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[54] **APPARATUS AND METHOD FOR TAMPING PARTICULATE MATERIALS INTO A CONTAINER**

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[52] **U.S. Cl.**.....**141/12,** 53/124 B, 100/295, 141/73, 141/98

[51] **Int. Cl.**.....**B65b 1/04,** B65b 3/04

[58] **Field of Search**.....141/71, 73, 12, 98, 286, 80; 53/124 B; 100/215, 295

[56] **References Cited**

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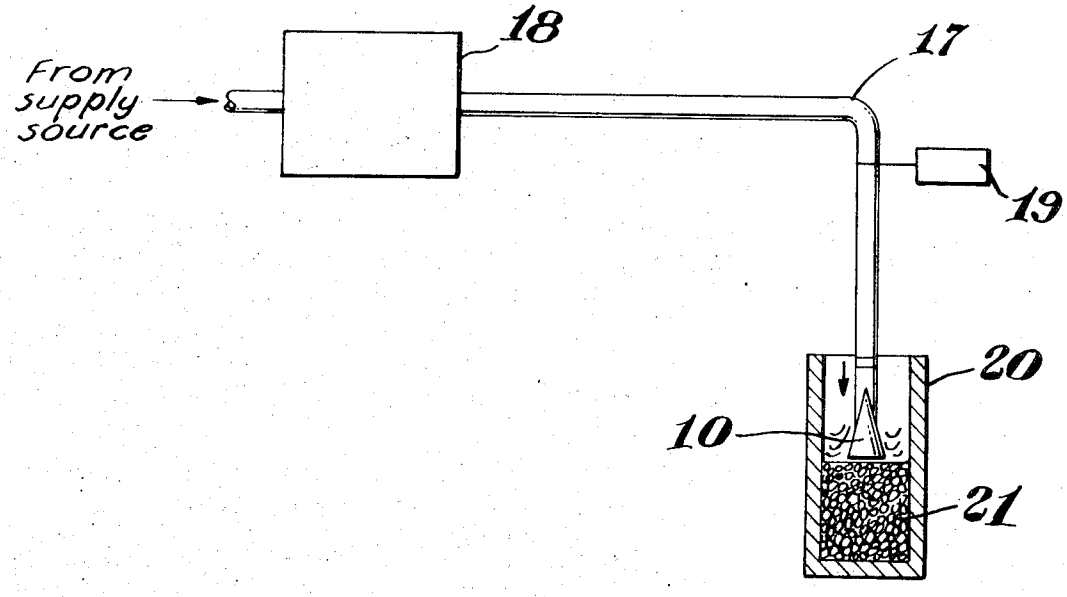
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[57] **ABSTRACT**

An apparatus is provided which when connected to the discharge end of a delivery hose for delivering free flowing particulate materials and reciprocated in a generally vertical direction during delivery of such materials compacts the materials into a container. The apparatus comprises a butt having an upper portion and a base, at least a portion of said upper portion decreasing in cross-sectional area from bottom to top, and a support means for attaching and aligning the butt below the discharge end of the delivery conduit so that the top of the butt faces the opening, and the longitudinal axis of the body is substantially in align with the longitudinal axis of the discharge end of the delivery conduit.

