(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 188 820**
A1

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **85116661.1**

(22) Date of filing: **31.12.85**

(51) Int. Cl.⁴: **B 65 B 1/38**

(30) Priority: **31.12.84 JP 280539/84**

(43) Date of publication of application: **30.07.86**
Bulletin 86/31

(84) Designated Contracting States: **CH DE FR GB IT LI**

(71) Applicant: **SUMITOMO CHEMICAL COMPANY, LIMITED,**
15 Kitahama 5-chome Higashi-ku, Osaka-shi
Osaka 541 (JP)

(72) Inventor: **Seino, Junzaburo, 808-463, Higashigaokacho,**
Kishiwada-shi Osaka (JP)
Inventor: **Nakatsuka, Kiyoharu, 4-2-1-214, Kasuga**
Suita-shi, Osaka (JP)

(74) Representative: **Haft, Berngruber, Czybulka,**
Hans-Sachs-Strasse 5, D-8000 München 5 (DE)

(54) Method of feeding a predetermined amount of powder, apparatus therefor and package used therein.

(57) A method and an apparatus for feeding a predetermined amount of powder are disclosed. These method and apparatus are based on an idea to handle the powder in the pseudo-agglomerated state.

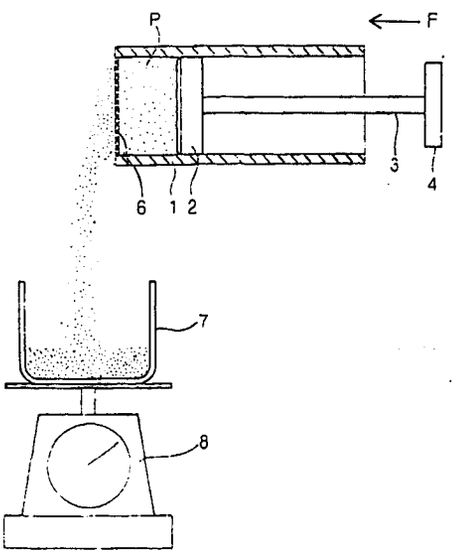
The feeding method comprises the steps of: incorporating the powder (P) into a tubular member (1) which is equiped with a piston (2) slidably movable in said tubular member; advancing the piston (2) to extrude the powder (P) out of the tubular member (1) in a pseudo-agglomerated state; and separating the extruded powder from the cylinder.

On the other hand, the powder feeding apparatus comprises an open ended tubular member (1), a piston (2) slidably mounted in the tubular member, a cutting means (6) mounted at the top opening of the tubular member.

According to these method and apparatus, feeding or weighing of powder can be conducted with precise accuracy without causing the classification of particles nor making a dust.

The automatization of the working in the laboratory or factory can be easily realized with these method and apparatus.

A package for powder used preferable in conducting the above method is also disclosed.



EP 0 188 820 A1

SPECIFICATION

Title of the Invention

Method of Feeding a Predetermined Amount of powder, Apparatus therefor and Package Used therein

Background of the Invention

Field of the Invention

The present invention relates to a method of feeding a predetermined amount of powder, an apparatus therefor and a package used therein.

More particularly, the present invention relates to a method for precisely feeding a predetermined amount of powder, an apparatus therefor and a package used therein, which is employable preferably in the automatic supply, package and weighing of powder.

Description of the Related Art

According to the evolution of the automatization of the working in the laboratories and factories, the development of automatic systems of feeding and weighing of powder has become an important subject to attain. That is, there are many kinds of powder which have various types and different physical properties. It is, however, very difficult to feed or weigh with precise accuracy the powder and thus there has not yet been established an automatic system therefor.

For example, in the field of dyeing technology where

more than thousand kinds of dyes are used, contamination of other dyes in a slight amound adversely, in sometimes, fatally affects the resulting dye product. In order to avoid the contamination, some apparatus are put for exclusive use to a certain kinds of powder materials. As mention above, however, there are too many kinds of powder materials to apply such exclusively used system to all the powder materials in the dye industries. Then, automatic feeding and weighing systems are used exclusively for specific kinds of powder materials. Further, when the exclusively used systems are intended to use for other kinds of powder materials, the systems must be washed and cleaned. Such cleaning is time consuming and troublesome. Moreover, the weighing of powder cannot be conducted automatically with precise accuracy by means of the apparatus of the prior art and therefore such a precise weighing of powder has been conducted manually.

In the dyeing factory, the weighing is not conducted for each dye powder but for a mixture containing more than two kinds of dye powders. Thus the weighing must be conducted with a great accuracy.

The weighing of the dye powder material has been conducted, in general, manually with a container which is top opened. Such a weighing operation involves a problem that the dye powder in the container absorbs moisture, resulting in a difference of concentration in the dye material in the same container.

The feeding or weighing of powders with a top opened container further makes a dust of powder which adversely affects the resulting product and contaminates the working environment. For this sake, the powder materials have been treated not to make a dust, that is, to dustless powders. These dustless powders, however, present generally a high stickiness and are difficult to feed smoothly with the typical powder feeder, such as a screw-type feeder or vibration-type feeder. Thus, such a sticky powder material has been handled manually for the accurate weighing.

Further, most of dyes are composed of various kinds of dye materials and further contain Glauber's salt or salt cake and dispersing agent for adjusting the concentration thereof. When such dye powders are fed by the vibration-type feeder or other type of feeder, they tend to be classified to groups of powders of the same physical property due to the difference of the specific density or particle size. Thus, it happens that dye material having a different concentration or composition would be supplied at each feeding or weighing chance.

On the other hand, when the powder material is fed by the screw-type feeder, they tend to agglomerate due to a high abrasion with the screw surface and the absorption of moisture. Thus, a smooth and uniform feeding becomes difficult, so that the feeding cannot be conducted automatically with accuracy.

There have been other problems in the operations of

feeding, weighing or packaging of dye materials in the factory. That is, such operations include to drop the powder in a container, so that powder of a low specific density tends to make a dust. Thus, in the factory, the dust must be absorbed by a vacuum system not to contaminate other powder materials. But, such absorption cannot be conducted perfectly and the loss of the dye materials due to the absorption is not negligible.

Accordingly the automatic weighing of the packaged powder material has not been fully applied to the dye materials.

Further, since the dye material is generally voluminous and the apparent density thereof is low, it is necessary to use a large package to pack it. Moreover, in order to prevent the variation of the concentration due to the vibration of the powder during the transport and the absorption of misture during the stockage, the dye material is usually packed in a compacted state in a double bag of which the inner bag is made of polyethylene.

The automatic feeding, weighing and packaging of powder into an opened bag or container involve many problems. Further, a small-sized package for powder has not been developed.

The fed or weighed dye material should be added gradually into hot water to resolve completely. If a great amount of dye material is added suddenly into hot water, it tends to agglomerate together and remain partially unsolved.

Thus, the dye material should be added little by little at a constant rate for a long time in order to resolve completely. In the case of preparation of an intermediate of the dye product, the powder material must be added at a constant rate to a reactive solution in a closed environment. Further, in the case of synthesizing a dye from powder materials such as powder of sodium carbonate, it is important to feed little by little powder materials to a reactive solution, while adjusting pH of the solution.

The above matters concern not only the dye industries but also other technical fields in which powders of non-organic compounds such as anhydrous sodium sulfate, and powder of organic compounds such as intermediate of dye, dispersing agent and fiber-based adhesive are handled. A resolution of these problems is required for advancing the automatization in the laboratory and factory.

Summary of the Invention

It is therefore an object of the present invention to resolve the above mentioned problems and to provide a method for feeding powder in a constant amount, which enables the automatization of the feeding, weighing and packaging of various kinds of powders.

It is another object of the present invention to provide a method and an apparatus for feeding a predetermined amount of powder without causing a dust and classification of the powder due to the difference in

particle size or specific density.

It is a further object of the present invention to provide a method and an apparatus for feeding a predetermined amount of powder little by little, which enable an appropriate automatization of the laboratory or factory where powder is handled.

It is a still further object of the present invention to provide a package for powder, which can contain a large amount of powder and can be stocked or transferred without causing the classification of particles nor deterioration with time.

According to the present invention, there is provided a method for feeding a predetermined amount of powder comprising the steps of:

incorporating the powder into a tubular member which is equipped with a piston slidably movable in said tubular member;

advancing the piston to extrude the powder out of the tubular member in a pseudo-agglomerated state; and

separating the extruded powder from the cylinder.

Here, the expression "pseudo-agglomerated state" of the powder is used to indicate a compacted state of the powder in which the powder maintains its compacted configuration due to the stickiness and the compaction thereof. In the pseudo-agglomerated state, the powder does not undergo the classification due to the difference in the specific density and the particle size of its constituting particles. Such a

pseudo-agglomerated state is readily obtained by compacting the powder with a low stress, since the powder presents a stickiness to a certain degree. The pseudo-agglomerated state of the powder is released with a slight shock such as by cutting the same with blade or by moving or extruding the same through a mesh of a net.

According to an embodiment of the present invention, the powder is incorporated or charged into the tubular member under a compacted condition to thereby form the pseudo-agglomerated state of the powder. For this sake, the powder may be pushed or absorbed into the tubular member.

According to a preferred embodiment of the present invention, the piston is retracted to depressurize the inside of the tubular member while concurrently pushing the powder into the tubular member.

According to another preferred embodiment of the present invention, the charging of the powder into the tubular member is conducted by the steps of:

connecting the top portion of said tubular member to a second tubular member which containg therein powder and is of a construction similar to the tubular member to be charged with the powder;

advancing the piston of the tubular member containing the powder while retracting concurrently the piston of the tubular member to be charged with the powder.

According to a still another preferred embodiment of the present invention, the incorporation of the powder into

the tubular member is conducted by the steps of:

attaching the tubular member to a container containing the powder therein, so that the tubular member is communicated with the container;

transferring the powder from the container to the tubular member.

The powder may be pushed into the tubular member from the container by means of a piston or absorbed into the tubular member by retracting the piston in the cylinder. In this embodiment also, the piston of the tubular member may be retracted to depressurize the inside of the tubular member while simultaneously pushing the powder into the tubular member from the container.

According to a preferred embodiment of the present invention, the tubular member is inserted into the container to receive therein the powder, and then it is retracted and detached therefrom.

According to a still further preferred embodiment of the present invention, the tubular member comprises an inner tube and an outer tube telescopically fitted on the inner tube. In this preferred embodiment, the inner tube and the outer tube are forced to advance into the container to thereby receive the powder in the inner tube and the inner tube is then retracted from the outer tube.

The powder may be charged into the tubular member under a non-compacted condition and then the piston is advanced to compact the powder to thereby form the pseudo-agglomerated

state of the powder.

According to an embodiment of the present invention, the separation of the extruded powder is conducted by cutting off the same. The cutting of the powder may be conducted by extruding the powder through a net which is extended across the top opening of the tubular member or by moving a blade across the top opening of the tubular member.

According to a still further preferred embodiment of the present invention, the relationship between the distance from the top portion of the tubular member to the front face of the piston, the advanced distance of the piston and the weight of the compacted powder extruded out of the tubular member is determined beforehand with respect to the powder to be fed, the advancement of the piston is adjusted in accordance with the predermined relationship.

According to the present invnetion, there is provided an apparatus for feeding a predetermined amount of powder, which comprises a open ended tubular member, a piston slidably mounted in the tubular member, a cutting means mounted at the top opening of the tubular member.

The apparatus may further comprise a cap fittable onto the top opening of the tubular member.

According to a preferred embodiment, the apparatus further comprises a step motor for driving the piston to advance in the tubular member.

The tubular member is preferably in a cylindrical form.

According to another preferred embodiment of the

present invention, the tubular member is provided with a scale at the outer surface for indicating the position of the piston.

According to the present invention, there is further provided an apparatus for feeding a predetermined amount of powder from a container containing the powder therein, which comprises:

a hollow body communicated with the inside of the container and having a substantially horizontal top portion of the form of semi-cylindrical shell, said top horizontal portion having a circular hole at each side thereof of which the diameter is substantially the same as that of semi-cylindrical shell;

a partition member having the both ends inserted through and supported by the circular holes of the top horizontal portion of the hollow body, the partition member being in the form of semi-cylindrical shell complementary with the shape of the top horizontal portion, whereby when the partition member is rotated about its axis, it closes a cylindrical space from the inside of the hollow body in cooperation with the top horizontal portion of the hollow body;

a piston inserted through the partition member and being slidable substantially hermetically through the cylindrical space formed by the partition member in cooperation with the top horizintal portion of the hollow body so that when the piston is advanced into the

cylindrical space, the powder is extruded from the circular hole opposite to that through which the piston is inserted; and

a cutting means mounted at the circular hole from which the powder is extruded.

According to a preferred embodiment of the present invention, the apparatus further comprises a cap detachably mounted on the circular hole at which the cutting means is mounted.

According to the present invention, there is also provided a package for containing powder therein, comprising a tubular member having the both ends opened, a first cap member mounted on the first end of the tubular member for closing the same and a second cap member mounted on the second end of the tubular member for closing the same and being slidable towards the first end and substantially hermetically through the tubular member, whereby when the second cap member is forced to slide through the tubular member, the powder is extruded from the first end.

According to a preferred emodiment of the present invention, the tubular member is made of paper, and the package further comprises an annular member mounted on the tubular member near the first end thereof, thereby reinforcing the tubular member.

According to a still further preferred embodiment of the present invention, a cutting means is mountable on the first end portion of the tubular member after the first cap

is detached therefrom, so that the extruded powder from the tubular member is cut off by the cutting means.

The above and other objects, features and advantages of the present invention will be apparent from the following description of the preferred embodiments of the present invention with reference to the accompanying drawings.

Brief Description of the Accompanying Drawings

Fig. 1 is a sectional view of a powder feeding apparatus according to an embodiment of the invention;

Fig. 2 shows how to use the powder feeding apparatus shown in Fig. 1;

Figs. 3 and 4 show respectively other usage of the apparatus shown in Fig. 1;

Fig. 5 is a shematic view of a powder feeding apparatus according to another embodiment of the invention;

Fig. 6 is an expanded view of the apparatus shown in Fig. 5;

Fig. 7 shows how to use the apparatus shown in Fig. 5;

Fig. 8 is a a schematic view of a package for powder according to the invention;

Fig. 9 is an expanded view of the package shown Fig. 8;

Fig. 10 shows how to use the package shown in Fig. 8 in th powder feeding method according to the invention;

Figs. 11 to 15 show respectively the steps for packing the powder into a cylinder according to an embodiment of the invention;

Figs. 16 and 17 show respectively the steps for packing the powder into a cylinder according to another embodiment of the invention;

Figs. 18 and 19 show respectively the steps for packing the powder into a cylinder according to a further embodiment of the invention;

Figs. 20 and 21 show respectively the steps for packing the powder into a cylinder according to still further another embodiment of the invention;

Figs. 22 to 26 show respectively the steps for packing the powder into a cylinder according to a still other embodiment of the invention;

Figs. 27 to 29 show respectively the steps for packing the powder into a cylinder according to a still other embodiment of the invention;

Figs. 30 to 32 show respectively the steps for packing the powder into a cylinder according to a still other embodiment of the invention;

Fig. 33 is a sectional view of a powder feeding apparatus according to another embodiment of the invention;

Figs. 34 to 36 show respectively the steps of the operation of the powder feeding apparatus shown in Fig. 33.

Fig. 37 is a graph showing the relationship between the distance L (the distance between the top portion of the cylinder and the front face of the piston) and the weight W_1 of the powder remaining in the cylinder.

Description of the Preferred Embodiments of the Invention

As mentioned above, according to the present invention, powder is incorporated into a tubular member and fed in the pseudo-agglomerated state from the tubular member. By handling the powder in the pseudo-agglomerated state in the tubular member, the powder can be isolated from the other kinds of powders, so that contamination of the powder with other powder is perfectly prevented. Further, it is not necessary to equip feeding or weighing apparatus or systems for exclusive use.

Since the powder is packed in a tubular member or cylinder in the pseudo-agglomerated state, it does not make a dust nor absorb moisture. Such characteristics is preferable for maintaining cleanly the working environment in the factrory.

Further, the package for powder according to the present invention contains the powder in the pseudo-agglomerated state, that is, in the compacted state, and therefore it is small-sized with respect to the amount of the powder contained therein. Moreover, the packed powder does not undergo the classification of particles due to the variation in the specific density and particle size, etc. during the transportation or handling thereof.

Further, the powder presents a certain degree of stickiness and thereforee it is readily transformed to the pseudo-agglomerated state. Thus the powder can be easily made in the agglomerated state, so that the feeding or

weighing thereof can be conducted rapidly and with precise accuracy.

Further, the feeding or weighing operation of powder can be easily automized by means of the powder feeding apparatus according to the present invention. For example, a plurality of the powder feeding apparatus, each of which is composed of a tubular member equipped with a piston therein and containing a powder in the pseudo-agglomerated state, are arranged so as to move in series. On the other hand, a weighing site composed of a weighing means and a driving means such as a step motor is disposed along the travelling line of the powder feeding apparatus for conducting the feeding or weighing of the powder with the powder feeding apparatus reached thereat. By controlling with a computer the operation of the weighing means, step motor and the travelling of the powder feeding apparatus, it is easily for the those skilled in the art to automize the feeding or weighing operation of the powder.

Now the present invention will be explained by way of Examples, which should be costrued as an illustration of the invention and not to restrict the scope of the invention.

Example 1

Now referring to Figs. 1 to 4, a powder feeding apparatus according to an embodiment of the present invention will be explained.

As shown in Fig. 1, the powder feeding apparatus

comprises a tubular member 1 of a constant section and a piston 2 hermetically and slidably movable in the tubular member 1. The tubular member 1 may present a section of any form such as a rectangular section, but it preferably presents a circular section.

The piston 2 is connected to a handle 4 through a piston rod 3. The piston 2 may be moved manually or driven by an appropriate means such as a step motor (not shown in the drawings).

Powder P is contained in the tubular member 1. In this example, the powder P has been compacted by advancing the piston 2 to present a pseudo-agglomerated state. The pseudo-agglomerated state of powder can be obtained by mounting a cap 5 on the top opening of the tubular member 1 and pressing the powder P against the cap 5 by the piston 2. Otherwise, powder may be charge into the tubular member 1 in the pseudo-agglomerated state.

The cap 5 is then removed from the tubular member 1 to expose a cutting means 6 which is mounted on the top portion of the tubular member 1. The cutting means 6 in the example shown in Figs. 1 and 2 comprises a net which is extended across the top opening of the tubular member.

