Figures 1 and 5, the body has a bore 48 to receive the barrel 36 with material clearance so that the capsule is loose and can jiggle around quite a little. Similarly the groove 50 which receives the flange 40 provides equal or greater clearance for the flange so that the jiggling is not impaired. The top flange 52 has opposite notches at 54 through which the lugs 46 can be moved axially and the groove 50 is filled in, or interrupted, at 56. Thus the user can move the capsule axially into position, and then turn it in either direction and it will turn 90 degrees and then be arrested between stops 56, so that the user will not inadvertently swing it through 180 degrees where it is likely to fall out again.

In the embodiment of Figures 1, 2 and 3, the end of the tube 18 projects slightly through the chamber 12. In the embodiment of Figures 5 and 7 the shape is otherwise identical, but the floor 58 of the modified chamber 60 slopes up to and flush with the bottom of the slot 34. The bottom of the cup is flush with the

end of the tube 18 and the small corner pockets at the bottom of the chamber 60 are filled in up to inclined planes or interior facets 62. This affords a particle of powder no resting place that is not inclined downwardly and toward the center so that the air stream entering through the slots 32 and 34 will always keep the lower portions of the chamber well scavenged. This scavenging action is assisted by the fact that the loose fit for the capsule 14 permits material leakage of air which will acquire considerable velocity directly downward as it passes through the annular clearance around the barrel 36, and tend to direct the main stream downward more or less and assist in keeping the chamber scavenged. The other function of the loose mounting is to permit a substantial movement or displacement of the capsule from the position of Figure 1, in which it is held by gravity, when the ball 20 strikes it, thus providing a more effective jolt to shake a small increment of the powder 16 out through the sieve 38.

Detachable connecting means are provided for connecting the cup 10 to a desired body cavity. In Figures 1, 2 and 3 I have illustrated a connector for the mouth. The body 10 has an external rabbet and the connector 64 has an internal rabbet. The flange 66 on the body 10 is interrupted in the middle of the top at 68 to define a notch and the connector flange has a filled-in portion at 70 to fit in the notch, so that the connector and body will always be assembled in the same relative positions. The body 64 has converging top and bottom walls and slightly diverging side walls to define a flaring shape ending in a horizontally wide and vertically narrow discharge opening 72 with at least the central portions of the top and bottom wall carrying outwardly directed flanges 74 by which the teeth of the user may comfortably and conveniently be engaged during use.

To use the device, a capsule is inserted as indicated in Figure 1 and the user slips the mouth piece between his lips and takes a deep breath. Because of the volume of the body and connector is a negligible fraction of the volume that even a child will inhale in this way, the increment of powder dislodged by the impact of the ball against the capsule will be swept through the chamber and into the body passages and followed by a considerable inhalation of pure air to scavenge both the device and the initial body passages.

Because, with the ball 20 in the full line position of Figure 1, the possible openings for reverse flow of air through the device are extremely constricted, the natural impulse of the user to withdraw the device or to release the lips and breathe out around it, is confirmed and enforced so that the moist air exhaled by the user does not go back through the device to moisten the walls of the chamber and cause the next increment of powder to be retained where it is not desired.

It will be obvious that the connectors can be shaped to fit any body cavity into which the patient can draw air. In Figures 5, 6 and 8 I have indicated a nosepiece also of transparent plastic. The portion of the nosepiece engaging the body 10 is of identical configuration with the connector 64, but it has a bifurcated body 76 terminating in spaced lobes 78 of a size or configuration to enter comfortably into the nostrils. And the interior clearance is also bifurcated to end in spaced discharge openings 80 positioned to deliver the stream of fluid close to the septum and substantially parallel thereto.

5

By varying the fineness of the powder and the mesh of the screen 30, various powdered medicaments can be administered at various rates. With sodium penicillin I prefer to use a screen of about 60 mesh, and it is not hard to granulate the powder by trial and error to a grain size such that an administration of 100,000 units is easily accomplished by normal breathing, in from five to ten minutes. I have also found that smoother and more accurate mechanical action can be secured by mixing the penicillin with at least a little other material intended to function as a diluent or vehicle.