10 Claims, 5 Drawing Figures



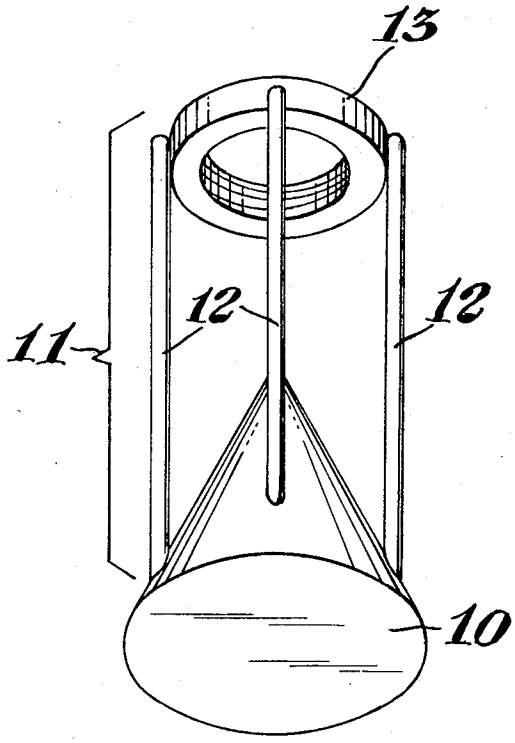


Fig. 1

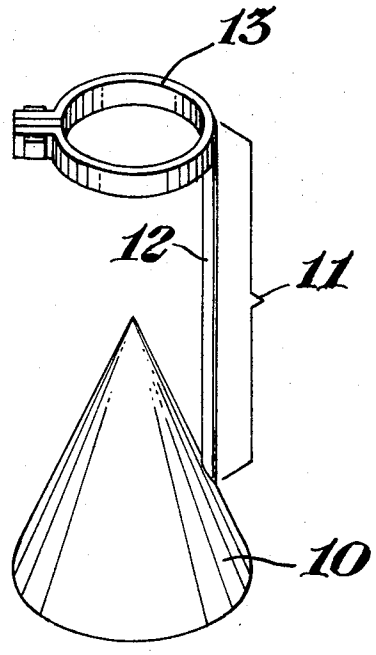


Fig. 2

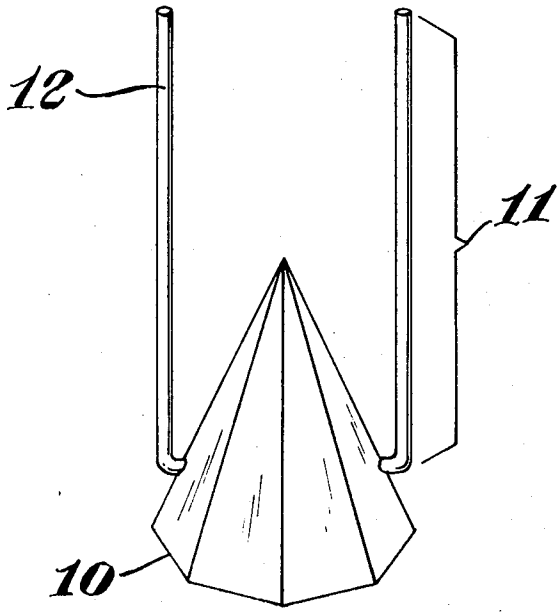


Fig. 3

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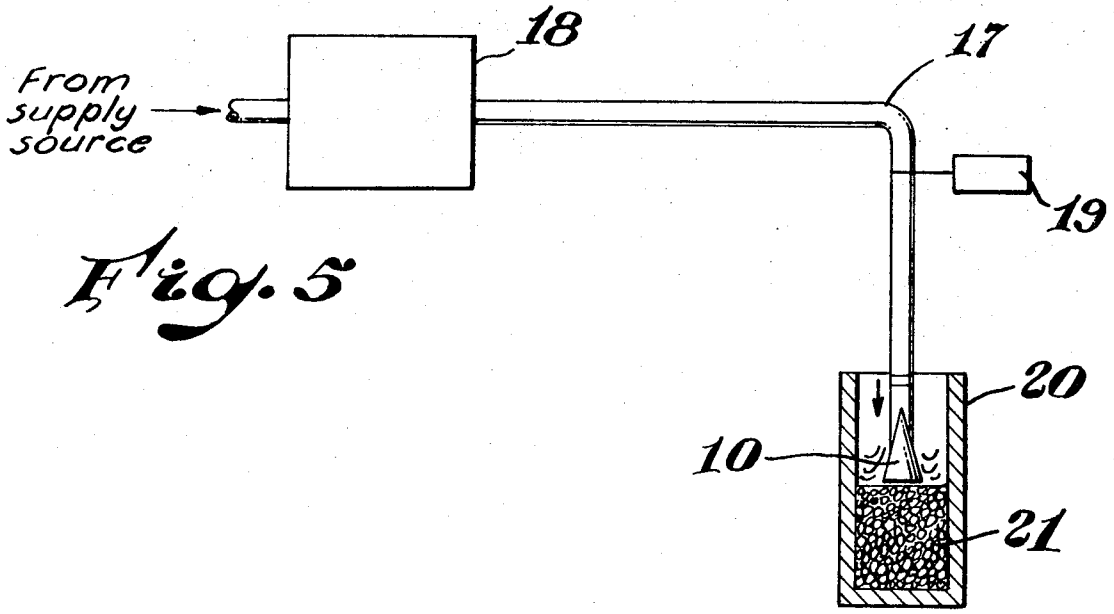