Then, as shown in Fig. 2, the piston 2 is forced to move in the direction F to extrude the compacted powder P out of the tubular member 1. The pseudo-agglomerated powder P is forced to move through the mesh of the net 6 and cut off to the powdery state. The thus cut off powder is

dropped into a container 7 on a weighing means 8. Thus, it is possible to feed a predetermined amount of powder by advancing the piston 2 in accordance with the weight measured by the weighing means 8.

As readily understood, since the powder does not move on an inclined plane during the feeding thereof, the powder does not undergo the classification of particles due to the difference in the particle size or specific density, etc. Further, it is possible to feed a very small amount of powder by adjusting minutely the advancement of the piston 2.

Now refering to Figs. 3 and 4, it will be explained how to incorporate the powder P in the tubular member 1.

Fig. 3 shows how to charge the tubular member with the powder P from a bottle 9.

As shown in Fig. 3, first, the top portion of the tubular member 1 is inserted into the powder P contained in the bottle 9. At this stage, the piston 2 is in the fully advanced position. That is, it is positioned near the top portion of the tubular member 1. Then, the piston 2 is retracted, that is, the piston is moved gradually in the direction F to thereby depressurize the inside of the tubular member 1 and thus absorb the powder P therein. Then, the powder cutting means 6 and the cap 5 are mounted on the top portion of the tubular member and then it may be transferred to the feeding site.

Fig. 4 shows another way how to charge the tubular

member 1' with the powder P. In Fig. 4, the tubular member 1 has been charged with the powder, for example, by the method shown in Fig. 3, and then the powder has been pressed against the cap 5 by means of the piston 2 to form a pseudo-agglomerated body P of powder. Then, the cap 5 is removed from the tubular member 1 which is then connected to another tubular member 1' similar thereto. The connection is preferably effected by threading these tubular member with each other.

As shown in Fig. 4, the pistons 2 and 2' are moved to the direction F with respect to the tubular members 1 and 1'. That is, the pseudo-agglomerated powder P in the tubular member 1 is forced to move therefrom and absorbed into the tubular member 1'. After the compacted powder P is completely transferred to the tubular member 1', the tubular members 1 and 1' are detached from each other. Then, the cutting means 6 may be mounted on the top portion of the tubular member 1', with which the feeding can be conducted as shown in Fig. 2.

Example 2

Referring to Figs. 5 to 7, the second embodiment of the present invention will be explained.

Fig. 5 shows a powder feeding apparatus 11 attached to a bottle 9 containing powder P therein. As shown in Fig. 5, the powder feeding apparatus 11 comprises a connecting member 12 threaded on the top portion of the bottle 9, a

body 13 formed integrally with the connecting member 12, a partition member 14 attached in the top horizontal portion of the body 13, and a piston member 15 movable coaxially in the partition member 14.

As explained hereinafter, the body 13 presents at the top portion thereof a semi-cylindrical shell. Further, the body 13 has two holes respectively at the both side of the top portion thereof. The partition means 14 and the piston means 15 are inserted through one of these holes into the top portion of the body 13, while a cutting means 16 is mounted on the other hole. Further, a cap 15 is mountable on the cutting means 16 to close the hole.

Referring Fig. 6, each member of the powder feeding apparatus shown in Fig. 5 will be explained in more detail.

As shown in Fig. 6 (a), the piston means 15 contains a piston 21 made of an elastic material such as rubber, a piston rod 22 connected at one end thereof with the piston 21, and a grip 23 connected to the other end of the piston rod 22. The piston rod 22 may be made from a plastic material such as Teflon integrally with the grip 23.

As shown in Fig. 6 (b), the partition member 14 is generally of an elongated form, of which the both end portions 24 and 25 are of a hollow cylindrical form and the center portion 26 presents a semi-cylindrical shell. The piston means 15 is inserted axially in the partition member 14 and slidable in the axial direction. The partion member 14 may be inserted into the holes of the top horizontal

portion of the body 13 and supported thereby in a horizontal position. As mentioned below, the partition member 14 is rotatable about its axis in the top horizontal portion of the body 13.

Fig. 6 (c) shows the connecting member 12 and the hollow body 13 of the powder feeding apparatus. As shown in Fig. 6 (c), the vertical section of the body 13 is generally of a trapezoidal form. The top horizontal portion 23 is opened at the both sides and is generally of the form of a semi-cylindrical shell. As mentioned above, the cutting means 16 is mounted across the hole at one side of the top horizontal portion 27, while the partition member 14 is inserted through the hole at the other side together with the piston means 15. In more detail, the partition member 14 is inserted through the hole into the top horizontal portion 27 and is supported rotatably by the two holes.

The shape of the center portion 26 of the partition member 14 is complementary to that of the top horizontal portion 27 of the body 13. The partition member 14 is rotatable and thus it takes two positions; that is, the semi-cylindrical shell of the partition member 14 is positioned at the same side as that of the top horizontal portion 27 to receive the powder P thereon, when the powder feeding apparatus is turned to an inverted position. On the other hand, it may be rotated at 180° to take an opposite position to close a cylindrical space together with the top horizontal shell 27. The piston 21 is hermetically slidable

through the thus formed cylindrical space.

Fig. 7 shows how to use the powder feeding apparatus shown in Figs. 5 and 6.

First, the powder feeding apparatus 11 is connected on the top opening of the bottle 9. At this stage, the semi-cylindrical shell of the partition member 14 is positioned at the same side as that of the top horizontal portion 27, so that, when the powder feeding apparatus 11 is turned to a vertically inverted position, the powder lies on the partition member 14.

Then, the powder feeding apparatus 11 is turned to a vertically inverted position together with the bottle 9 and is maintained in position by a supporting means 28.

Next, the partition member 14 is rotated about its axis at 180° to form a cylindrical space in cooperation with the semi-cylindrical shell 27 of the body 13, so that powder is isolated in the form of a cylinder. Next, the piston means 15 is connected at the grip 23 to a driving axis 30 of a step motor 29. The driving axis 30 is constructed so as to advance stepwisely. The piston means 15 is advanced by the step motor 29 to extrude the powder out of the cylindrical space formed by the partition member 14 and the top horizontal portion 27 (which is now positioned at the bottom). The compacted powder is forced to move through the mesh of the cutting means 16 to thereby become a powdery state and dropped into a container 7 on the weighing means 8.

The powder feeding apparatus of the present example is preferably employed for feeding powder little by little into a solution in a flusc, while agitating the solution in the laboratories.

Example 3

Referring Figs. 8 to 10, the third embodiment of the present invention will be explained.

Fig. 8 shows a package 31 for containing powder, which is preferably used in conducting the method of the present invention in the factory. Fig. 9 shows the package 31 in an expanded form.

As shown in Figs. 8 and 9, the package 31 comprises a hollow cylindrical body 32 made, for example, of a hard paper such as a paperboard, a metal ring 34 fitted on the body 32 at one end thereof for reinforcing it, a first and second caps 33 and 35 attached detachably to the ends of the body 32 for closing the both ends thereof.

The metal ring 34 is mounted on the body of paper so as to maintain body 32 in the cylindrical form even if the first cap 33 is removed from the package 31. The second cap 35 is in the form of a cup, the peripherical flange portion is extended in the form of a cylinder of which the diameter is substantially the same as that of the body 32. As mentioned below, the second cap 35 can be used as a piston to extrude the powder out of the package 31 in the factory.

Fig. 10 shows how to use the package 31 in conducting

the powder feeding method according to the present invention.

First, powder is incorporated into the package 31 by an appropriate means so that the powde_ is contained in the package 31 in the pseudo-agglomerated state. The thus obtained package of powder may be transported or saled as it is. During the transportation of the package, the powder does not undergo the classification to particles, since the powder is contained in the pseudo-agglomerated state. Further, the package is small-sized with respect to the amount of the powder contained therein.

Now, the powder feeding method using the package 31 will be explained with reference to Fig. 10. First, the package of powder 31 is mounted on supporting means 36 so as to maintain the same in position. Then, the first cap 33 is detached and a cutting means 37 such as a metal net is attached to the top portion of the package. On the other hand, a driving means 38 is connected to the second cap 35.

In the example shown in Fig. 10, the driving means 38 comprises an abutting member 39 for abutting the second cap 35, a connecting rod 40 threaded on the surface thereof, a converting means 42 for converting rotation into rectilinear movement, and a motor equipped with reducing gears (not shown). The abutting member 39 is of a disc form which is fitted in the second cap 35 so that it pushes the second cap 35 through the body 32 of the package. On the other hand, the converting means comprises a supporting stand 4 having a

hole internally threaded with which the externally threaded portion of the connecting rod 40 is meshed.

Thus, when the connecting rod 40 is rotated, it advances rectilinearly together with the abutting member 39 which, in return, pushes the second cap 35 through the body 31 of the package. The powder is thus extruded out of the package and cut by the cutting means 37 and drops in the container 7 mounted on the weighing means 8.

The advancement of the second cap 35 can be adjusted minutely so that the feeding of powder can be also adjusted at precise accuracy. Such a feeding system enables automatization of powder feeding operation in the factory.

Example 4

Referring to Figs. 11 to 15, another embodiment of the present invention will be explained.

The powder feeding apparatus according to the present embodiment comprises a container 51 for containing therein powder A. The container 51 is provided at the lowest portion of the side wall thereof with an inlet hold 52 on which a cylinder 53 is mounted. The cylinder 53 is adapted to move in the container. The cylinder 53 is open ended and has a sufficient length to extend across the container 51 as shown in Fig. 12. The cylinder 53 may be of any sectional form, but it is preferable to present a circular section.

The cylinder 53 is movable rectilinearly in the forward and backward directions through the hole 52 in the container

51. In the most advanced position, the cylinder 53 reaches at an opening or hole 54 on the sidewall of the container at the opposite side. In the most retracted position, the top portion of the cylinder 53 is positioned near the hole 52. The cylinder 53 may be detachable from the container 51.

For facilitating the advance of the cylinder 53 through powder A in the container 51, the top portion of the cylinder 53 may be edged or the cylinder 53 may be advanced while being rotated about its axis.

The cylinder 53 is equipped with a pistion 55 connected with a piston rod 55a. The piston 55 is hermetically slidable on the inner wall of the cylinder 53. Thus, the piston 55 is moved forwardly to compact the powder in the cylinder to thereby control the degree of the compaction of the powder, or to extrude a predetermined amount of the powder B from the outlet hole 54a. In order to obtain a hermetical contact between the piston 55 and the inner wall of the cylinder 53, the piston 55 is made of an elastic material such as natural or synthetic rubber, functional plastic, etc.

The powder feeding apparatus is further equipped with a closing plate 56 at the outlet hole 54. Thus, the outlet hole 54 is normally closed by the plate 56, and is opened by moving the plate 56 upwardly when the feeding is to be effected.

The powder feeding apparatus is further equipped with a knife 57 at a position above the outlet hole 54. The knife

57 is provided with an underblade and it may be dropped to cut the extruded pseudo-agglomerated powder. The cutting may be conducted by other means, such as a net extended across the outlet hole 54.

The cylinder 53 and the piston 55 may be equipped with air escape holes to facilitate the absorption of powder into the cylinder when it receives a powder.

The powder feeding apparatus of this example operates as follows:

(1) First, the outlet hole 54 is closed with the plate 56 and the cylinder 53 is maintained at the retracted position, as shown in Fig. 11. Then, powder A is supplied into the container 51 from an inlet not shown in the drawings.

(2) Next, the cylinder 53 is forced to advance in the container 51 to a position close to the outlet hole 54 to thereby receive therein the powder A. This advancement of the cylinder 53 may be made while rotating the same. Thus, the powder received in the cylinder 53 is isolated from the powder A in the container 51. Since the powder is somewhat sticky, the powder received in the cylinder 53 is compacted and may be in the pseudo-agglomerated state.

When the degree of the compaction of the powder B is insufficient to obtain an appropriate pseudo-agglomerated state, the powder may be further compacted

by advancing the piston 55 by a distance "l" as shown in Fig. 15. The degree of the compaction of the powder B is determined in function of the distance "L" between the top portion 53a of the cylinder 53 and the front face of the piston 55, the amount of powder B received in the cylinder 53 and the distance "l". If these relationship is determined beforehand, the degree of the compression of the powder B, that is, the degree of the pseudo-agglomeration of the powder B may be readily controlled by adjusting the advancement of the piston 55. For this sake, it is convenient to provide on the outer surface of the cylinder 53 a scale indicating the distance "l".

(3) When a pseudo-agglomerated state of the powder B is obtained, the plate 56 is moved upwardly to open the outlet hole 54 and the piston 55 is further advanced with a predetermined length to extrude a predetermined length of the pseudo-agglomerated powder B out of the cylinder 55, as shown in Fig. 13. Since the powder has an appropriate stickiness, it becomes to the pseudo-agglomerated state with a low compression and then the configuration thereof is maintained without easily being broken.

(4) The cutter is moved downwardly onto the portion of the pseudo-agglomerated powder Bwhich is projected

out of the cylinder 53. Due to the cutting by the knife 57, the falsely bonded sites of the powder E are broken so that the original state of the powder is recovered. Thus, the cut off powder drops into a container 7 on a weighing means 8.

In the powder feeding apparatus shown in Figs. 11 to 14, the advancement of the piston 55 may be controlled in accordance with the measured weight of the fed powder to automize the feeding operation.

In another way of employment of the powder feeding apparatus, the apparatus is positioned in the state shown in Fig. 12, and then the cylinder 53 is retracted and detached from the container 51. The portion of the compacted powder which is projected from the top portion of the cylinder is then cut off to thereby obtain a powder feeding apparatus similar to that shown in Figs. 1 to 4. That is, a powder cutting means 6 and a cap 5 are mounted on the top portion of the cylinder 53 to transport it, and at the feeding site, the cap 5 is removed from the cylinder 53 and then the feeding operation may be conducted in a way similar to that shown in Fig. 2.

Further, the piston rod 55a may be threaded to the piston 55 and the threaded hole may operate as an air escape. Moreover, the piston rod 55a is preferably detachable from the piston and it is detached from the piston 55 in the case of the transportation thereof.

In the following Examples 5 to 10, it will be explained how to incorporate or charge the powder of the pseudo-agglomerated state into a cylinder which is subsequently usable as the tubular member of the powder feeding apparatus shown in Fig. 1.

Example 5

Referring to Figs. 16 and 17, a further embodiment of the present invention will be explained in order to show how to charge a cylinder with a powder of the pseudo-agglomerated state.

As shown in the drawings, the apparatus for incorporating powder into a cylinder comprises a container 51, a cylinder 53 and a piston rod 60. These cylinder 53 and a piston rod 60 are detachably mounted on the container 51 at opposite side to each other. These cylinder 53 and piston rod 60 are movable on the bottom surface of the container 51 in the same rectilinear direction. The apparatus further comprises a partition plate 61 at the inlet hole through which the cylinder 53 is inserted into the container, to thereby close the hole. The partition plate 61 is movable vertically. At the upper position of the partition plate 61, the inlet hole is opened as shown in Fig. 17, while, at the lower position, the inlet hole is closed as shown in Fig. 16.

The operation of the apparatus is as follows:

First, the apparatus stands in the state shown in

Fig. 16. Then, the partition plate 61 is moved upwardly to open the inlet hole so that the powder A can be transferred from the container 51 into the cylinder 53. Then, the piston rod 60 is forced to advance into the container 51 as shown in Fig. 17, so that the powder is pushed towards the cylinder 53 and pressed to some extent to form the pseudo-agglomerated state B of powder. After the front portion of the piston rod 60 reaches at the front portion of the cylinder 53, the piston rod 60 is retracted and then the partition plate 61 is moved downwardly to close the inlet hole. Then, the cylinder 53 is detached from the container 51 to obtain a cylinder 53 equipped with a piston 55, which may be used as a powder feeding apparatus shown in Figs. 1 and 2. That is, the cylinder 53 containing therein the pseudo-agglomerated powder B may be used as a package of powder as it is, or may be used as a powder feeder with which a predetermined amount of powder may be fed little by little by advancing the piston 55 and cutting the extruded portion of the pseudo-agglomerated powder.

Example 6

Another embodiment of the present invention will be explained with reference to Figs. 18 and 19 to show how to incorporate the powder of the pseudo-agglomerated state into a cylinder.

In this example, the container 51 is provided at the bottom thereof with an inlet hole through which the powder A

may be transferred out of the container. The apparatus comprises a cylinder 53 equipped with a piston 55 and piston rod 55a, which is detachably mounted to the inlet hole so as to receive the powder A therein. The apparatus further comprises a partition plate 61 which is movable to close the inlet hold or to open the same.

The operation of the apparatus is as follows:

First, the apparatus stands in the state shown in Fig. 18. Then, the piston 55 is retracted downwardly to depressurize the inside of the cylinder 53, so that the powder A is absorbed into the cylinder 53. The powder is absorbed in the pseudo-agglomerated state since the powder is compacted due to the absorption pressure.

Thereafter, the partition plate 61 is moved to shut the inlet hole. If necessary, the piston is advanced to further compact the powder B to enhence the compaction of the powder in order to ensure the pseudo-agglomeration of the powder. Then, the cylinder 53 is detached from the container 51.

In this example, the cylinder 53 may include a depressurizing means to depressurize the inside of the cylinder 53.

Example 7

A further embodiment of the invention will be explained with reference to Figs. 20 and 21 in order to show how to charge a cylinder with a pseudo-agglomerated powder.

The apparatus shown in Figs. 20 and 21 is similar to

that shown in Figs. 16 and 17, except that the partition plate 16 shown in Figs. 16 and 17 is not equipped.

In this example, the powder is charged into the cylinder 53 by pushing the powder towards the cylinder 53 and concurrently absorbing the same into the cylinder. The operation is conducted as follows:

First, the piston rod 60 is in the retracted position while the piston 55 is in the advanced position.

Then, the piston rod 60 is forced to advance in the container 51 to press the powder A towards the cylinder 53, while the piston 55 is retracted to absorb the powder A into the cylinder 53, as shown in Fig. 2o. These two actions are made simultaneously until the front portion of the piston rod 60 reaches at the inlet hole at which the cylinder 53 is mounted, as shown in Fig. 21. Then, the cylinder 53 is detached from the container 51 to provide a powder feeding apparatus similar to that shown in Fig. 1.

The amount of the powder B and the degree of the compaction thereof are determined in function of the advancing length L_1 of the piston rod 60 and the retraction length L_2 of the piston 55. Accordingly, the formation of the pseudo-agglomerated state of the powder B is smoothly attained. Moreover, it is not necessary to dispose an air escape hole nor depressurising hole for the apparatus of this example.