Because the energy of the user's breath actuates the timed discharge, there is no other instrumentality with which any synchronism needs to be maintained. Further, because there is no extraneous power imposed on the ingoing air stream, the patient's natural and normal lung movements are not disturbed and upset by being pushed or pulled in a way that is always uncomfortable and frequently unexpected and bad for the morale of the patient.

The capsule 36 is of such size that it can be housed within the chamber and the body 64 or 76. While it is contemplated that the capsules will be sold in quantity in separate packages this specific item is useful in a large institution where a supply of the devices can be prepared in sterile condition by a student nurse, with a capsule housed in each device for quick use in emergencies, such as acute attacks of asthma.

This application is a continuation in part of my co-pending application, Serial Number 772,104, filed September 4, 1947.

Others may readily adapt the invention for use under various conditions of service, by employing one or more of the novel features disclosed, or equivalents thereof. As at present advised with respect to the apparent scope of my invention, I desire to claim the following subject matter.

I claim:

1. Equipment for introducing an airborne powdered medicament into body cavities, which comprises: a body defining a passage; said passage having an inlet; means for enabling the user to move successive charges of gas through said passage; a medicament container in said passage having an opening permitting exit of powder; a charge of medicament in said container; said medicament being powdered finely enough to pass out through said opening, at least when jolted; and means actuated by the flow of an initial portion of a normal charge of gas, for jolting said container to discharge medicament from said open end.

2. Equipment according to claim 1 in which said jolting means is movable along said passage in the direction of flow; and stop means in said passage arresting the movement of said jolting means to cause a jolt.

3. Equipment according to claim 2 in which said stop means is said container; and said jolting means is a piston guided by said passage to strike said container.

4. Equipment for introducing an airborne powdered medicament into body cavities, which comprises: a body defining a passage; said passage having an inlet; means in the nature of a passage outlet shaped to fit a body opening of the user for enabling the user to move successive charges of air through said passage; a medicament container in said passage having an opening permitting exit of powder; a charge of medica-

6

ment in said container; said medicament being powdered finely enough to pass out through said opening, at least when jolted; and means actuated by the passage of an initial portion of a normal charge of air, for jolting said container to discharge an increment of medicament from said open end.

5. Equipment according to claim 4 in which the parts are shaped to guide the air flow close to the discharge opening after the jolt; whereby the discharged powdered medicament is picked up in the stream of air to be carried out of the device through said outlet.

6. Equipment according to claim 4 in which said jolting means is movable along said passage in the direction of flow; and stop means in said passage arresting the movement of said jolting means to cause a jolt.

7. Equipment according to claim 6 in which said stop means is said container, and said jolting means is a piston guided by said passage to strike said container.

8. Equipment according to claim 4 in which said container has a plurality of spaced openings in one end, and is otherwise completely closed.

9. Equipment according to claim 4 in which the parts are shaped to restrict the container opening, whereby the increment discharged at the time of jolting is a minor fraction of the original charge in said container.

10. Equipment for introducing an airborne powdered medicament into body cavities, which comprises: a body defining a passage; said passage having an inlet; means in the nature of a passage outlet shaped to fit a body opening of the user for enabling the user to move successive charges of air through said passage; a stationary medicament container in said passage having openings at one end to permit discharge of powder; a charge of powder in said container, fine enough to work out through said openings when said container is jolted; said passage being enlarged into a chamber around said container; said passage inlet being of relatively small and constant cross section; a piston slidable in said inlet; stop means at the intake end of said inlet to prevent exit of said piston; said container being located in said chamber adjacent the delivery end of said inlet in a position where said piston will strike it at the end of the piston stroke; said body defining bypass openings around said piston when said piston is adjacent said container; said bypass openings directing the flow of air close to said container openings to entrain the discharged powder; said container being mounted loosely to enhance the agitation of said powder when said piston strikes said container.