Fig. 5

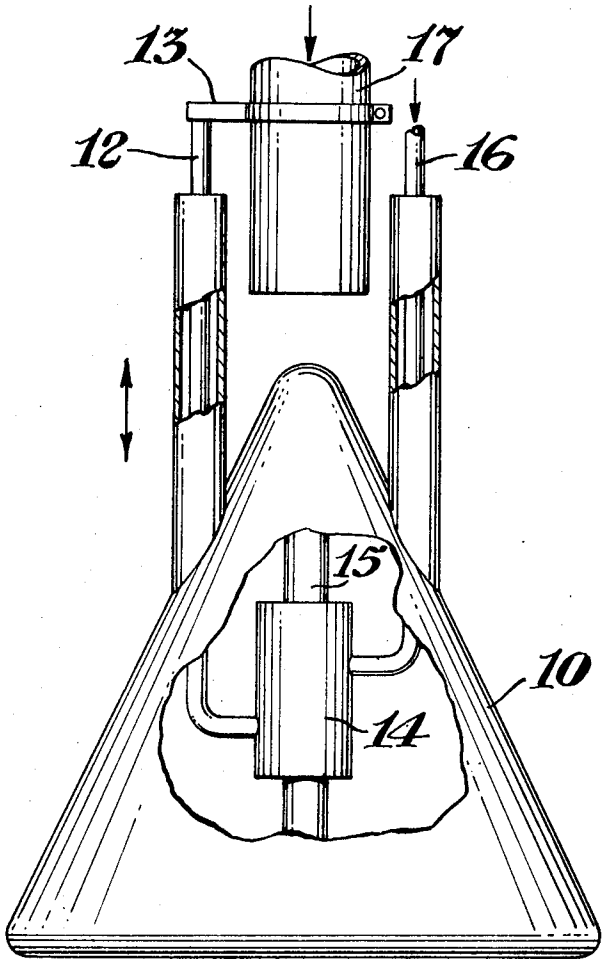


Fig. 4

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APPARATUS AND METHOD FOR TAMPING PARTICULATE MATERIALS INTO A CONTAINER

BACKGROUND OF THE INVENTION

It is often desirable to compact free flowing particulate materials into various sized containers and the like in order that more material may be placed in the container and/or higher packing densities can Such achieved. Scuh free flowing materials are often introduced into containers through delivery conduits, e.g., hoses and the like. Particulate materials which are loaded in this manner include, for example, grain, gravel sand, free flowing dry blasting agents and the like. In the past, attempts have been made to compact these materials by employing various vibrators or rammers such as, for example, the one disclosed in U.S. Pat. No. 2,719,029. However, no apparatus or method has been developed for simultaneously loading and tamping particulate materials into a container. Also, the material may be in a container which is too remote or large for normal compacting techniques to be employed.

The present invention pertains to an apparatus and method which is particularly adapted to loading free flowing dry blasting agents into boreholes, individual containers and the like. These free flowing dry blasting agents, e.g. such as those disclosed in U.S. Pat. Nos. 2,975,046; 3,094,096 and 3,432,371 and other types generally known as ANFO, are generally either pre-packaged or bulk loaded.

Of the pre-packaged type there are two common methods of loading employed. In one the blasting agent is loosely packed into a paper or plastic bag which is opened in the field and the contents poured into the blast hole. In the other method a package, e.g. a cylinder of paper, plastic or metal or the like, is filled with an explosive in a manufacturing plant to a high density by vibrating, ramming or the like and the container is loaded into a blast hole slightly larger in diameter than the container. In the first method the blast hole is well filled with a low density blasting agent. In the second case the blast hole is only partially filled with a high density blasting agent causing poor coupling. In either method the full potential of the blast hole and explosive is not utilized.

Bulk loading is generally accomplished by blowing a blasting agent into a borehole from a hose located near ground level thus achieving nearly the same results as in the method of pouring the explosive from a package. It is often desirable, however, to increase the amount of blasting agent in the borehole by compacting the generally low density blasting agent.

The method and apparatus of the present invention now allows for the bulk loading and compacting of boreholes and other containers with a particulate material to increase the loaded density thereof. It is especially useful where the material to be packed comprises particles of a range of different sizes.