According to the method of the present example, the powder can be packed without soiling the outer surface of

the cylinder 53. Moreover, the cylinder 53 may be used for automatic feeding or weighing of powder.

Example 8

Referring to Fig. 22 to 26, a further embodiment of the present invention will be explained to show another way for incorporating a pseudo-agglomerated powder into a cylinder.

In this example, a pair of cylinders 53, 53' are mounted to the sidewall of the container 51 near the bottom thereof. These cylinders 53 and 53' are directed to an opposite direction to each other. Each of the cylinders 53 and 53' are equipped with pistons 55, 55' and piston rods 55a, 55a'.

As shown in Fig. 22, one of the cylinders 53 and 53' is adapted to advance into the container 51 and the other cylinder 53' is detachably connected to the container. Further, the cylinder 53 is of the same length as the distance between the inlet holes at which the cylinders 53 and 53' are mounted respectively, so that, when the cylinder 53 is advanced completely into the container 51, the cylinder 53 becomes contacted and communicated with the cylinder 53'.

The operation of this apparatus is as follows:

At the first stage, the cylinders 53, 53' are in the retracted position and the front portions of the cylinders 53, 53' and the pistons 55, 55' are positioned respectively near the inlet holes. That is, the piston 55 and 55' are

completely advanced into the cylinders. Then, the cylinder 53 is forced to advance into the container 51 to thereby receive the powder A therein, while the piston 55 thereof and the cylinder 53' and its piston 55' are maintained in position with respect to the container 51, as shown in Fig. 22.

During the final stage of the advancement of the cylinder 53, the powder A received in the cylinder 53 cannot escape therefrom and therefore it is slightly compacted to form a pseudo-agglomerated state B. When the degree of the compaction is not satisfactory, the piston 55 is advanced slightly to further compact the powder, while the piston 55' is fixed in position.

Then the fixation of the piston 55' is released and the piston 55 is forced to advance in the cylinder 53 so that the compacted powder B is moved into the cylinder 53'. When the compacted powder B is completely transferred into the cylinder 53' as shown in Fig. 25, the cylinder 53' is detached from the container 51. Thus the cylinder 53' contains therein the compacted powder B and is usable for the powder feeding method according to the present invention. Moreover, the outer surface of the thus handled cylinder 53' is maintained clean.

Although the container 51 shown in Figs. 22 to 25 is equipped with only one pair of cylinders, it may be equipped with a plurality of pairs of cylinders, which are mounted at positions staggered vertically or horizontally with each

other pair.

In Fig. 6, the container 51 is equipped with two pairs of cylinders 55, 55' staggered vertically and thus it exerts operation effectivity twice higher than that of the apparatus shown in Figs. 22 to 25.

Example 9

A further embodiment of the present invention will be explained with reference to Figs. 27 to 29 to show a still another way for incorporating a pseudo-agglomerated powder into a cylinder.

In this example, a cylinder means 53 is mounted to the side wall near the bottom of the container 51 so as to advance into the container 51. The cylinder means 53 comprises an inner cylinder 81 equipped therein with a piston 55 and a piston rod 55a connected thereto and an outer cylinder 82 mounted telescopically on the inner cylinder 81.

At the position shown in Figs. 27 and 28 where the inner cylinder 81 is advanced fully into the outer cylinder 82, the gap between the front portions of the inner and outer cylinders 81 and 82 is hermetically sealed by an annular member 62.

The operation of this apparatus is as follows:

First, the cylinder means 53 is mounted at the inlet hole and is forced to advance in the container 51 in which a large amount of powder A is contained, while the gap between

the front portions of the inner and outer cylinders 81 and 82 is sealed by the annular member 62. The powder A is received in the inner cylinder 81, and when the top portion of the cylinder means 53 reaches and contacts with the opposite side wall of the container 51, the received powder A is compacted to some degree to present a pseudo-agglomerated state B.

When the compaction of the powder B is insufficient for the subsequent use, the powder B is further compacted by advancing the piston 55.

As shown in Fig. 29, the inner cylinder 81 is then extracted from the outer cylinder 82 which is maintain in position, thereby obtaining a compacted powder B without soiling the outer surface of the inner cylinder 81.

The inner cylinder 81 may be extracted from the container 51 together with the outer cylinder 82 and then it is further extracted from the outer cylinder 82 to obtain the cylinder 81 containing therein the compacted powder B.

Example 10

Referring to Figs. 30 to 32, a further embodiment of the present invention will be explained in order to show a still further way for charging a cylinder with a pseudo-agglomerated powder.

The container 51 according to this embodiment comprises three separating tubes 63, 64, 65 which are mounted vertically therein and of which the bottom open ends are

respectively connected to the outlet holes disposed at the bottom of the container 51. The container 51 is further equipped with a partition plate 66 which are movable horizontally to close or open the top holes of the separating tubes 63, 64, 65.

On the other hand, three cylinders 53 are mounted detachably on the outlet holes at the bottom of the container 51 to be communicated respectively with the separating tubes 63, 64, 65. Each of cylinders 53 is equipped therein with a piston 55 and a piston rod 55a connected thereto.

The operation of the apparatus is as follows:

First, the cylinders 53 are attached on the bottom of the container 51 so that they are communicated respectively with the tubes 63, 64, 65, with the pistons 55 being advanced to the upmost position. Then, the partition plate 66 is moved to open the top opening of the tubes 63, 64, 65, so that the powder A is dropped in the tubes 63, 64, 65.

After the separating tubes 63, 64, 65 are filled with the powder A, the partition plate 66 is moved to close the top holes of the tubes 63, 64, 65. Each of the pistons 55 is then retracted gradually to absorb the powder A into the cylinder 53. When the power A is absorbed, it is compacted to become the pseudo-agglomerated state B. If the compaction of the powder B is insufficient, the piston 53 is slightly advanced upwardly to further compact the powder B.

Then, the cylinders 53 is detached from the container

51 to thereby obtain three cylinders each containing therein a pseudo-agglomerated powder B as shown in Fig. 32. These cylinders 53 can be handled without soiling the outer surface thereof with the powder.

The apparatus may be equipped with a pressurizing means for absorbing the powder from the cylinders 63, 64, 65 to the cylinders 53.

We conducted an experiment with the apparatus shown in Figs. 30 to 32.

First, having mounted the separating tubes 63, 64, 65 (inner diameter: 1.4 cm, length: 6.3 cm) to the container 51 as shown in Fig. 30, a dye dispersing agent was fed to the container to a height of 8 cm and the top portion thereof was maintained horizontally, so that the separating tube 63, 64, 65 were completely embedded in the powder. Then, the partition plate 66 was moved to close the inlet holes of the tubes 63, 64, 65, and then the pistons 55 were gradually retracted downwardly to absorb the powder in the cylinders 53. Thereafter, the cylinders 53 were detached from the container 51. All of the powder B was extruded from each of cylinders 53 by advancing the piston 55 completely and the extruded powder was weighed. The measured weight for each of the three cylinders 53 was: 7.02g, 7.02g, 6.98g. Thus, it is ascertained that powder can be charged into the cylinder 53 with precise accuracy by means of the apparatus shown in Figs. 30 to 31.

Example 11

Now referring to Figs. 33 to 36, a powder feeding apparatus according to another embodiment of the present invention will be explained.

The powder feeding apparatus of the present example comprises a container 51 having on the side wall near the bottom thereof a pair of holes which are positioned symmetrically with respect to the center of the bottom of the container 51.

An annular flange 52a is provided on one of the holes through which a piston 55 in the cylindrical form is inserted. On the other hand, a cylinder 53 is attached on the other hole to be communicated with the inside of the container 51. The piston 55 is connected to a handle through a piston rod 55a and has a length longer than the distance between the two holes. The piston 55 is movable in the same direction as the longitudinal axis of the cylinder 53 so that it may be advanced beyond the hole at the opposite side and partially inserted into the cylinder 53.

As shown in the drawings, the apparatus is further equipped with a cutting means 57 at the front hole of the cylinder 53. Although a knife 57 having a blade at the lower portion is illustrated in Figs. 33 to 36, the cutting means may be composed of a net extended across the front hole of the cylinder 53. The knife 57 is movable downwardly to cut off the pseudo-agglomerated powder B.

The operation of the powder feeding apparatus of this

example is as follows:

At first, the apparatus stands as shown in Fig. 33. That is, the piston 55 is maintained at the retracted position. The container 51 contains a powder A therein.

Then the piston 55 is forced to advance in the container to a position near the hole of the opposite side to thereby push the powder A into the cylinder 53 as shown in Fig. 34. The piston 55 is further advanced into the cylinder 53 so that the powder is separated from that contained in the container 51 and is compacted to a certain degree to present a pseudo-agglomerated state B. The pseudo-agglomerated powder B is extruded out of the cylinder 53 by further advancing the piston 55 as shown in Fig. 35.

Then, the pseudo-agglomerated powder B extruded from the outlet hole 53a is cut by the cutting means 57 to drop in the container 7 on the weighing means 8.

In order to facilitate the formation of the pseudo-agglomerated state, the inner diameter of the cylinder 53 may be made gradually smaller towards the outlet hole 53a.

The cylinder 53 may be detachable from the container and closed at the bottom, it may be used as a package for containing therein a powder in the pseudo-agglomerated state. For such use, a package shown in Figs. 8 and 9 may be preferably used as the cylinder 53.

Now, the method for feeding powder will be explained by way of experiment to show the technical advantage of the present invention.

Experiment 1

The apparatus shown in Fig. 11 was used.

The cylinder 53 was of 1.5 cm in the inner diameter and 9.0 cm in the length. The cylinder was provided with a scale on the outer surface thereof to facilitate the adjustment of the advancement of the piston 55. The cylinder was made of polypropylene resin and the piston 55 was of isopropylene rubber.

On the other hand, the container 51 was of 4.2 cm in the inner diameter and 8.0 cm in the height. A dye dispersing agent of formalin condensate of naphthalenesulfonic acid was fed into the container 51 to a height of 4.0 cm.

The distance L between the front portion of the cylinder 53 and the front face of the piston 55 was set at 3.5 cm. The cylinder 53 was forced to advance in the powder up to contact the side wall of the opposite side, while maintaining the distance L at 3.5 cm. Then, the piston 55 was advanced slightly to further compact the powder in the cylinder 53.

The cylinder 53 was then extracted from the container 51 and the portion of the pseudo-agglomerated powder extruded from the top portion of the cylinder was cut off so that the top portion of the compacted powder was meshed with the front portion of the cylinder 53. Then, all of the pseudo-agglomerated powder contained in the cylinder 53 was weighed by feeding out the powder into the container 7 as

shown in Fig. 2.

Such an operation was repeated five times and the measured weights are shown in the Table 1.

Table 1

1st measurement	4.34 g
2nd measurement	4.33 g
3rd measurement	4.25 g
4th measurement	4.34 g
5th measurement	4.24 g

As readily understood for the result shown in Table 1, powder can be separated from the container with precise accuracy according to the present invention. The mean weight of the measurement is 4.30 g with a precision of ± 1.2 %.

Experiment 2

A powder of 4.35 g was separated and contained in the cylinder 53 by the method as explained in Experiment 1. The front portion of the cylined 53 was closed by mounting a cap of polypropylene resin thereon and left for a week at room temperature (15 to 30°C). The powder was then weighed as shown in Fig. 2. Such an experiment was repeated three times. In each time, variation in the weight and the absorption of moisture have not been observed. Thus, it is

understood that the cylinder 53 can be used as a good package of the powder because of its sealing property and the compaction of the powder.

The apparent density of the dye dispersing agent used in Experiment 1 was 0.597. On the other hand, the inner volume of the cylinder 53 used in Experiment 1 was ($\pi/4 \times 1.42 \times 3.5 =$) 5.39 cm^3. Thus, the cylinder 53 can contain 3.22 g of the powder in the non-compacted state. In Experiments 1 and 2, however, the cylinder could contain the powder in an amount 1.35 times higher than the above. Thus, a smaller sized package can be provided according to the present invention.

Experiment 3

4.35 g of the powder B was packed in the cylinder 53 and fed out by advancing the piston 55 by 0.5 cm at each time. The thus extruded powder was cut off and weighed as shown in Fig. 2. The weight W_1 of the powder remaining in the cylinder and the weight W_2 of the powder fed out in each advancement of 0.5 cm of the piston 55 were measured. The result is shown in Table 2. In Table 2, L indicates the distance between the top portion of the cylinder and the front face of the piston.

Table 2

L (cm)	W_1 (g)	W_2 (g)
3.5	4.35	—
3.0	3.50	0.85
2.5	2.70	0.80
2.0	2.00	0.70
1.5	1.40	0.60
1.0	0.87	0.53
0.5	0.40	0.47
0	less than 0.01	0.39 to 0.40

The result shown Table 2 is also represented in Fig. 37.

Such an experiment was repeated several times and the same result was obtained. That is, there is a certain relationship between the distance L and the weight W_2 for a certain kind of powder. Thus, if such a relationship is determined beforehand, the feeding of the powder can be automatically conducted with precise accuracy.

Experiment 4

Using the relationship shown in Fig. 37, 3.00 g of the dye dispersing agent was fed with high precision.

The piston 55 was advanced from L = 3.5 cm to L = 1.7 cm to extrude the powder B and the extruded powder was cut off. The advancement of piston of this time took

five seconds. The cut off powder was weighed by an electronic weighing machine saled with a mark LIBROR EO-H 200 by SHIMAZU CORPORATION. The measured weight was 2.650 g. The piston 55 was further advanced to L = 1.6 cm and the extruded powder was cut off and measured. The total weight of the fed out powder was 2.86 g. The piston 55 was further advanced to L = 1.5 cm and the extruded powder was cut off two times to adjust minutely the amount of the fed out powder. The total weight of the powder fed out with the above operations was 3.002 g. These feeding operations took 12 seconds and the error was only 0.002 g.

Although these experiments were conducted with a dye dispersing agent of formalin condensate of naphthalenesulfonic acid, the same result could be obtained with other kinds of powder, such as a dye dispersing agent saled with a trademark of SUMICARON RED S-2GF by SUMITOMO CHEMICAL Co., Ltd. and commercially available anhydrous sodium sulfate powder.

Claims:

1. Method for feeding a predetermined amount of powder comprising the steps of:

incorporating the powder into a tubular member which is equipped with a piston slidably movable in said tubular member;

advancing the piston to extrude the powder out of the tubular member in a pseudo-agglomerated state; and

separating the extruded powder from the cylinder.

2. Method as claimed in Claim 1, wherein the powder is incorporated into the tubular member under a compacted condition to thereby form the pseudo-agglomerated state of the powder.

3. Method as claimed in Claim 2, wherein the powder is pushed into the tubular member.

4. Method as claimed in Claim 2, wherein the powder is absorbed into the tubular member.

5. Method as claimed in Claim 4, wherein the piston is retracted to absorb the powder into the tubular member.

6. Method as claimed in Claim 4, wherein the piston is retracted to depressurize the inside of the tubular member while simultaneously pushing the powder into the tubular

member.

7. Method as claimed in Claim 1, wherein the incorporation of the powder into the tubular member is conducted by the steps of:

connecting the top portion of said tubular member to a second tubular member which contains therein powder and is of a construction similar to the tubular member to be incorporated with the powder;

advancing the piston of the tubular member containing the powder while retracting concurrently the piston of the tubular member to be incorporated with the powder.

8. Method as claimed in Claim 1, wherein the incorporation of the powder into the tubular member is conducted by the steps of:

attaching the tubular member to a container containing the powder therein, so that the tubular member is communicated with the container;

transferring the powder from the container to the tubular member.

9. Method as claimed in Claim 8, wherein the powder is pushed into the tubular member from the container by means of a piston.

10. Method as claimed in Claim 8, wherein the powder is

absorbed into the tubular member.

11. Method as claimed in Claim 10, wherein the piston of the tubular member is retracted to absorb the powder into the tubular member.

12. Method as claimed in Claim 8, wherein the piston of the tubular member is retracted to depressurize the inside of the tubular member while simultaneously pushing the powder into the tubular member from the container.

13. Method as claimed in Claim 8, wherein the tubular member is inserted and advanced into the container to receive therein the powder, and then it is retracted and detached therefrom.

14. Method as claimed in Claim 13, wherein the tubular member comprises an inner tube and an outer tube telescopically mounted on the inner tube.

15. Method as claimed in Claim 14, wherein the inner tube and the outer tube are forced to advance into the container to thereby receive the powder in the inner tube and the inner tube is then retracted from the outer tube.

16. Method as claimed in Claim 1, wherein the powder is incorporated into the tubular member under a non-compacted

condition and then the piston is advanced to compact the powder to thereby form the pseudo-agglomerated state of the powder.

17. Method as claimed in Claim 1, wherein the powder is cut off to separate the extruded powder from the tubular member.

18. Method as claimed in Claim 17, wherein the cutting of the powder is conducted by extruding the powder through a net which is extended across the top opening of the tubular member.

19. Method as claimed in Claim 17, wherein the cutting of the powder is conducted by moving a blade across the top opening of the tubular member.

20. Method as claimed in Claim 1, further comprising the steps of:

determining beforehand the relationship between the distance from the top portion of the tubular member to the front face of the piston, the advanced distance of the piston and the extruded weight of the compacted powder out of the tubular member, with respect to the powder to be fed;

after incorpotating the powder in the pseudo-agglomerated state into the tubular member, advancing the piston in accordance with the predermined relationship.

21. Method as claimed in Claim 1, wherein the powder presents a pseudo-agglomerated state when it is compacted with a slight force and looses the pseudo-agglomerated state when it is cut.

22. Apparatus for feeding a predetermined amount of powder, which comprises an open ended tubular member, a piston slidably mounted in the tubular member, a cutting means mounted at the top opening of the tubular member.

23. Apparatus as claimed in Claim 22, further comprising a cap mountable onto the top opening of the tubular member.

24. Apparatus as claimed in Claim 22, wherein the tubular member is connectable to a second tubular member similar thereto.

25. Apparatus as claimed in Claim 22, wherein the cutting means is composed of a net which is extended across the top opening of the tubular member.

26. Apparatus as claimed in Claim 22, wherein the cutting means is composed of a knife movable across the top opening of the tubular member.

27. Apparatus as claimed in Claim 22, further comprising a step motor for driving the piston to advance in the tubular

member.

28. Apparatus as claimed in Claim 22, wherein the tubular member is in the cylindrical form.

29. Apparatus as claimed in Claim 22, wherein the tubular member contains a scale on the outer surface for indicating the position of the piston.