11. Equipment for introducing an airborne powdered medicament into body cavities, which comprises: a body defining a passage; said passage having an inlet; means in the nature of a passage outlet shaped to fit a body opening of the user for enabling the user to move successive charges of air through said passage; a stationary medicament container in said passage having openings at one end to permit discharge of powder; a charge of powder in said container, fine enough to work out through said openings when said container is jolted; said passage being enlarged into a chamber around said container; said passage inlet being a relatively small and constant cross section; a piston slidable in said inlet; stop means at the intake end of said inlet to prevent exit of said piston; said container

7

being located in said chamber adjacent the delivery end of said inlet in a position where said piston will strike it at the end of the piston stroke; said body defining bypass openings around said piston when said piston is adjacent said container; said bypass openings directing the flow of air close to said container openings to entrain the discharged powder; said container being mounted loosely to enhance the agitation of said powder when said piston strikes said container, said inlet being curved around and back toward said body.

12. Equipment for introducing an airborne powdered medicament into body cavities, which comprises: a body defining a passage; said passage having an inlet; means in the nature of a passage outlet shaped to fit a body opening of the user for enabling the user to move successive charges of air through said passage; a stationary medicament container in said passage having openings at one end to permit discharge of powder; a charge of powder in said container, fine enough to work out through said openings when said container is jolted; said passage being enlarged into a chamber around said container; said passage inlet being of relatively small and constant cross section; a piston slidable in said inlet; stop means at the intake end of said inlet to prevent exit of said piston; said container being located in said chamber adjacent the delivery end of said inlet in a position where said piston will strike it at the end of the piston stroke; said body defining bypass openings around said piston when said piston is adjacent said container; said bypass openings directing the flow of air close to said container openings to entrain the discharged powder; said container being mounted loosely to enhance the agitation of said powder when said piston strikes said container; said body being separable, along a parting line girdling said chamber, into a portion integral with said inlet and supporting said container, and a portion integral with said outlet; said inlet body portion having a lateral opening for introduction of said container into operative position in said chamber with at least a portion of said container still accessible from outside said chamber.

13. Equipment for introducing an airborne powdered medicament into body cavities, which comprises: a body defining a passage; said passage having an inlet; means in the nature of a passage outlet shaped to fit a body opening of the user for enabling the user to move successive charges of air through said passage; a stationary medicament container in said passage having openings at one end to permit discharge of powder; a charge of powder in said container, fine enough to work out through said openings when said container is jolted; said passage being enlarged into a chamber around said container; said passage inlet being of relatively small and constant cross section; a piston slidable in said inlet; stop means at the intake end of said inlet to prevent exit of said piston; said container being located in said chamber adjacent the delivery end of said inlet in a position where said piston will strike it at the end of the piston stroke; said body defining bypass openings around said piston when said piston is adjacent said container; said bypass openings directing the flow of air close to said container openings to entrain the discharged powder; said container being mounted loosely to enhance the agitation of said powder when said piston strikes said container; said body having a lateral opening for introduction of said container into opera-

8

tive position in said chamber with at least a portion of said container still accessible from outside said chamber.

14. Equipment for introducing an airborne powdered medicament into body cavities, which comprises: a body defining a passage; said passage having an inlet; means in the nature of a passage outlet shaped to fit a body opening of the user for enabling the user to move successive charges of air through said passage; a stationary medicament container in said passage having openings at one end to permit discharge of powder; a charge of powder in said container, fine enough to work out through said openings when said container is jolted; said passage being enlarged into a chamber around said container; said passage inlet being of relatively small and constant cross section; a ball piston slidable in said inlet; stop means at both ends of said inlet to prevent exit of said piston; said container being located in said chamber adjacent the delivery end of said inlet in a position where said piston will strike it at the end of the piston stroke; said body defining bypass openings around said piston when said piston is adjacent said container; said bypass openings directing the flow of air close to said container openings to entrain the discharged powder; said container being mounted loosely to enhance the agitation of said powder when said piston strikes said container; said body being separable, along a parting line girdling said chamber, into an inlet portion integral with said inlet and supporting said container, and an outlet portion integral with said outlet; said inlet body portion having a lateral opening for introduction of said container into operative position in said chamber with at least a portion of said container still accessible from outside said chamber; said chamber being large enough to house the entirety of said container in inoperative stored position.

