

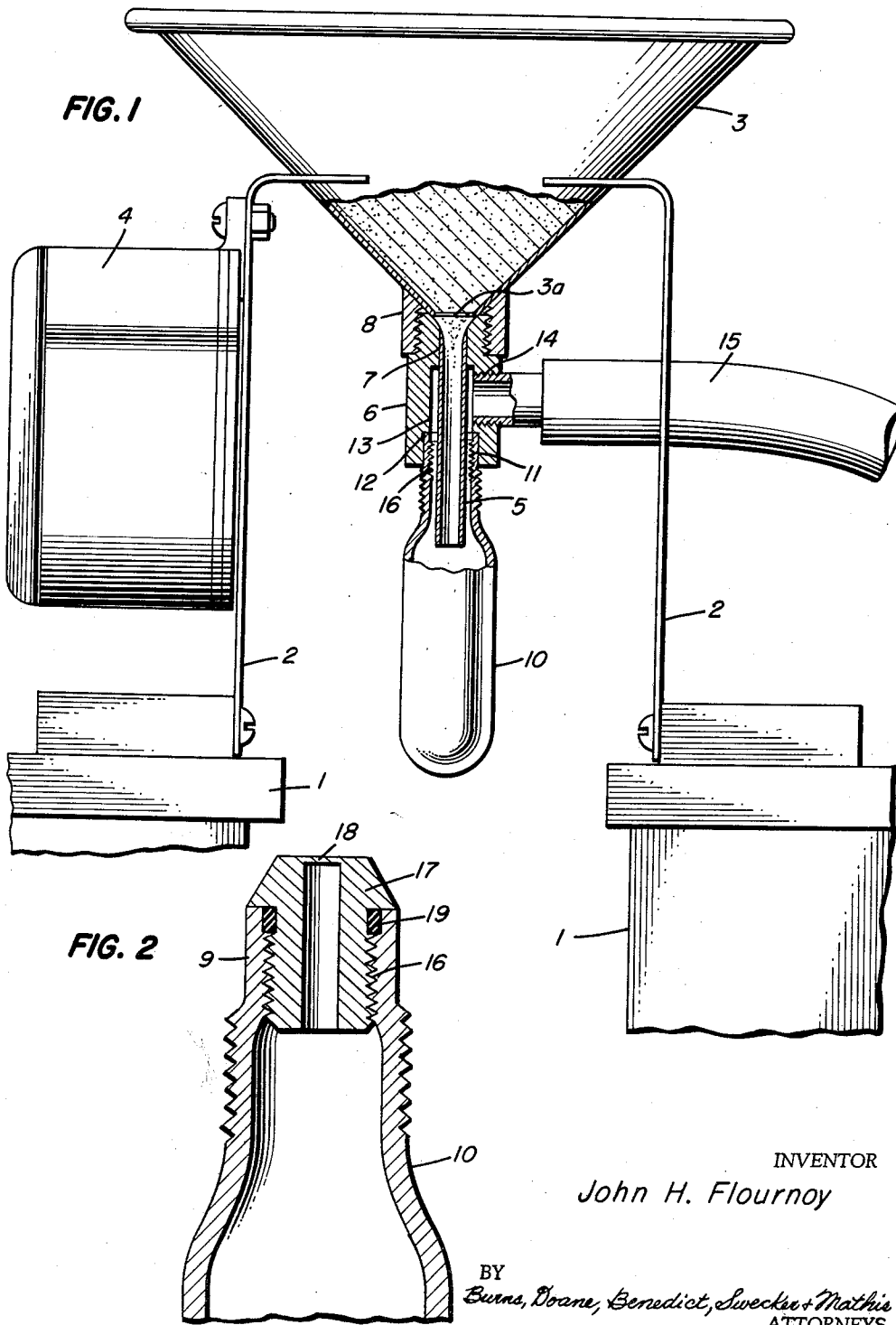
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J. H. FLOURNOY

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METHOD OF CHARGING CARBON DIOXIDE CYLINDERS

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METHOD OF CHARGING CARBON DIOXIDE CYLINDERS

John H. Flournoy, Huntington, W. Va., assignor to South Laboratories, Inc., Huntington, W. Va., a corporation of West Virginia

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5 Claims. (Cl. 62-47)

The present invention relates to a method of charging small carbon dioxide cylinders having narrow necks by employing finely ground solid carbon dioxide. More broadly, the invention entails a unique method of conveying solid carbon dioxide.

It has heretofore been the practice to charge narrow necked carbon dioxide receptacles or cylinders by introducing liquefied carbon dioxide into such cylinders and then hermetically sealing the cylinders while maintaining the liquefied carbon dioxide under pressure. An obvious disadvantage of practicing this prior art method resides in the need for complex and expensive pressure maintaining equipment to handle the liquefied carbon dioxide. While the pressure equipment requirement can be somewhat reduced by refrigerating the liquefied carbon dioxide, the refrigeration operation itself imposes substantial equipment demands. During the charging and sealing of charged cylinders, complex pumping and charging apparatus is required. In addition, it has been found to be difficult to control the exact amount of liquid placed within cylinders being charged.

Recognizing the distinct need for a less cumbersome technique for charging carbon dioxide cylinders, it is an object of this invention to present a charging method which may be effected without the complex liquid carbon dioxide handling apparatus previously employed.

It is a particular object of the invention to provide a cylinder charging method wherein carbon dioxide is employed in a conveniently manipulatable solid form during the charging operation.