30. Apparatus for feeding a predetermined amount of powder from a container containing the powder therein, which comprises:

a hollow body communicated with the inside of the container and having a substantially horizontal top portion of the form of semi-cylindrical shell, said top horizontal portion having a circular hole at each side thereof of which the diameter is substantially the same as that of semi-cylindrical shell;

a partition member having the both ends supported by the circular holes of the top horizontal portion of the hollow body, the partition member being in the form of semi-cylindrical shell complementary with the shape of the top horizontal portion, whereby when the partition member is rotated about its axis, it closes a cylindrical space from the inside of the hollow body in cooperation with the top horizontal portion of the hollow body;

a piston inserted through the partition member and

being slidable substantially hermetically through the cylindrical space formed by the partition member in cooperation of the top horizintal portion of the hollow body so that when the piston is advanced into the cylindrical space, the powder is extruded from the circular hole opposite to that through which the piston is inserted; and

a cutting means mounted at the circular hole from which the powder is extruded.

31. Apparatus as claimed in Claim 30, wherein the hollow body is threadably connected to the container.

32. Apparatus as claimed in Claim 30, further comprising a cap detachably mounted on the circular hole at which the cutting means is mounted.

33. Apparatus as claimed in Claim 30, wherein the cutting means is composed of a net extended across the circular hole at the side of the top horizontal portion of the hollow body.

34. Apparatus as claimed in Claim 30, wherein the cutting means is composed of a knife movable across the circular hole at the side of the top horizontal portion of the hollow body.

35. Apparatus as claimed in Claim 30, wherein the partition

member has end portions of the cylindrical form which are supported by the circular holes of the top horizontal portion of the body, and the piston is connected with a piston rod which is extended through one of the cylindrical end portions of the partition member.

36. Apparatus as claimed in Claim 35, wherein the piston is driven by a step motor connected through the piston rod.

37. Package for containing powder therein, comprising a tubular member having the both ends opened, a first cap member mounted on the first end of the tubular member for closing the same and a second cap member mounted on the second end of the tubular member for closing the same and being slidable substantially hermetically through the tubular member, whereby when the second cap member is forced to slide through the tubular member, the powder is extruded from the first end.

38. Package as claimed in Claim 37, wherein the tubular member is made of paper, and the package further comprises an annular member mounted on the tubular member near the first end thereof, thereby reinforcing the tubular member.

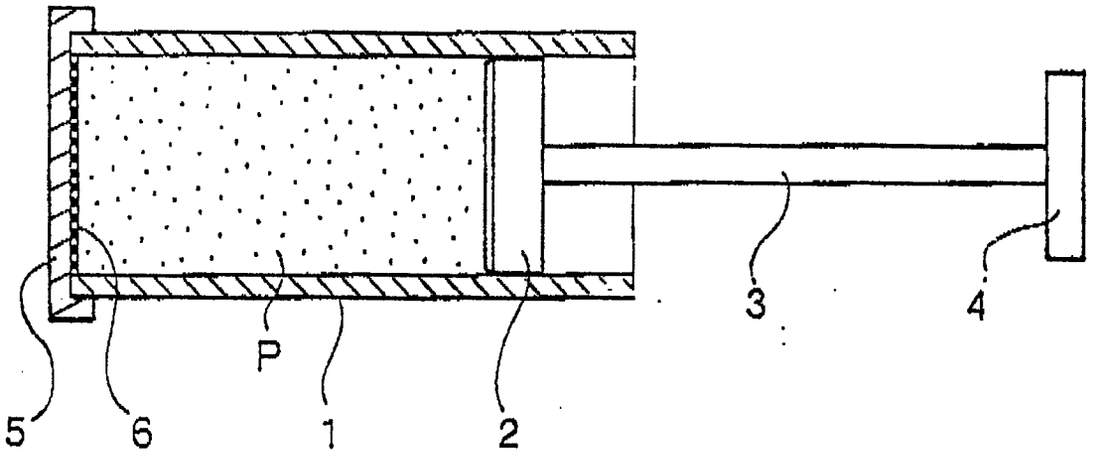
39. Package as claimed in Claim 37, wherein the second cap member comprises a metallic disc and an annular flange portion perpendicularly extented from the periphery of the

disc.

40. Package as claimed in Claim 37, wherein a cutting means is mountable on the first end portion of the tubular member after the first cap member is detacned therefrom, so that the extruded powder from the tubular member is cut off by the cutting means.

0188820

Fig.1



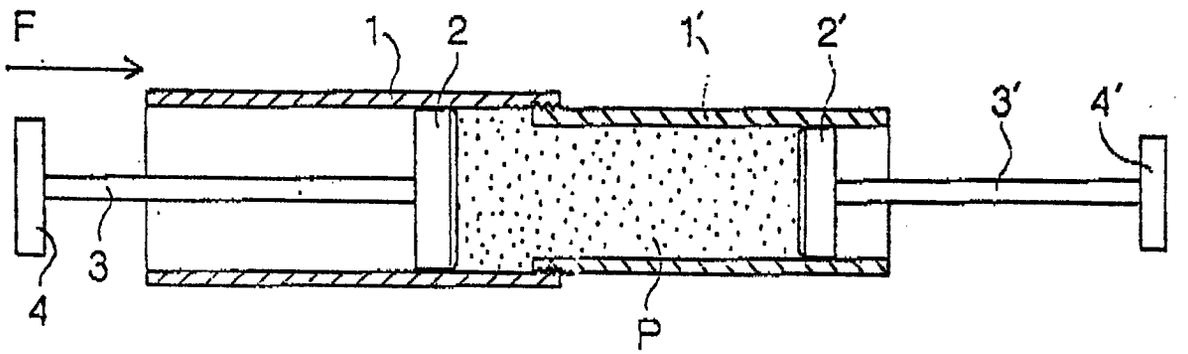


Fig.4

0188820

Fig. 2

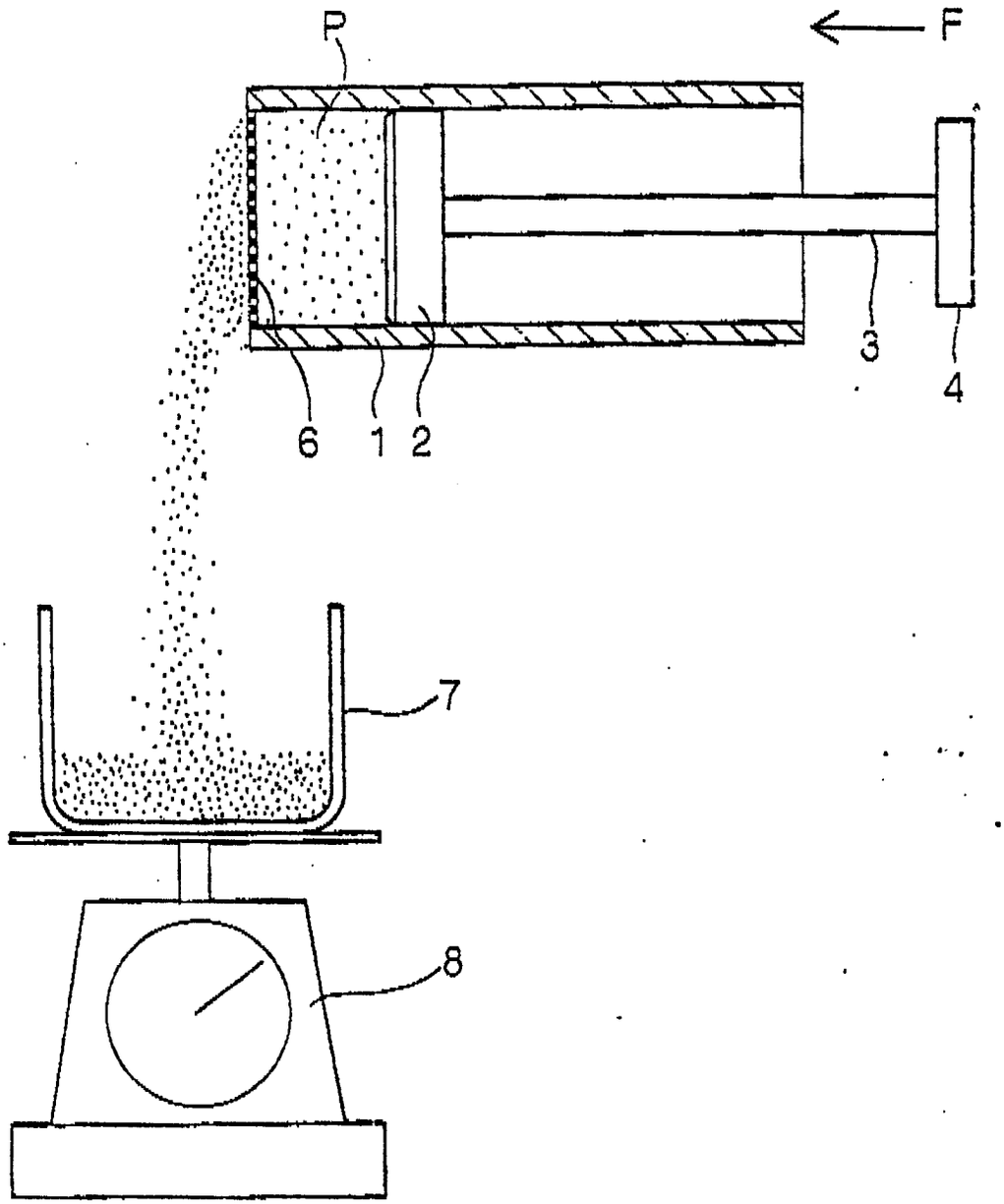
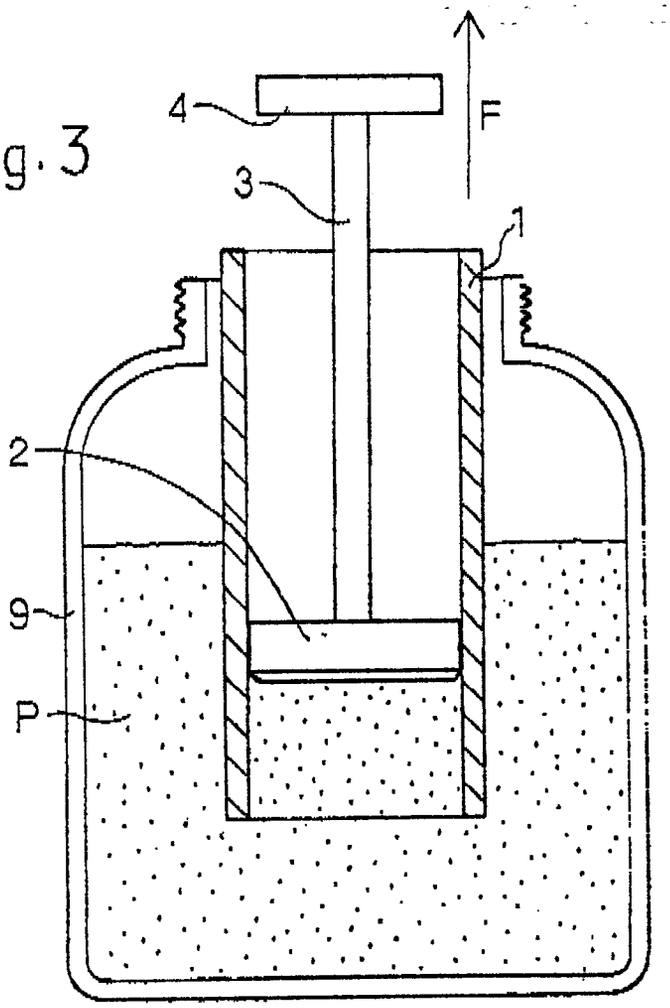


Fig. 3



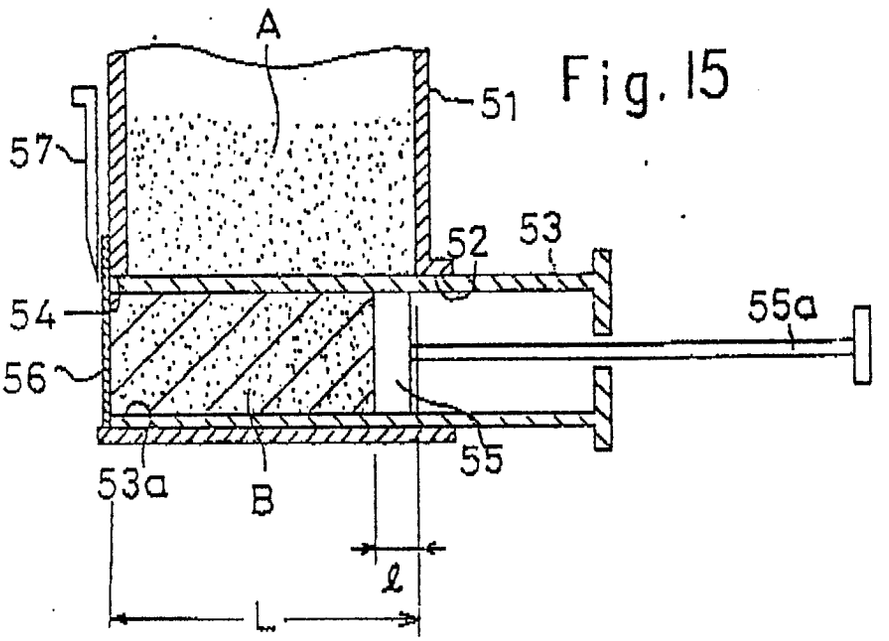


Fig. 15

4/22

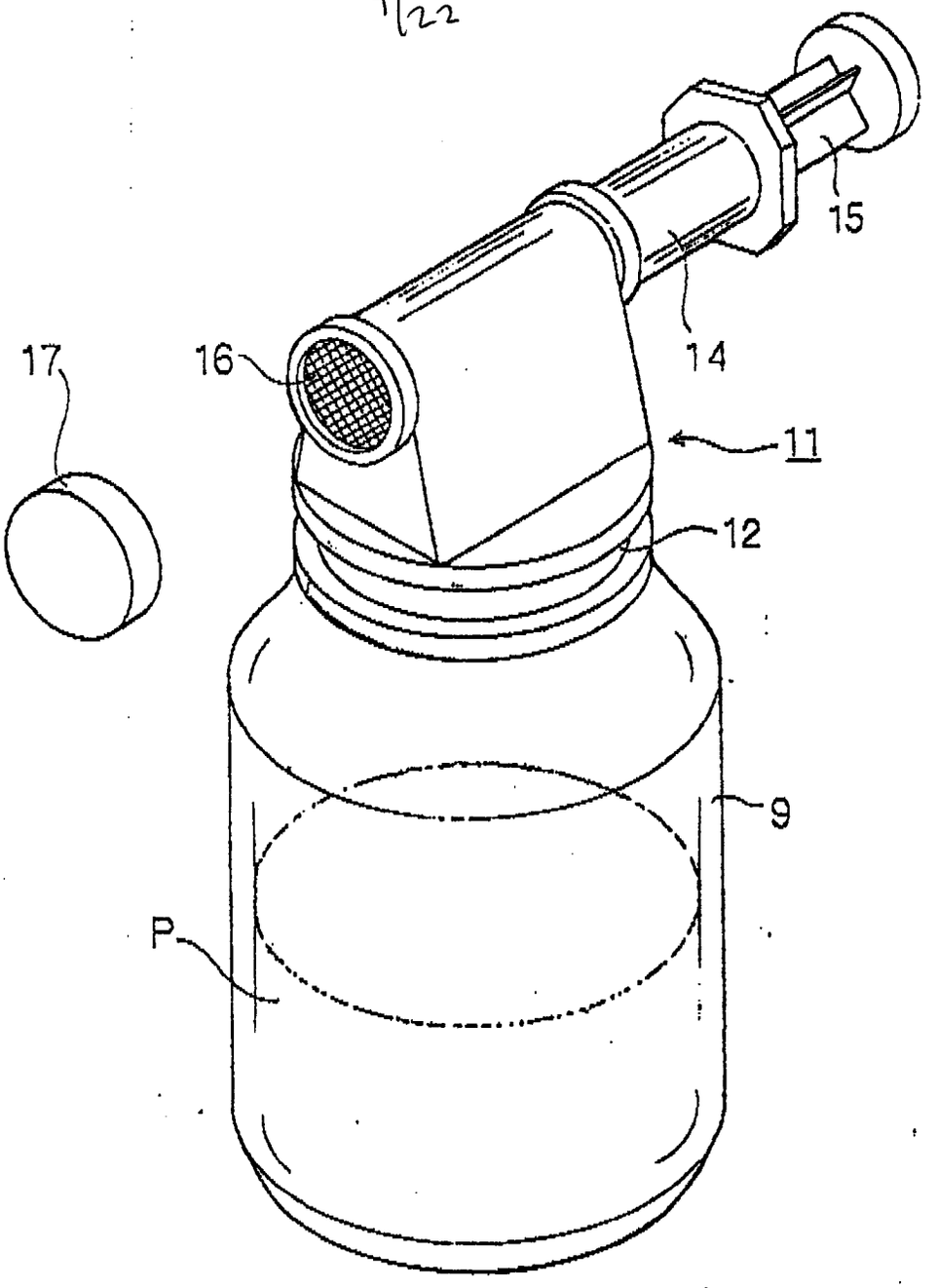
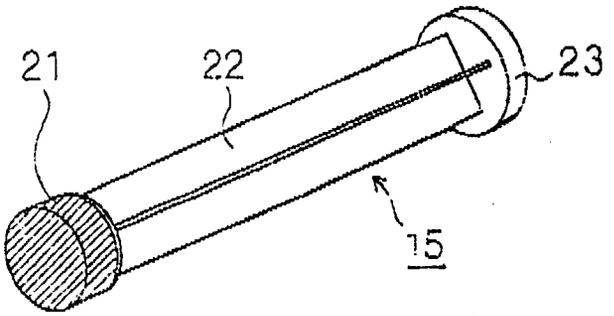