SUMMARY OF THE INVENTION

The apparatus of the present invention comprises a butt which decreases in cross-sectional area from the base to the top thereof and having attached thereto a support means for attaching and aligning the butt a distance from the discharge end of a delivery conduit so that the top of the butt faces the discharge end and the longitudinal axis of the butt is substantially aligned with the longitudinal axis of the discharge end of the delivery conduit.

In the method of the present invention a low density particulate material is discharged from the delivery conduit and into a container while the butt is oscillated in a generally vertical direction. Because the butt of the apparatus is tapered the flow of particles from the conduit is diverted in an outwardly direction. The oscillation of the butt compacts the particulate material into the container. Also, because the butt is tapered the apparatus rises on top of the column of particulate material and will not become buried therein.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. **1–3** depict various embodiments of the apparatus of the present invention wherein the apparatus comprises a generally conical shaped butt **10**, having attached thereto a support means **11** comprising spacing member **12** and fastening means **13** for attaching and aligning the butt to a delivery conduit.

FIG. **4** illustrates (partially in schematic) an apparatus of the invention having a means for oscillating the butt independently of the delivery hose.

FIG. **5** illustrates partially in schematic the operation of the apparatus shown in FIG. **1** in the method of the present invention.

PREFERRED EMBODIMENTS OF THE INVENTION

In general, cylindrical or polygonal, e.g. square, triangular, frustoms, or any other shaped butt **10** having various cross-sectional shapes can be employed. At least a portion of the butt should be tapered (i.e. decrease in cross-sectional area from the base to the top).

The base of the butt is generally flat, but preferably it is slightly convexed. The latter shape allows for easier manipulation of the apparatus when filling containers with a particulate material. The plane of the base is generally perpendicular to the longitudinal axis of the butt.

The butt can be constructed of any suitable material. It can be solid or hollow and can be constructed of, for example, cementitious types of materials, e.g., plastics, concrete, wood or metal such as, for example, steel, aluminum or the like. It also can be hollow to decrease the weight thereof and in this instance may be constructed of, for example, steel, aluminum, various alloys, plastics or other similar materials.

The size of the butt is not critical to the practice of the invention. However, preferably the cross-sectional area at the base of the butt is at least as large as the cross-sectional area of the opening of the discharge conduit employed. More preferably it is larger than the cross-sectional area of the opening of the discharge conduit. It is appreciated that the larger the base of the butt the more efficient the compacting operation will be since a larger area of the material is contacted with the butt during each oscillation thereof.

The support means **11** attached to the butt may be of any convenient, desirable design. Three embodiments are shown in FIGS. **1–3** but the invention is not limited thereto. The support means **11** must generally be of a type such that the top of the butt can be aligned to face

the opening of the discharge conduit a distance therefrom, with the longitudinal axis of the butt generally aligned with the longitudinal axis of the discharge conduit. Also the support means **11** must have sufficient structural strength and rigidity such that it will not give or break during the loading or compacting operation.

One simple design for the support means **11** is shown in FIG. **3**. It comprises at least one spacing member **12** firmly attached to the butt **10** and extending above the top thereof. The spacing member **12** is attached to a delivery hose such as, for example, by tape, metal clamps or the like.

FIGS. **1** and **2** depict additional embodiments of suitable support means **11** for affixing and aligning the butt **10** in the proper position. In FIG. **1** the support means **11** comprises a plurality of spacing members **12** firmly attached to the butt **10** and extending above the top thereof. The opposite ends of the spacing members **12** are affixed to a fastening means **13** for attaching the spacing members **12** to the discharge end of a delivery conduit. In FIG. **1** the fastening means **13** comprises a female threaded coupling which is attached to a suitable male coupling attached to the end of a delivery conduit. The reverse type of threaded coupling is also suitable. In FIG. **2** only one spacing member **12** is employed and the fastening means **13** comprises a screw clamp mechanism. As can be envisioned, many other suitable support means **11** for attaching and aligning the butt **10** a distance from the open end of the delivery conduit can be employed. The important features, however, must be that the top of the butt **10** is aligned to face the open end of the discharge conduit a distance therefrom so that the longitudinal axis of the butt is substantially in align with the longitudinal axis of the discharge conduit.