15. Equipment for introducing an airborne powdered medicament into body cavities, which comprises: a body defining a passage; said passage having an inlet; means for enabling the user to move successive charges of air through said passage; a slidable member in said passage adapted to be actuated by the flow of air in said passage; a stop member in said passage positioned to arrest the movement of said slidable member at the end of its stroke, whereby said slidable member and stop are jolted; one of said members being a container having an opening at one end to permit discharge of powder; said container being otherwise closed, whereby powder can only leave said container by permitting air to replace the powder liberated; a charge of powder in said container, fine enough to work out through said opening when said container is jolted; said passage defining a chamber around said container; said body and said slidable member defining bypass openings around said slidable member when said slidable member is adjacent said stop member, whereby, after a jolt, air can continue to flow; said bypass openings directing the flow of air close to said container openings to entrain the discharged powder.

16. Equipment for introducing an airborne powdered medicament into body cavities, which comprises: a body defining a passage; said passage having an inlet; means in the nature of a passage outlet shaped to fit a body opening of the user for enabling the user to move successive charges of air through said passage; a slidable member in said passage adapted to be actuated by the flow of air in said passage; a stop mem-

ber in said passage positioned to arrest the movement of said slidable member at the end of its stroke, whereby said slidable member and stop are jolted; one of said members being a container having an opening at one end to permit discharge of powder; said container being otherwise closed, whereby powder can only leave said container by permitting air to replace the powder liberated; a charge of powder in said container, fine enough to work out through said opening when said container is jolted; said passage defining a chamber around said container; said body and said slidable member defining bypass openings around said slidable member when said slidable member is adjacent said stop member, whereby, after a jolt, air can continue to flow; said bypass openings directing the flow of air close to said container openings to entrain the discharged powder.

17. Equipment according to claim 16 in which said container is the stop member for said slidable member.

18. A device adapted to dispense a powdered medicament comprising, in combination: a body defining a passage; said passage having an inlet portion, and an outlet portion adapted to fit a body opening; said inlet portion being of approximately constant cross section; a piston slidable in said inlet portion; stop means at the intake end of said inlet portion to prevent exit of said piston; said body defining bypass openings around said piston when said piston is adjacent the discharge end of said inlet portion; said body being adapted to receive a powder container in a position where said piston will be arrested at the discharge end of said inlet portion by impact against the container; said inlet portion being of relatively small cross section compared with said outlet portion; stop means on said body positioned to prevent said piston from leaving said inlet portion when no container is present; and means for normally keeping said piston adjacent the inlet end of said inlet portion when not drawn toward said stop means by air flow.

19. A device adapted to dispense a powdered medicament comprising, in combination: a body defining a passage; said passage having an inlet portion and an outlet portion adapted to fit a body opening; said inlet portion being of approximately constant cross section; a piston slidable in said inlet portion; stop means at the intake end of said inlet portion to prevent exit of said piston; said body defining bypass openings around said piston when said piston is adjacent the discharge end of said inlet portion; said

body being adapted to receive a powder container in a position where said piston will be arrested at the discharge end of said inlet portion by impact against the container; stop means on said body positioned to prevent said piston from leaving said inlet portion when no container is present; and means for normally keeping said piston adjacent the inlet end of said inlet portion when not drawn toward said stop means by air flow.

20. A device adapted to dispense a powdered medicament comprising, in combination: a body defining a passage; said passage having an inlet portion and an outlet portion adapted to fit a body opening; said inlet portion being of approximately constant cross section; a piston slidable in said inlet portion; stop means at the intake end of said inlet portion to prevent exit of said piston; said body defining bypass openings around said piston when said piston is adjacent the discharge end of said inlet portion; said body being adapted to receive a powder container in a position where said piston will be arrested at the discharge end of said inlet portion by impact against the container; and stop means on said body positioned to prevent said piston from leaving said inlet portion when no container is present.

21. A device adapted to dispense a powdered medicament comprising, in combination: a body defining a passage; said passage having an inlet portion and an outlet portion adapted to fit a body opening; said inlet portion being of approximately constant cross section; a piston slidable in said inlet portion; stop means at the intake end of said inlet portion to prevent exit of said piston; said body defining by-pass openings around said piston when said piston is adjacent the discharge end of said inlet portion; said body being adapted to receive a powder container in a position where said piston will be arrested at the discharge end of said inlet portion by impact against the container.

MACK R. FIELDS.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,214,032	Stewart	Sept. 10, 1940

FOREIGN PATENTS

Number	Country	Date
471,490	Germany	Apr. 22, 1927