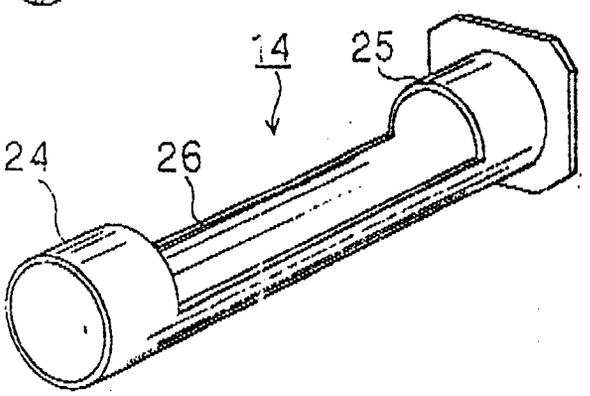
Fig. 5

Fig. 6 5/22

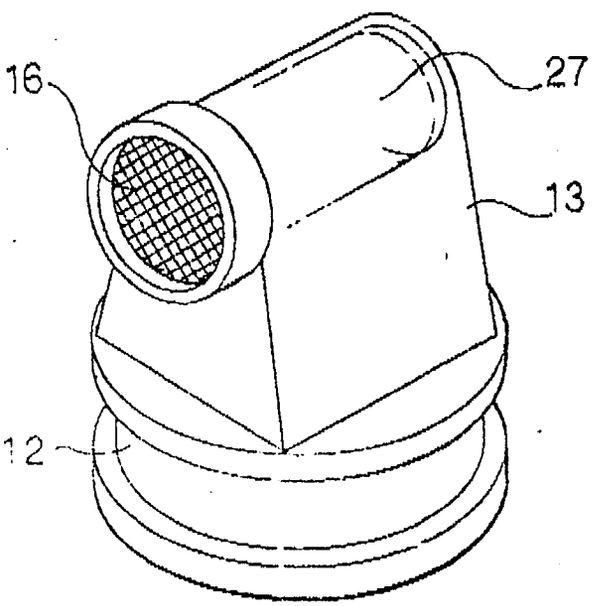
(a)



(b)



(c)



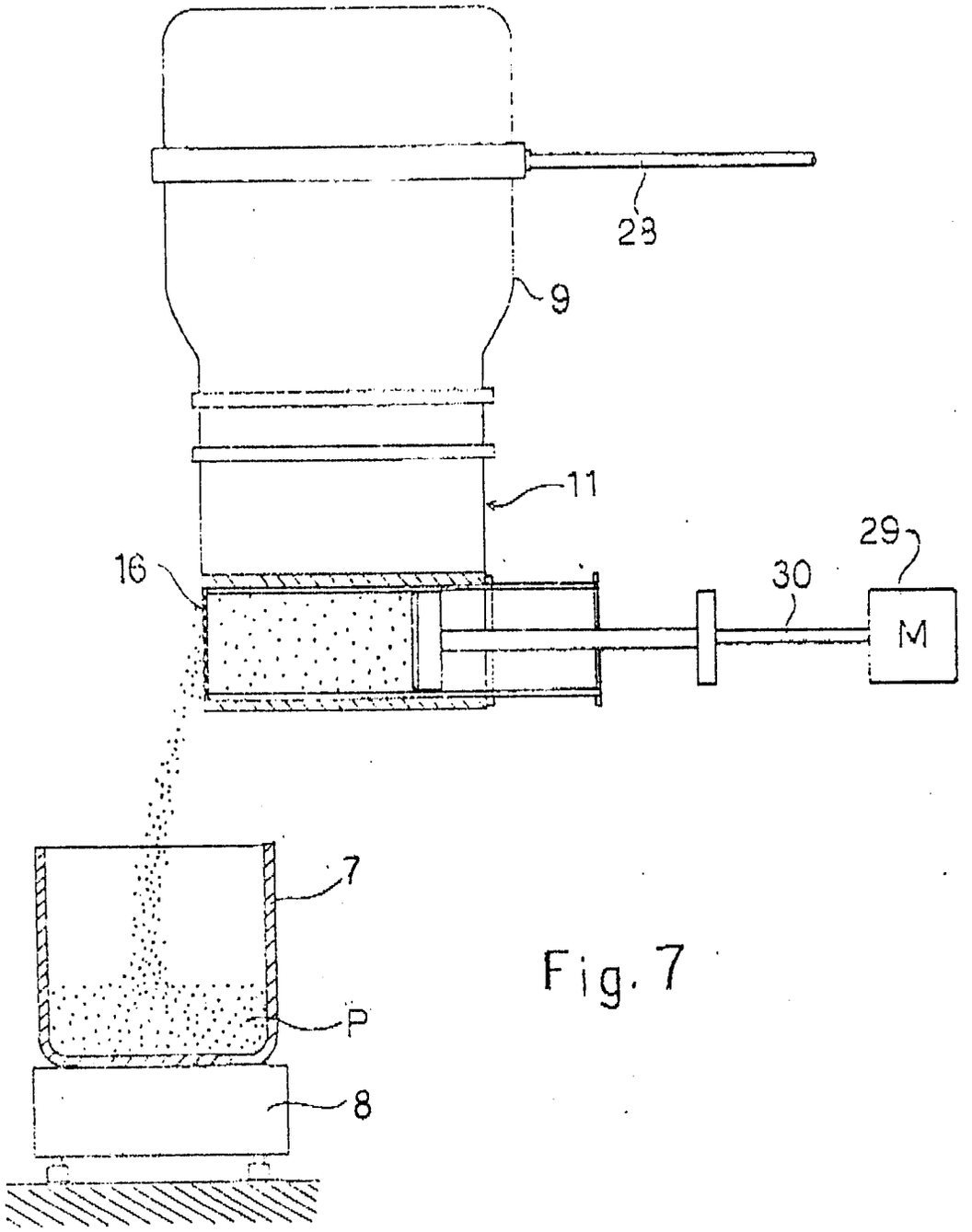


Fig. 7

Fig. 8

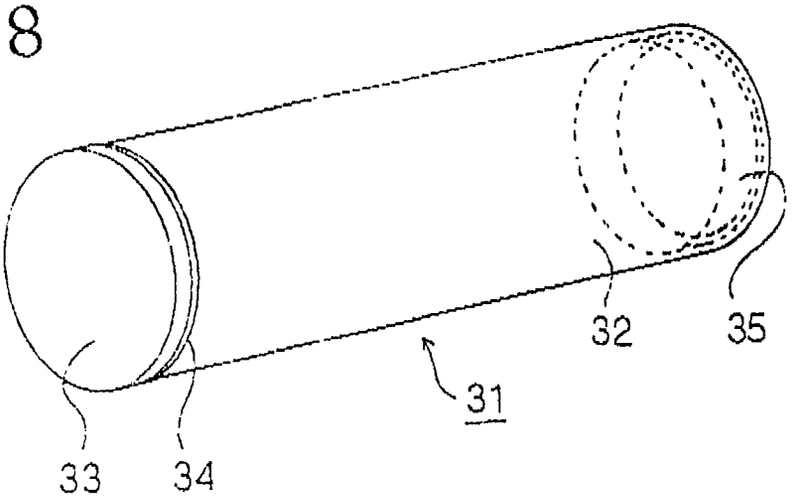
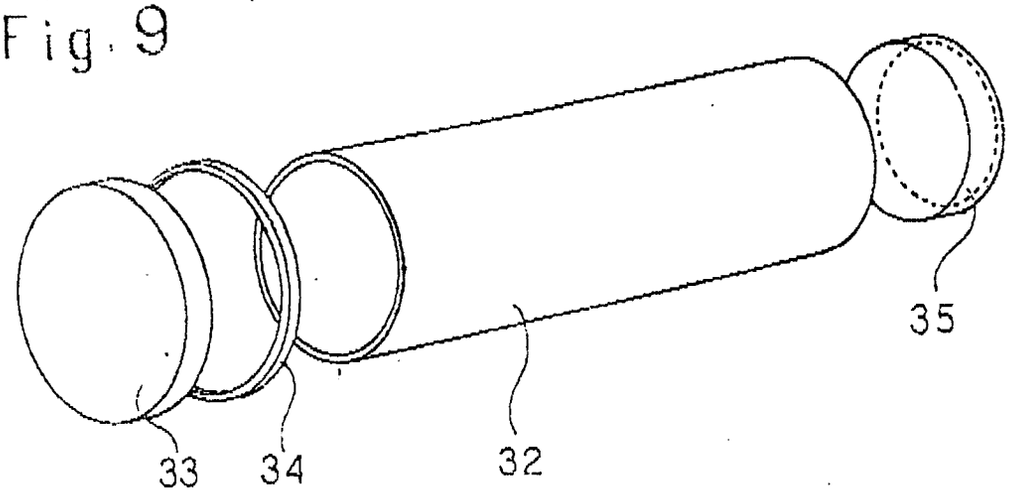


Fig. 9



0188820

Fig.10

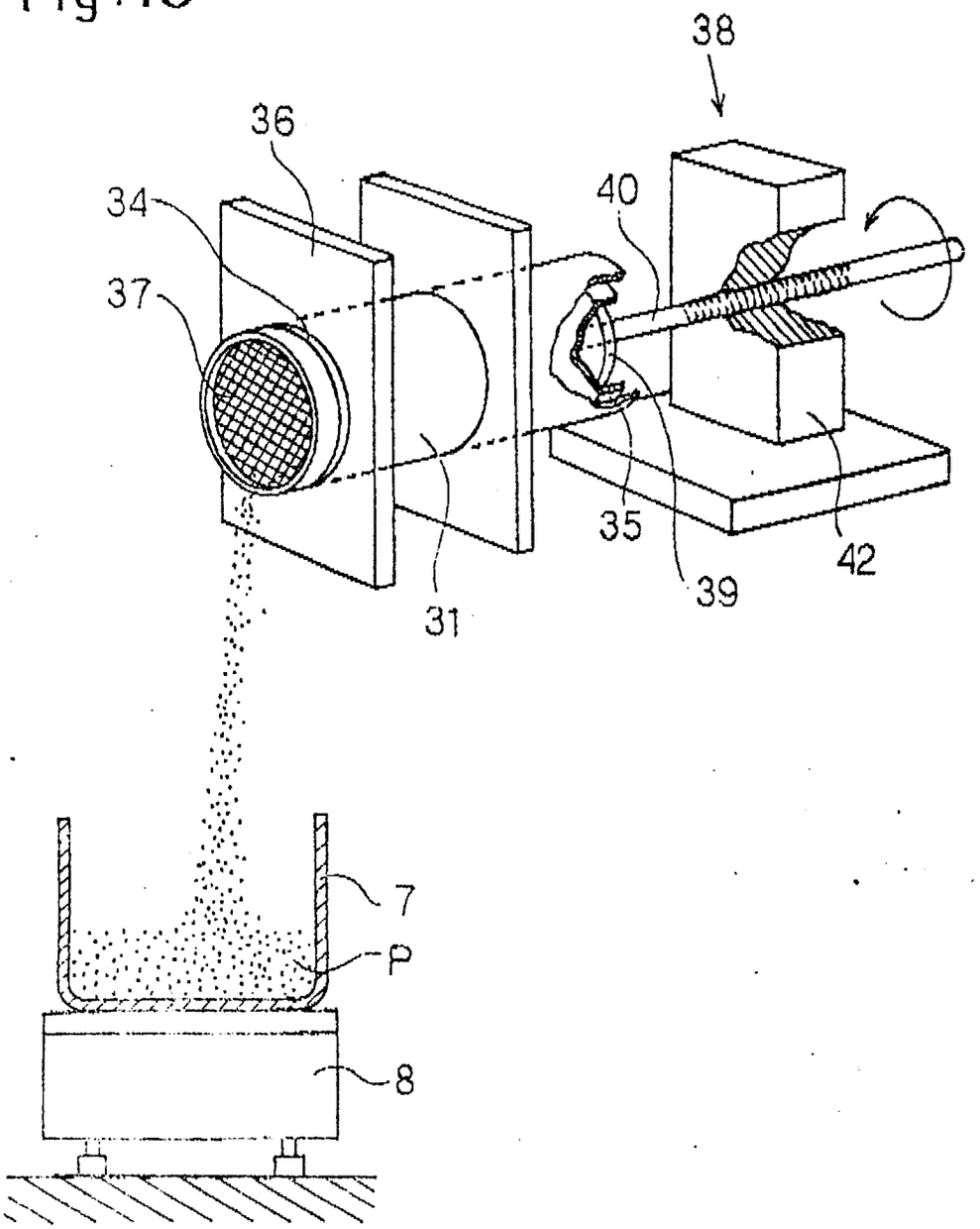


Fig. 11

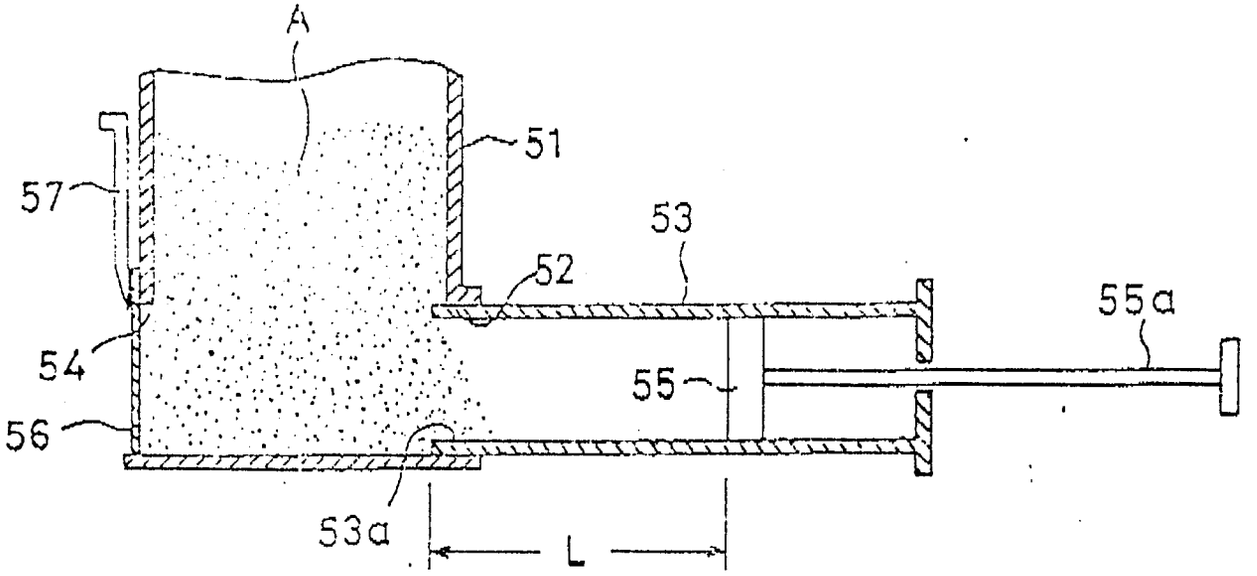


Fig. 12

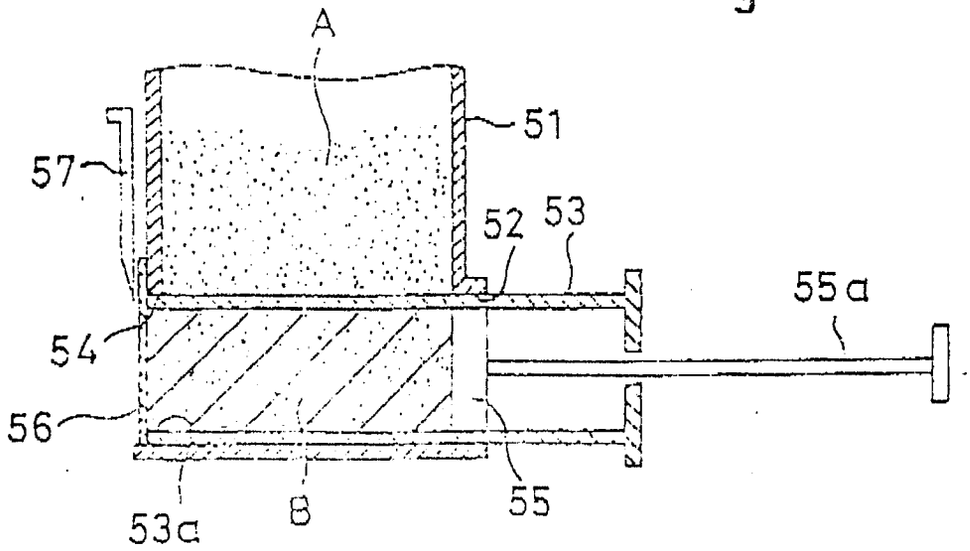


Fig. 13

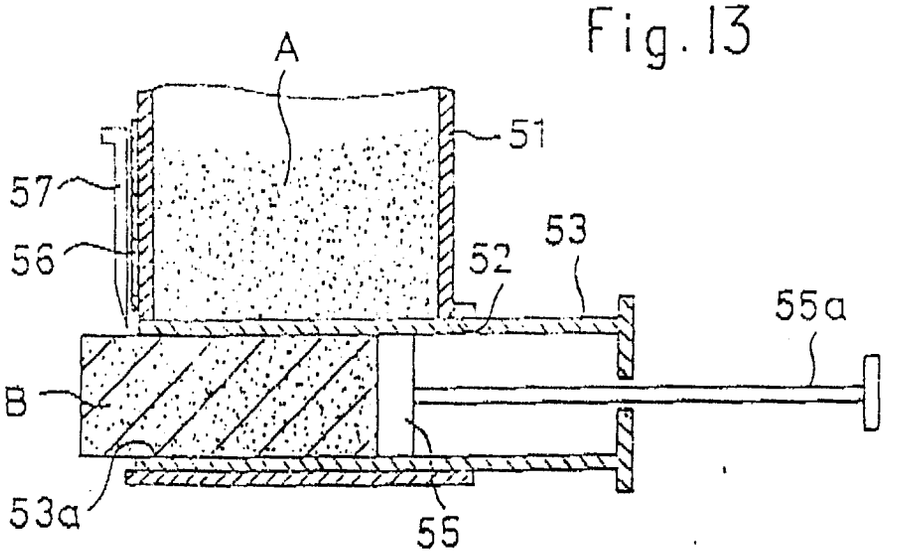
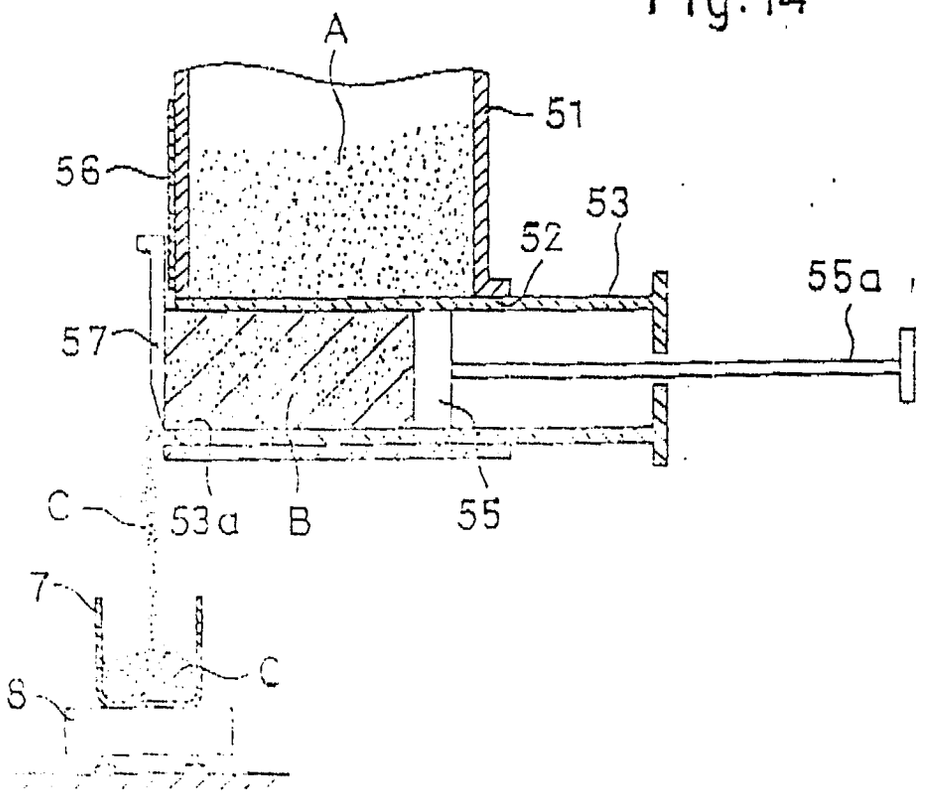