In the embodiments illustrated in FIGS. **1–3** the butt is oscillated by oscillating the delivery conduit to which it is attached. However, the apparatus may be so designed that the butt can be oscillated independently of the delivery conduit. The exact means employed to oscillate the butt independently of the delivery conduit is not critical to the practice of the invention. For illustrative purposes one means for oscillating the butt independently of the delivery conduit is illustrated in FIG. **4**.

In FIG. **4** the butt **10** is hollow and is slidably engaged to a spacing member **12** which is in turn associated with a motor **14** (e.g., electric or air) which is slidably engaged to the butt **10** through means **15**. The motor is activated through connection **16** (e.g., which is a compressed air hose or electrical connection); the connection **16** also being slidably engaged through the butt **10**. The motor, spacing member and butt are associated so that in operation the motor **14**, when activated, causes the butt **10** to oscillate in a generally vertical direction beneath the discharge end of the conduit **17**. The motor **14** employed is not critical to the practice of the present invention and may comprise a standard air motor design such as employed on sand rammers, air hammers and the like. Examples of such air motors may be found in *Compression Air and Gas Handbook*, 3rd Ed. 1961.

In the practice of the present invention, the apparatus is attached to the discharge end of a delivery conduit which is employed to deliver a free flowing particulate material into a suitable container. In FIG. **5**, an apparatus having a stationary butt (as illustrated in FIGS. **1–3**) is shown attached to a delivery conduit **17** which is attached to a delivery pump **18**, e.g., a bulk loader, air blower or the like, which is in turn attached to a supply source, e.g., a delivery truck, etc., for the particulate material being loaded, e.g., a dry particulate blasting agent, grain or the like (not shown). In this embodiment an automatic oscillator **19**, e.g., an air driven motor with an offset cam, is attached near the discharge end of the delivery conduit **17** so that the hose is automatically oscillated in a generally vertical direction as the particulate material is loaded into a container **20** (e.g., a borehole). The automatic oscillator **19**, however, is not essential, for the delivery conduit may be oscillated, for example, by an operator holding the delivery conduit. Likewise, an apparatus having a butt which oscillates independently (e.g., FIG. **4**) can be employed.

In operation the particulate material flows from the discharge end of the conduit **17** and past the butt **10** of the apparatus so that it is thrown out in a generally sideways direction. The butt is oscillated up and down and in contact with the material as it is loaded into the container, thus packing it more tightly. Because of the tapered shape of the butt it tends to ride on top of the packed material **21** and does not become embedded therein.

If the apparatus has a butt which independently oscillates, as for example, as illustrated in FIG. **4** the delivery hose **17** need not be oscillated as illustrated in FIG. **5** (although it can be if desired).

EXAMPLE 1

In this example the apparatus (tamping device) of the present invention comprised a conical shaped butt made of an epoxy resin having a base about 3 inches in diameter and a vertical height of about 4 and ¼ inches. The support means consisted of three ⅛-inch diameter steel rods spaced 120° apart and embedded in the top portion of the butt. They extended above the top of the body. The delivery hose employed consisted of a 0.75 inch inside diameter hose connected to a bulk loader for a metallized dry blasting agent. The bulk loader was a Swedish ANOL air powered loader. The apparatus (tamping device) was attached to the discharge end of the hose with the top of the cone placed about 1 inch from the open end of the hose. The blasting agent to be loaded has a pour density of about 0.877 grams/cc and a packed density (by hand) of about 1.03 grams/cc. To simulate a borehole, a cardboard tube approximately 6 inches in diameter and 4 feet long was employed.

As a control the indicated dry blasting agent was blown into a tube from the top at about 50 psi pressure thus simulating the presently accepted field practice of bulk loading a particulate dry blasting agent. The apparatus of the invention was not connected to the delivery hose in the control. The cardboard tube was loaded to a density of about 10.88 pounds/lineal foot or a specific gravity of about 0.894, just slightly higher than the pour density. Next the tamping device, as previously described, was affixed to the delivery hose and the end of the hose and the tamping device were lowered to the bottom of a cardboard tube. The hose

was manually oscillated at about 200 to 250 oscillations per minute with a vertical displacement of about 3 inches. The blasting agent was loaded again at a pressure of about 50 psi as in the control run. During the loading there was no tendency at any time for the conical shaped tamping device to become embedded in the dry blasting agent, but instead it rode up on the top of the column of blasting agent. In this run the tube packed to a density of 12.88 pounds/lineal foot or a specific gravity of 1.06 thus showing an improvement in both density and total contents over merely blowing or pouring the dry blasting agent into the tube or even hand packing it.