Fig. 14



0188820

Fig. 16

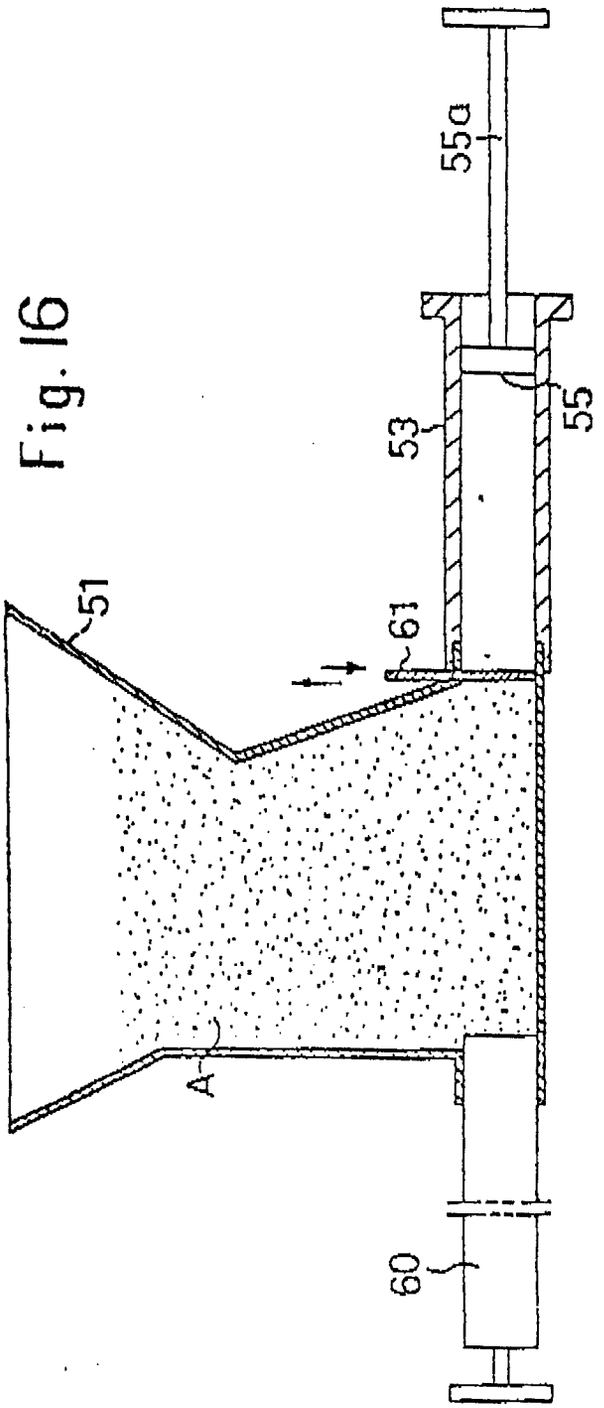


Fig. 17

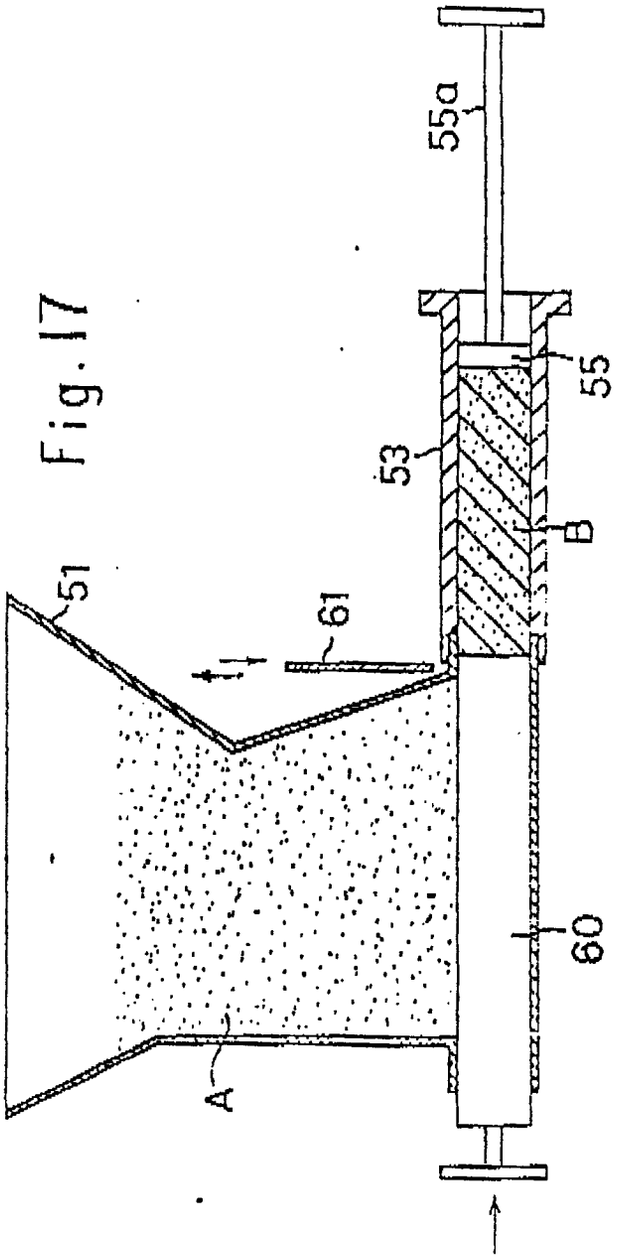
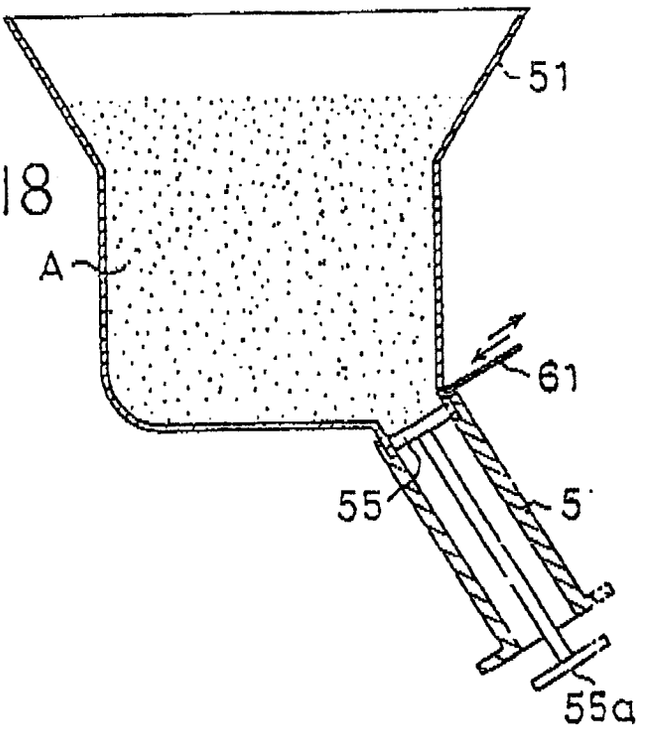


Fig. 18



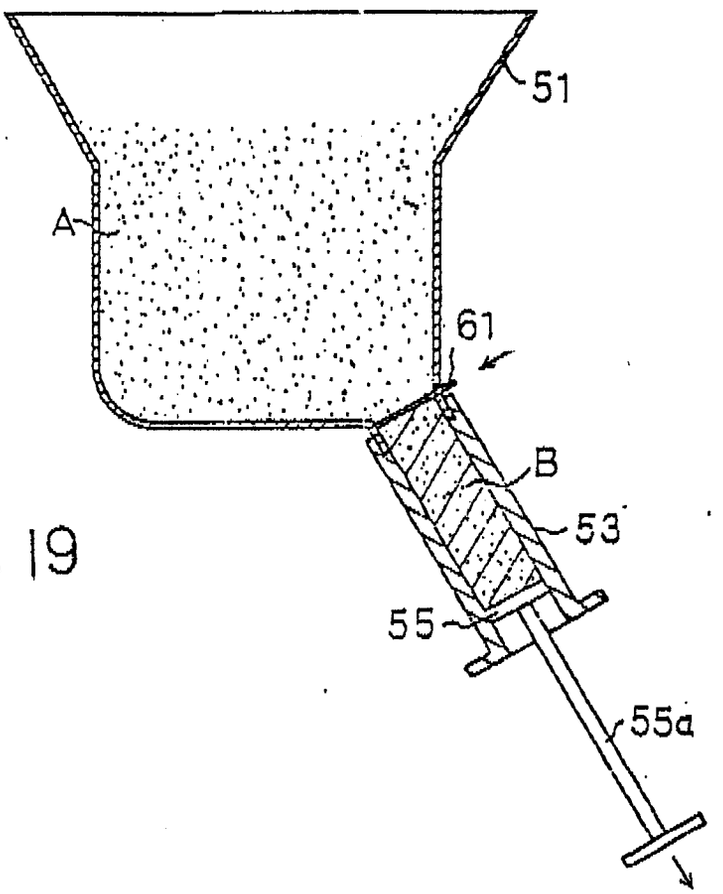


Fig. 19

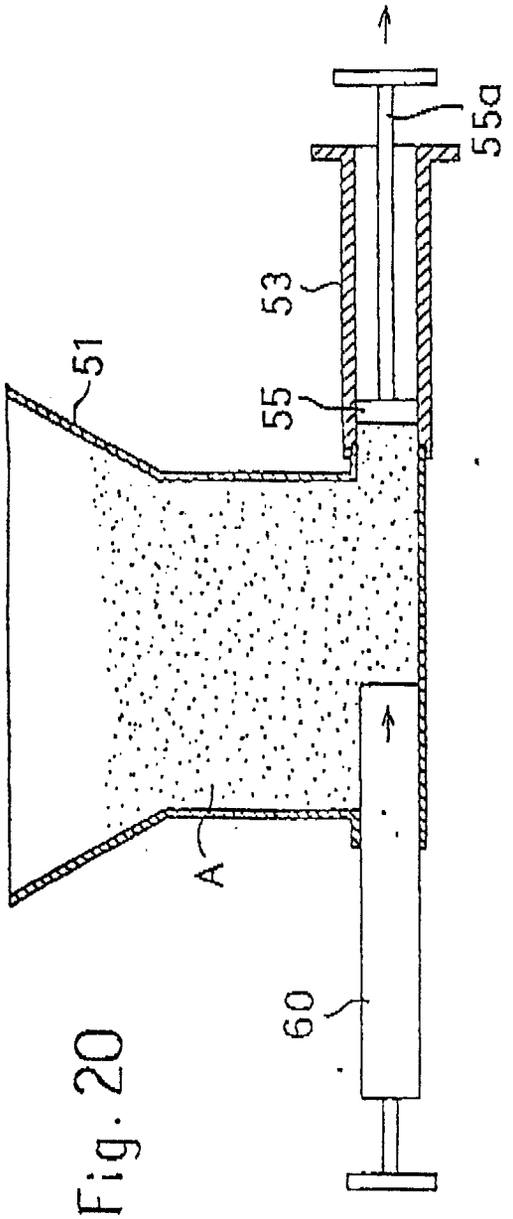


Fig. 20

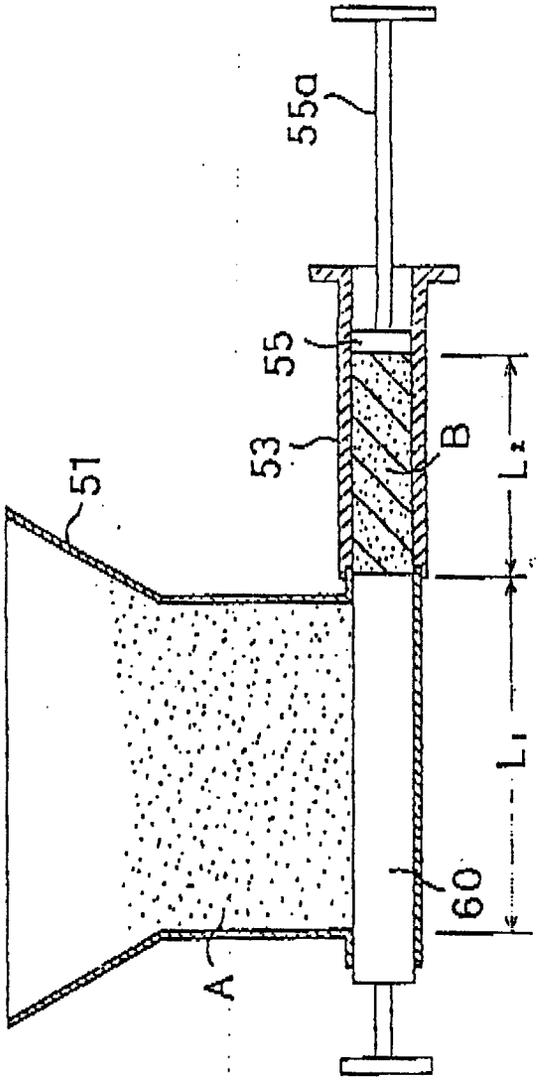


Fig. 21

Fig. 22

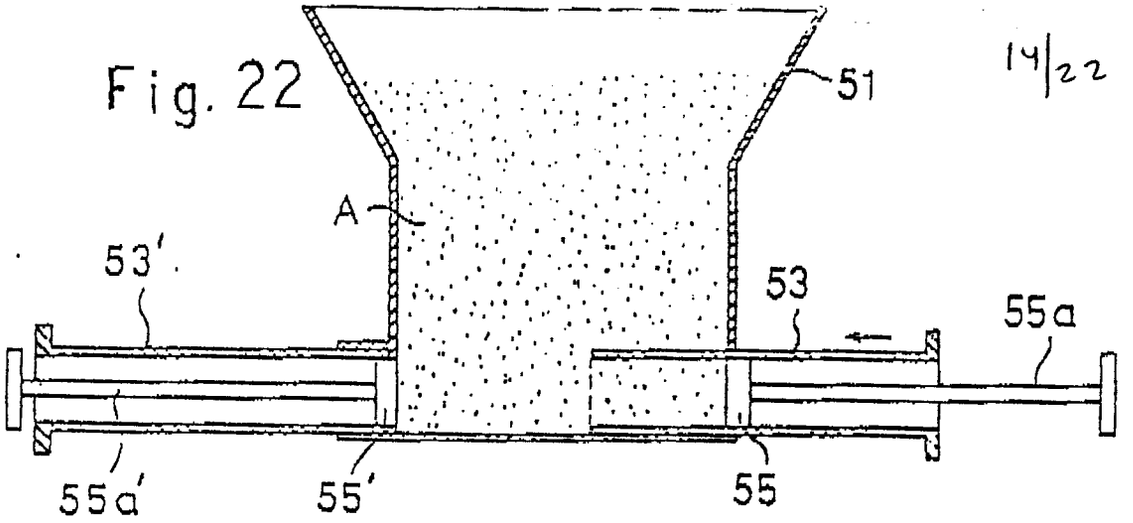


Fig. 23

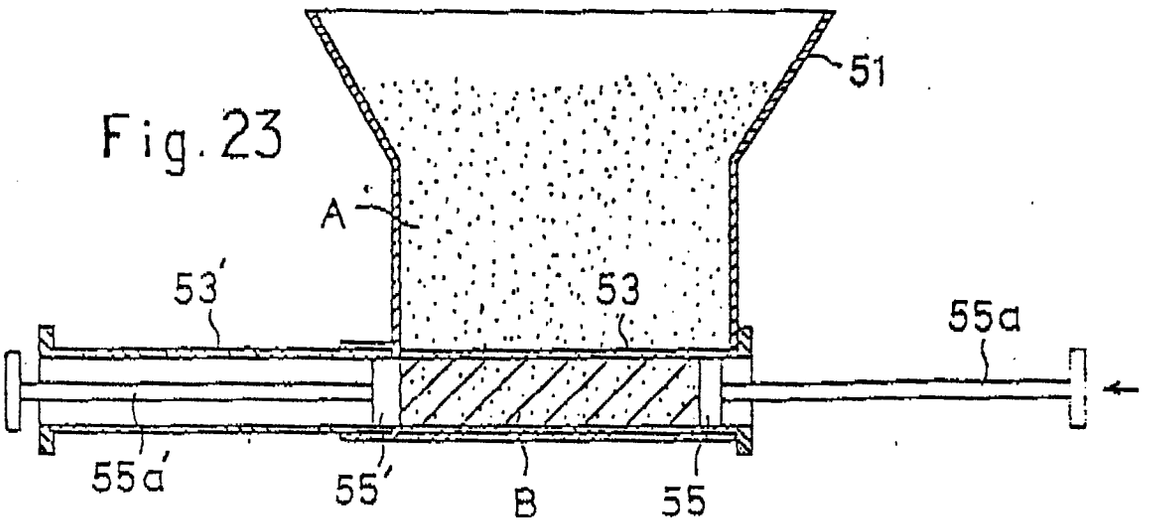


Fig. 24

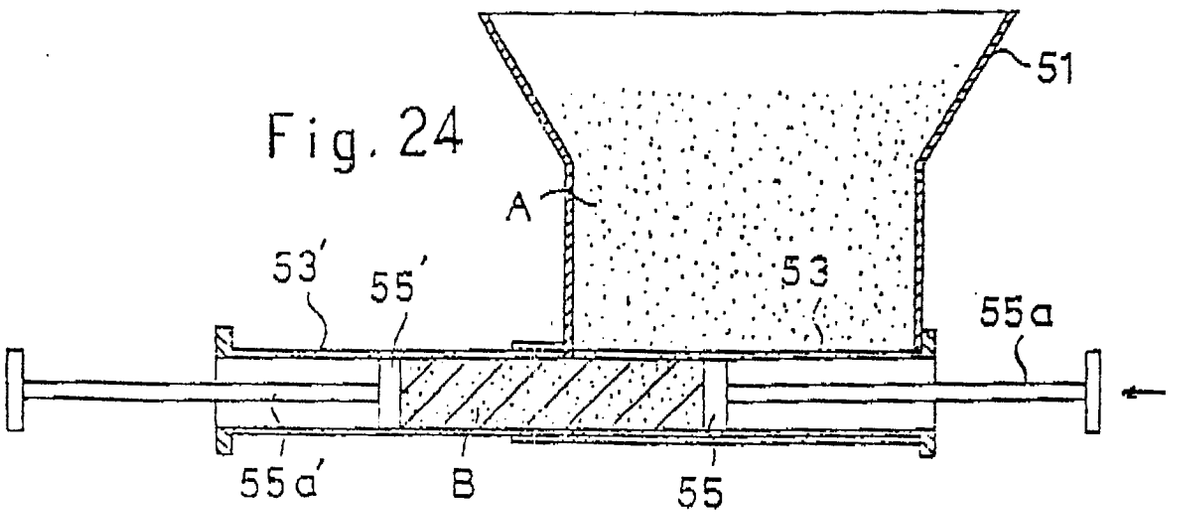


Fig. 25

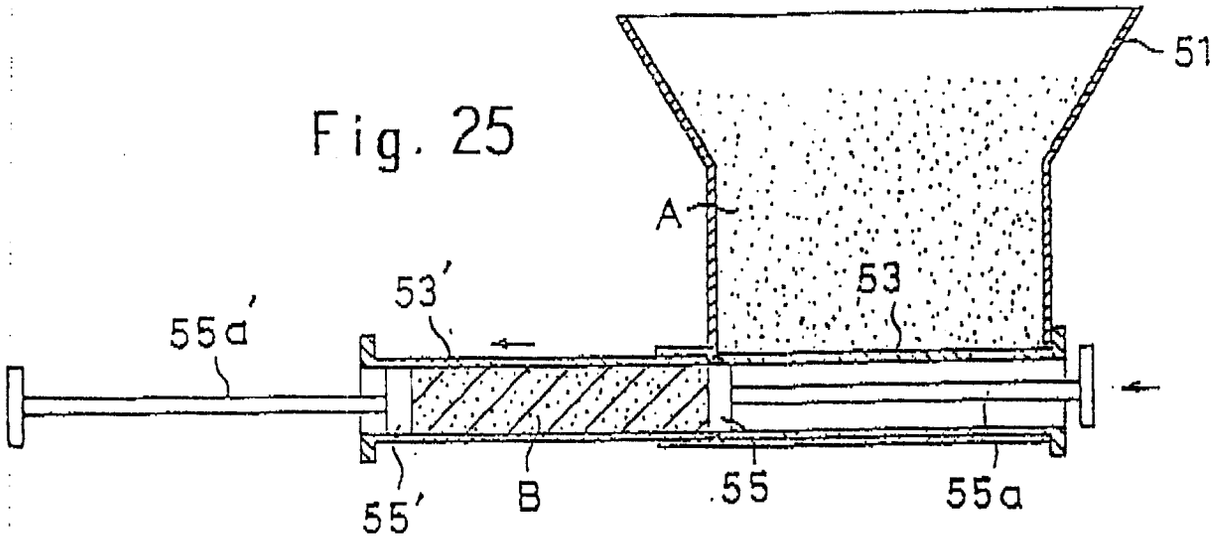

51
A
53
53'
55a'
55'
B
55
55a

Fig. 26

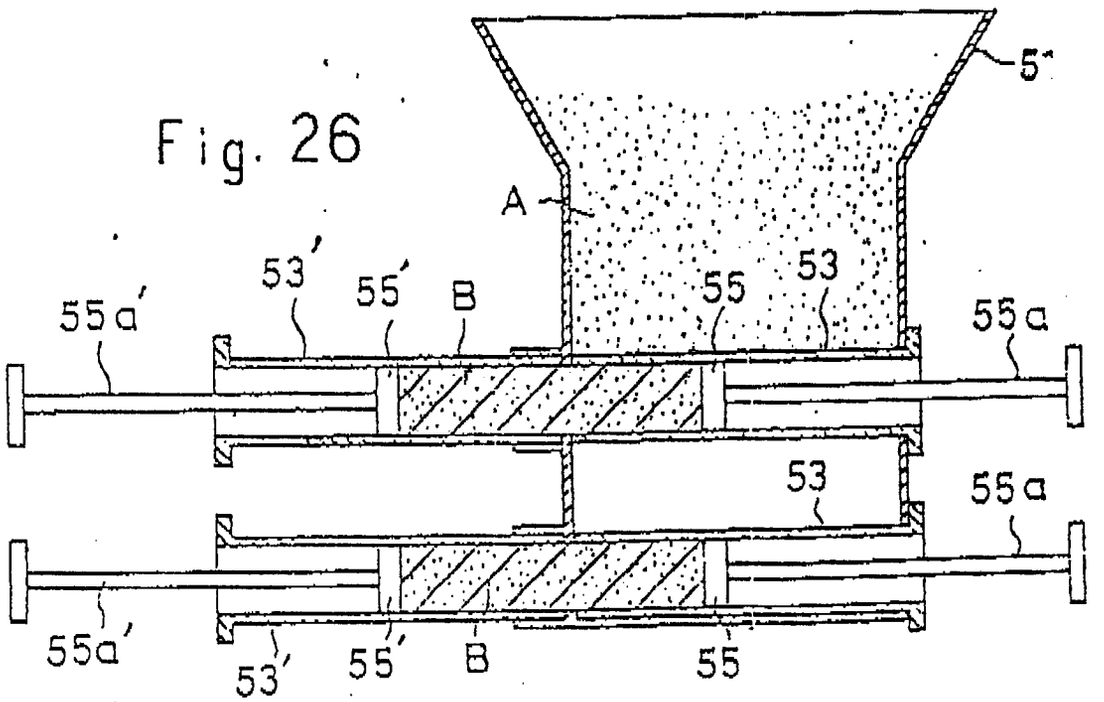

51
A
53'
55'
B
55
53
55a'
55a
53
55a
55a'
53'
55'
B
55

Fig. 27

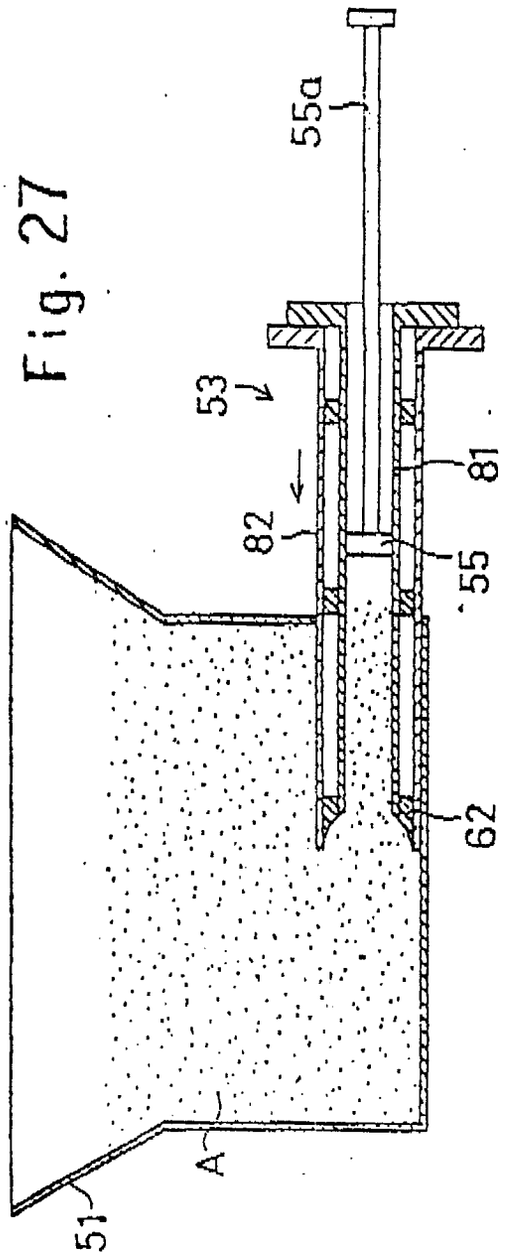
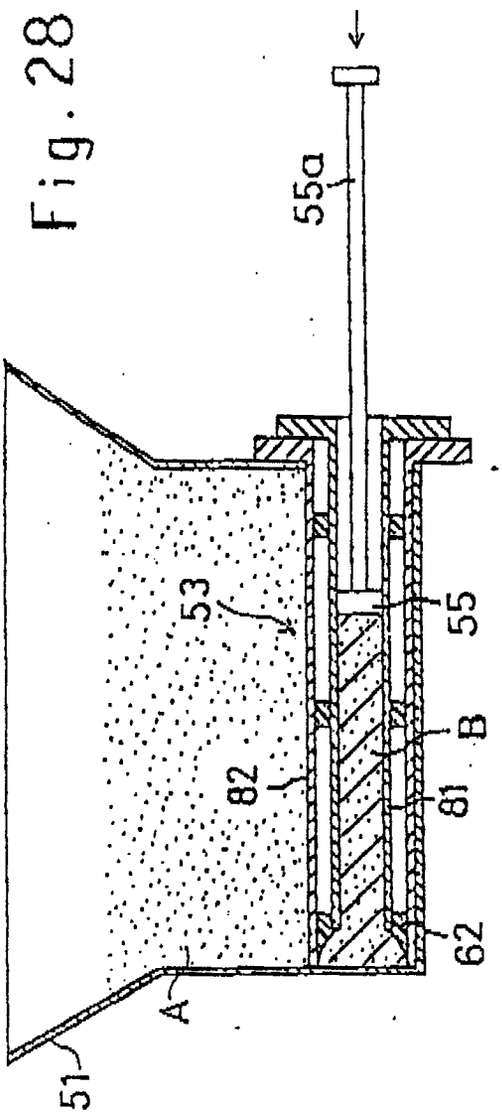