In the bulk loading of a dry particulate blasting agent into a borehole in the field a delivery hose with a tamping device as described herein is attached to the discharge end thereof and lowered to the bottom of the blast hole. A rapid vertical oscillation of about 200 cycles per minute with some vertical displacement is begun and the blasting agent is blown into the blast hole from a bulk loading delivery truck. The blasting agent is made up of various sized particles. The tamper moves and shakes these particles causing them to fit among each other in a way to create a mixture containing fewer voids. Furthermore, the tamping action of the device compacts the placed blasting agent to a higher density than is achieved without the use of such an apparatus.

What is claimed is:

1. An apparatus which comprises, in combination:
   a. a butt at least a portion of which tapers in cross-sectional area from the base to the top thereof,
   b. a delivery conduit having a discharge opening at one end,
   c. a support means one end attached to the butt and the other end attached to the discharge end of said conduit, said top of the butt supported a distance from and facing the open end of the delivery conduit, and the longitudinal axis of the butt substantially aligned with the longitudinal axis of the discharge end of the delivery conduit,
   d. in cooperation with said butt a means for oscillating said butt in a direction along said longitudinal axis, and
   e. a means in cooperation with said delivery conduit for supplying particulate material to said delivery conduit under pressure.

2. The apparatus as defined in claim 1 wherein the support means comprises at least one spacing member attached to the butt and extending above the top thereof.

3. The apparatus as defined in claim 2 wherein the support means includes in addition attached to the end of the spacing member opposite to the end attached to the butt a means for fastening the spacing member to said discharge end of a delivery conduit.

4. The apparatus as defined in claim 1 wherein the support means comprises at least one spacing member attached to the butt and extending above the top thereof, and a means attached to the other end of the spacing member for fastening the spacing member to the discharge end of said delivery conduit.

5. The apparatus as defined in claim 1 wherein the butt is slidably engaged to the support means, and said oscillating means consists of a motor attached to the butt in a manner to oscillate the butt along the support means.

6. The apparatus as defined in claim 5 wherein the support means comprises at least one spacing member extending above the top of said butt and slidably engaged thereto at one end, and a means for fastening the spacing member to the discharge end of said delivery conduit attached to the other end of the spacing member, the butt is hollow and the motor is an air motor associated with the hollow interior of the butt in a manner to oscillate the butt on the spacing member when the motor is activated.

7. An apparatus which comprises, in combination:
   a. a hollow butt which tapers in cross-sectional area from the base to the top thereof,
   b. a delivery conduit having a discharge opening at one end,
   c. at least one support member slidably engaged through the wall of the butt with one end extending into the hollow interior thereof, the other end of the spacing member extending above the top of the butt and attached to said discharge end of said delivery conduit, said top of the butt supported a distance from and facing the open end of said conduit, and the longitudinal axis of the butt substantially aligned with the longitudinal axis of the discharge end of said conduit,
   d. a motor attached to the interior of the butt and to the end of the support member extending into the butt in a manner to oscillate the butt on the support member when the motor is activated,
   e. a means for activating the motor slidably engaged through the wall of the butt and connected to the motor, and
   f. a means, in cooperation with said delivery conduit, for supplying particulate material to said delivery conduit under pressure.

8. The apparatus as defined in claim 7 wherein the motor is an air motor and the means for activating the motor is a conduit for transporting a gas under pressure to operate the motor.

9. A method for delivering and compacting particles into a container which comprises:
   a. introducing the particles into a container through a delivery conduit by gas flow under pressure;
   b. deflecting the particles as they are discharged from the open-end of the delivery conduit by a butt fastened to the discharge end of the conduit and in the stream of the discharged particles by a support means, the butt being tapered in cross-sectional area from the base to the top thereof;
   c. oscillating the butt in a generally vertical direction; and
   d. contacting the base of the oscillating butt with particles in the container during their discharge therein to continuously compact them into the container while it is being filled.

10. The method as defined in claim 9 wherein the particles are constituents of an explosive composition, and the container is a borehole which is at least partially filled with the explosive.

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