Fig. 28



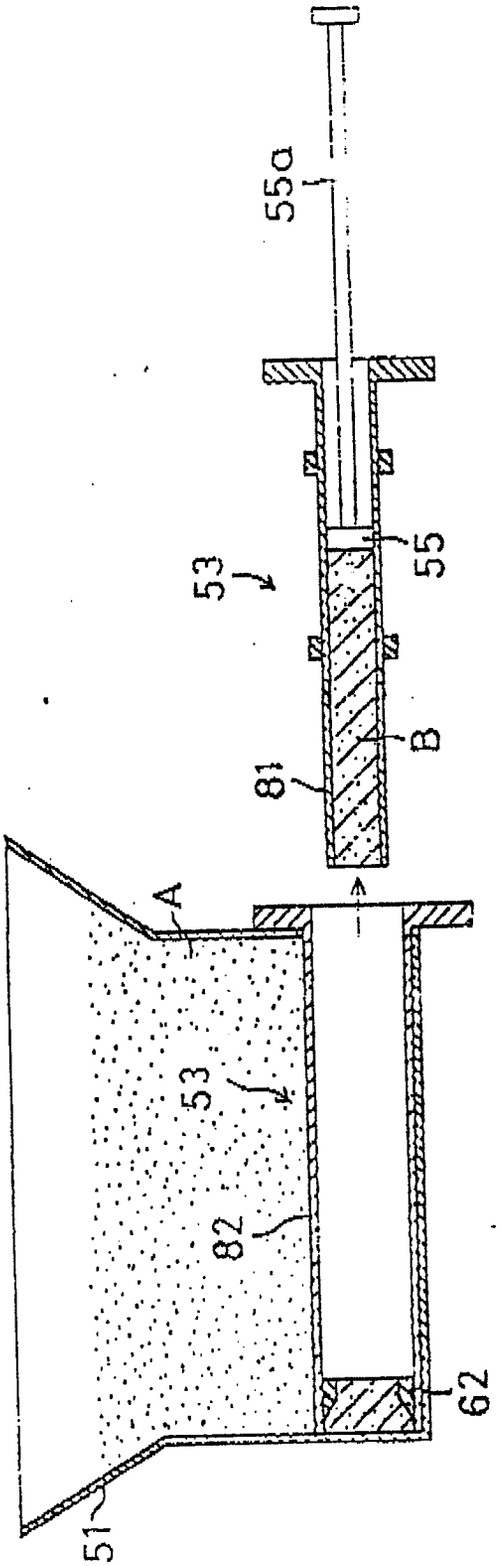


Fig. 29

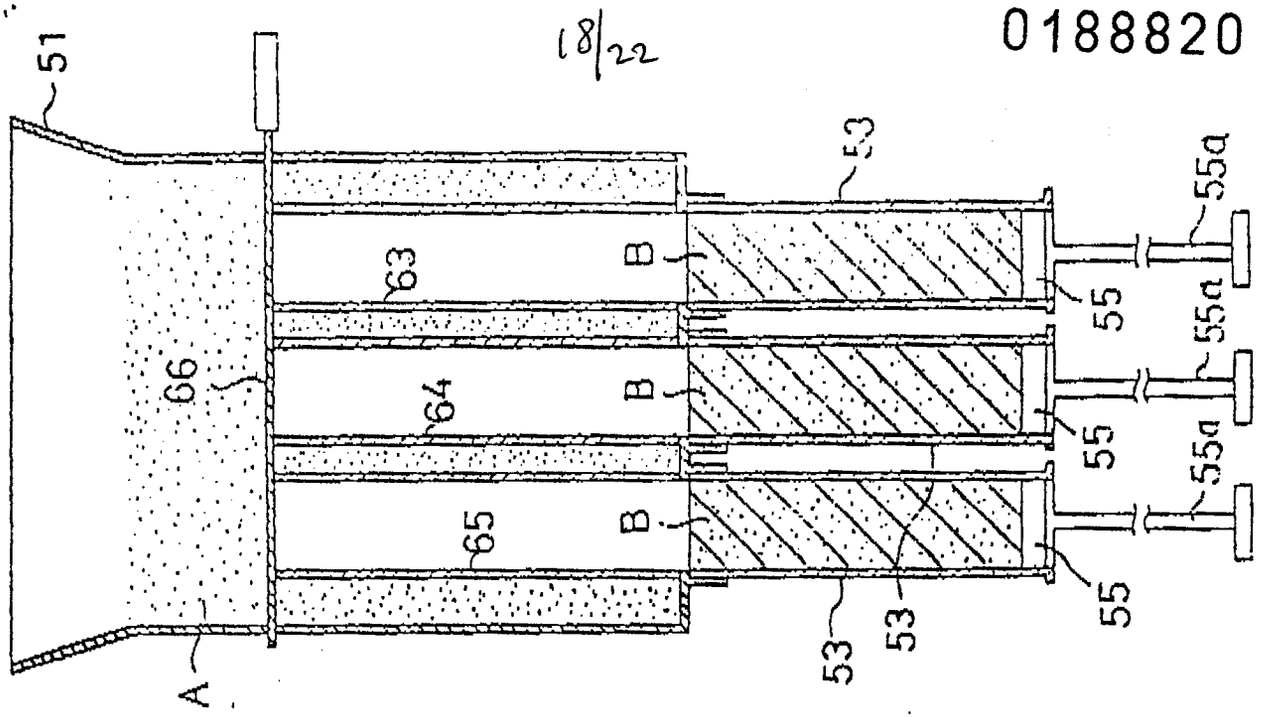


Fig. 31

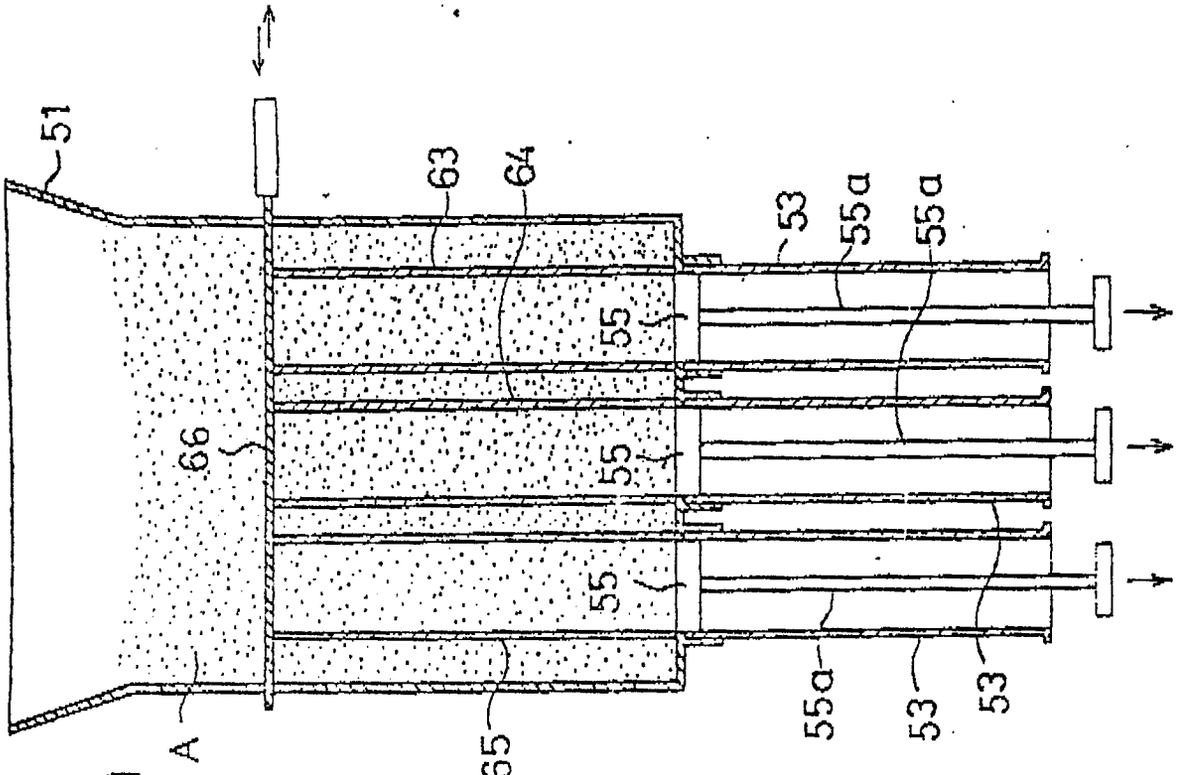


Fig. 30

0188820

Fig. 32

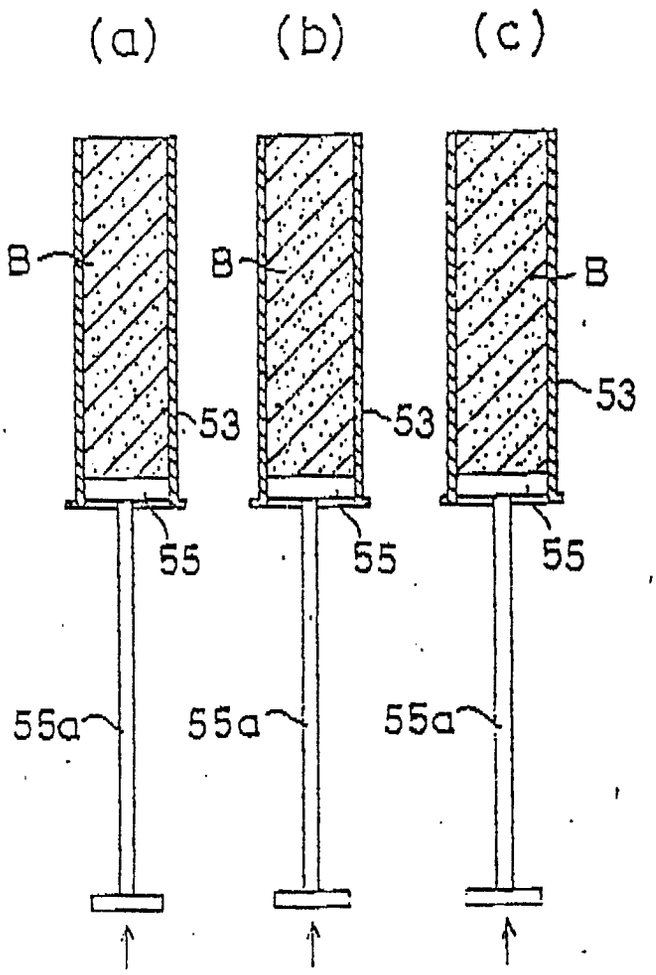


Fig. 33

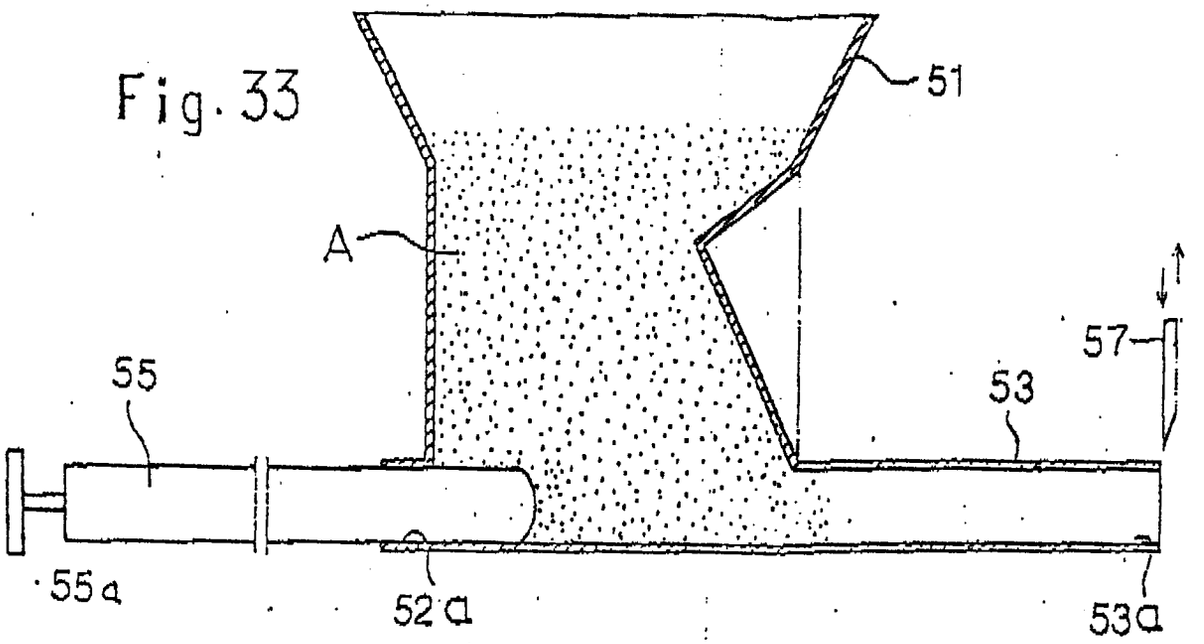


Fig. 34

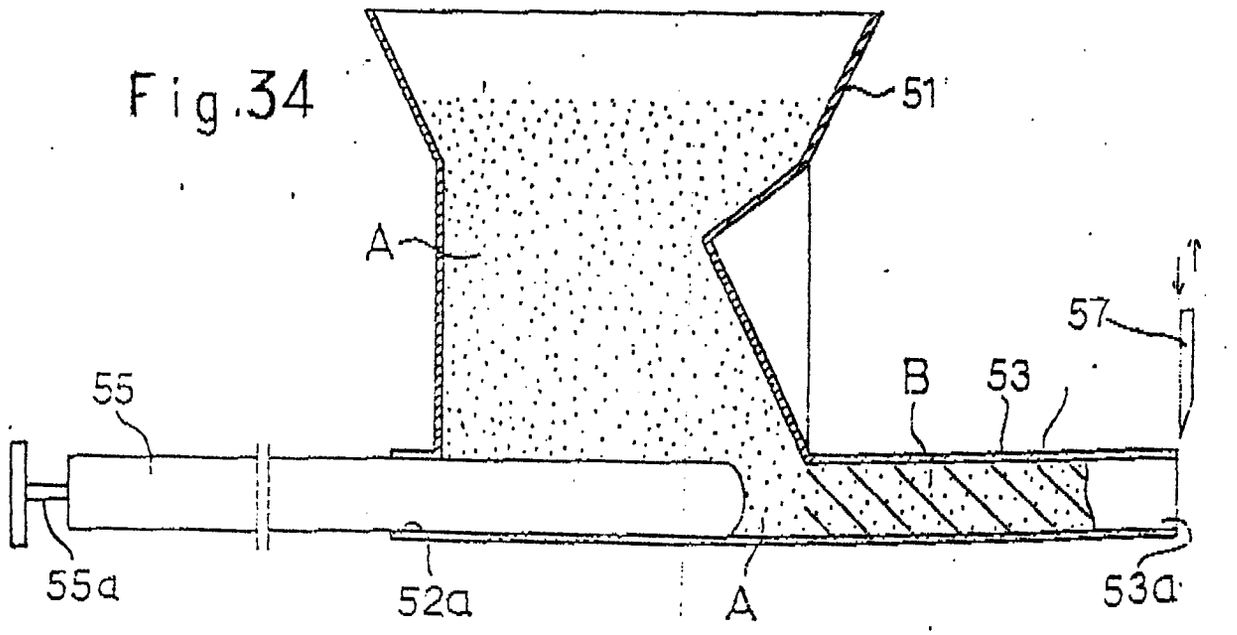


Fig. 35

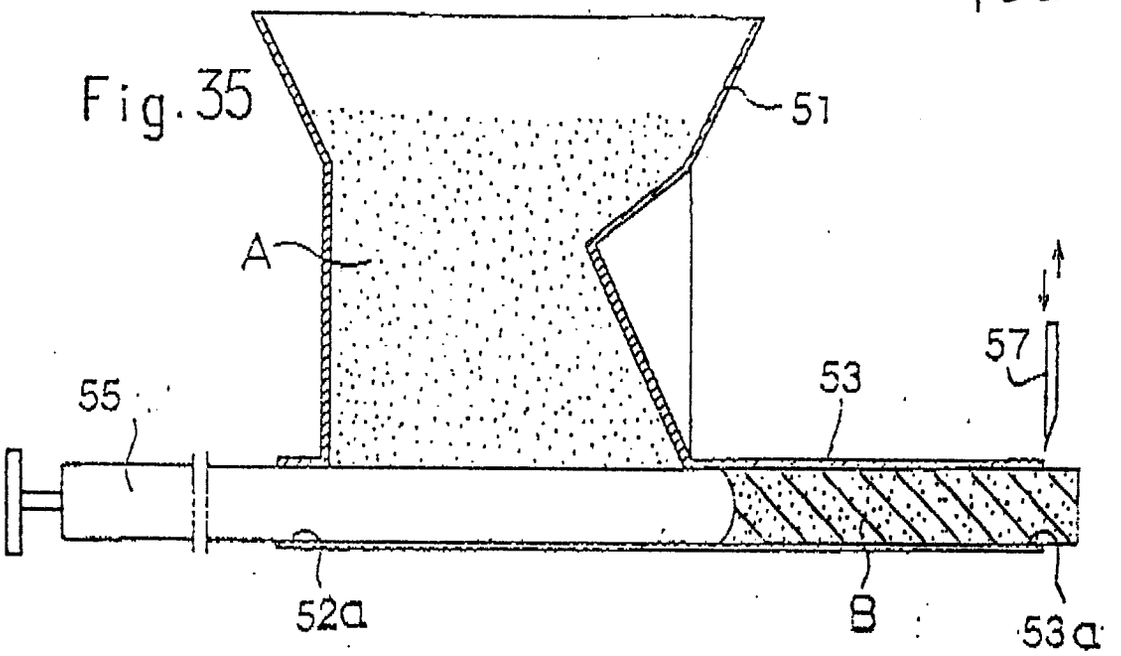


Fig. 36

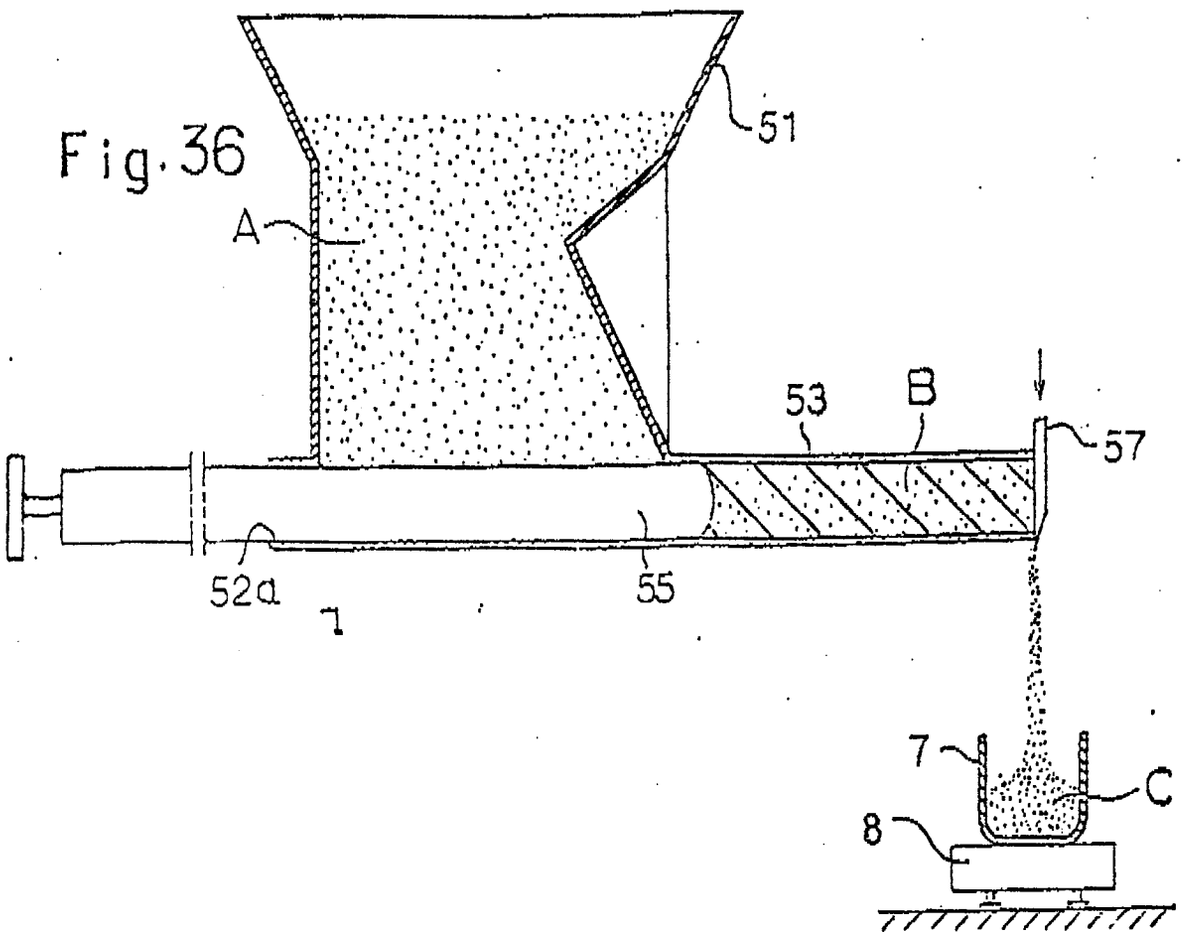
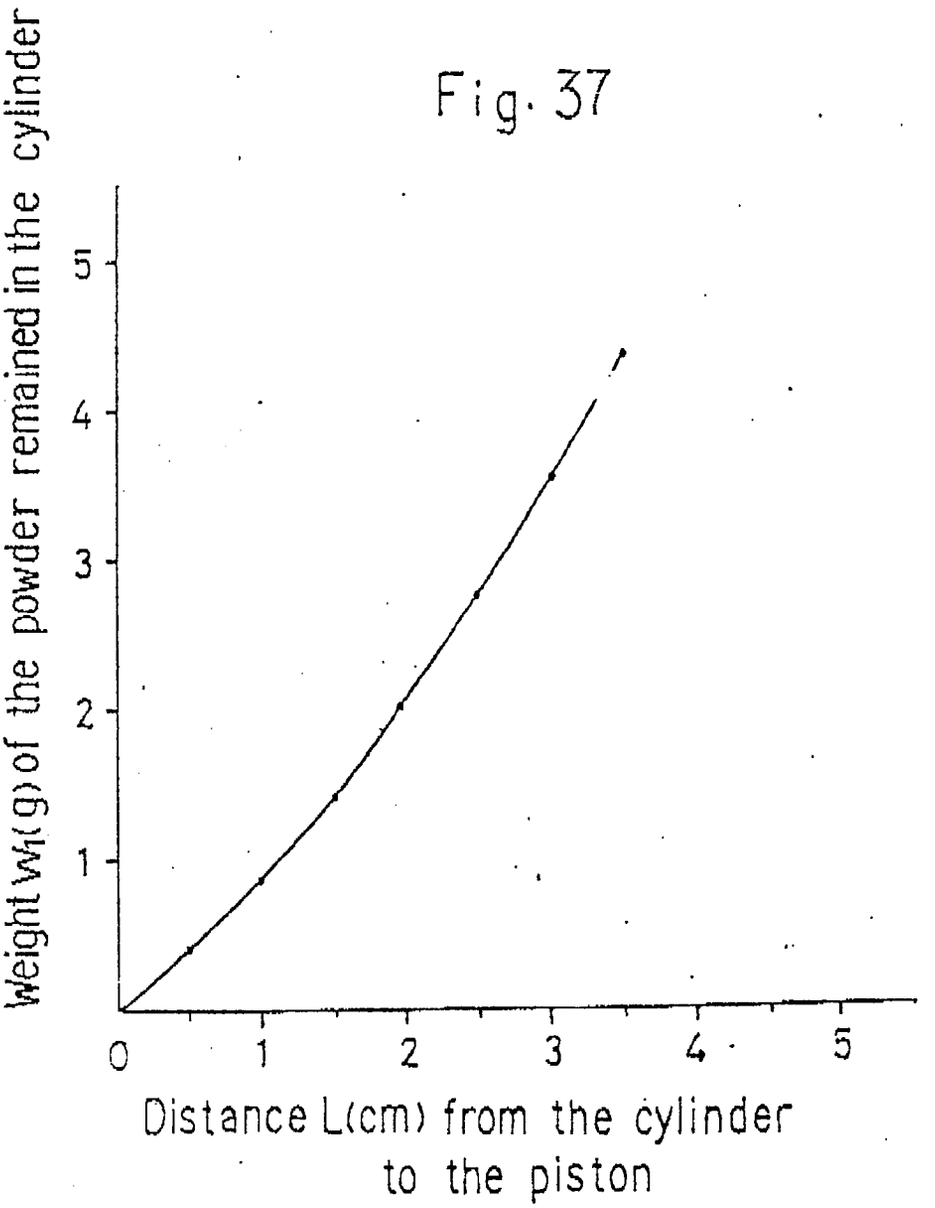


Fig. 37


Weight Wt(g) of the powder remained in the cylinder
1
2
3
4
5
0
1
2
3
4
5
Distance L(cm) from the cylinder to the piston

European Patent Office

EUROPEAN SEARCH REPORT

0188820
Application number

EP 85 11 6661

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
			B 65 B 1/38
X	DE-A-2 050 885 (FRATELLI ZANASI) * Page 10, line 6 - page 14, line 27; figures *	1,2,16,17,20,28,29	
X	GB-A-2 021 528 (J. RICHARDS) * Page 2, line 117 - page 3, line 85; figures 4-11 *	1,2,4,5,8,13-16,23,27,28	
X	US-A-3 893 492 (J. NOHREN) * Column 3, lines 12-62; figures *	1,2,4,5,16,17,22,27,28	TECHNICAL FIELDS SEARCHED (Int. Cl.4)
A	US-A-3 913 795 (R. COUCHER) * Column 3, line 19 - column 5, line 26; figures *	8,10,11,27	B 65 B B 65 G G 01 F F 42 B A 61 J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	10-04-1986	JAGUSIAK A.H.G.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO Form 1503 03.82