A further object of the invention is to provide a carbon dioxide cylinder charging technique wherein the transfer of a carbon dioxide charge to a cylinder interior may be accomplished without refrigeration or high pressure equipment and wherein the charged cylinder may be sealed under atmospheric pressure.

An additional and highly significant object of the present invention is to provide a new and improved method of conveying carbon dioxide in solid form which is of particular value in effecting the entry of solid carbon dioxide into narrow necked receptacles.

A final object of the present invention is to provide a method of charging CO₂ cylinders whereby light and inexpensive equipment may be employed.

To accomplish the foregoing objects there is contemplated a carbon dioxide cylinder charging technique wherein finely ground particles of solid carbon dioxide are passed through a relatively restricted passage to a cylinder to be charged. During movement of the particles through the passage, the particles are agitated while a vacuum is concurrently applied to the discharge end of the passage to both assist in the movement of the particles and to effect withdrawal of sublimed gas formed in the charging member or in the cylinder being charged. The charged cylinder is then sealed in the presence of atmospheric pressure.

While in a preferred form of the invention, each charge of solid carbon dioxide particles is measured and individually placed within the charging member to effect charging of a cylinder, it is anticipated that a continuous supply of particles may be conveyed to the charging member.

In describing the invention reference will be made to an exemplary apparatus illustrated in the accompanying drawings wherein:

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FIG. 1 is a partially sectioned side elevational view of the apparatus; and

FIG. 2 is a sectioned view of a portion of a cylinder which is to be charged by the method of the present invention.

The apparatus employed in carrying out the present invention comprises a stationary base member 1 and a pair of vertically disposed resilient brackets 2 which are adapted to support a charge receiving receptacle, i.e., hopper 3. Hopper 3 is positioned above the base member and terminates in a relatively restricted outlet or passage 3a. A conventional electro-mechanical vibrating device 4, the purpose of which is hereinafter described, is affixed to one of the resilient brackets to impart horizontal vibratory motion to the bracket and the bracket supported hopper 3.

A vertically disposed hollow charging member 5 is employed to form an elongated continuation of passage 3a. Charging member 5 is adapted to be secured within an axial bore of a coupling member 6 by any suitable means such as welding or a press fit at a connecting point 7. Obviously this member could alternatively be made integral with the hopper 3 or the coupling 6. To position the charging member 5 in axial alignment with a downwardly opening hole 3a in the bottom of the material receiving hopper 3, the upwardly extending portion of the coupling 6 is adapted to be received in threaded engagement with a downwardly extending sleeve member 8 affixed to the bottom of the hopper.

The cylindrical, narrow necked portion 9 of a cylinder to be charged is adapted to be slideably and sealingly received in engagement with the inner tubular wall 11 of a downwardly opening recess 12 in the bore of the coupling 6.

Intermediate of the length of the coupling bore there is provided an annular enlargement or chamber 13 communicating with a laterally extending opening 14. Opening 14, as illustrated, is threadedly adapted to receive a tube 15 connected to a conventional source of vacuum, not shown.

As shown in FIGURE 2 the narrow necked portion 9 of the cylinder is internally threaded at 16 to receive a closure member in the form of a threaded cap 17. Cap 17, at its upper surface, has a frangible seal portion 18. Sealing means in the form of a resilient O-ring 19 may be provided to effect a hermetic seal between the cap 17 and the cylinder necked portion 9.

From FIGURE 1 it will be noted that the diameter of the hollow charging member 5 is sufficiently small to permit the member to be received within the narrow necked portion 9 of the cylinder 10 so as to leave an annular space therebetween communicating the interior of the cylinder with the chamber 13. With the charging member thus positioned, it is insured that the ground carbon dioxide will enter the cylinder 10 and not be drawn into the vacuum hose 15.

In practicing the present invention, the narrow necked portion of the cylinder to be charged is manually held or mechanically secured as by a friction fit within the recess 12 of the coupling 6. A measured charge of finely ground particles of solid carbon dioxide is placed within the charge receiving hopper 3. Either concurrently with the charging or immediately thereafter, the vibrating device 4 is energized and vacuum is applied to the discharge end of the hollow charging member 5 and the interior of the cylinder 10 through the passage defined by the tubing 15, the annular chamber 13, and the annular space between the charging member 5 and threaded necked portion 16 of the cylinder. The combined actions of vibrating the charging member by means of vibrator 4 and subjecting the discharge end of the charging member to vacuum greatly facilitates the passage of carbon dioxide particles through the hopper passage and charging member and

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prevents bridging or blocking of these areas. Additionally, the imposed vacuum acts to withdraw from the cylinder and charging member any sublimed carbon dioxide gas contained therein which would tend to impede the particle flow. Upon completion of the charging step the cylinder is removed from the charging apparatus and sealed in the presence of atmospheric pressure.

In describing the operation of a preferred apparatus which may be utilized in charging narrow necked carbon dioxide cylinders, the several advantages inherent in the method of this invention have been demonstrated. The use of powdered carbon dioxide as opposed to liquid carbon dioxide permits the charging operation to be conducted at room temperature and with charging receptacles exposed to atmospheric pressure. Likewise, charged cylinders may be sealed under atmospheric pressure at the completion of the charging operation without any appreciable loss of carbon dioxide content.

The vacuum and vibration filling technique enables the conveying of solid carbon dioxide in a powdered or finely ground form through passages or conduits of a highly constricted character. It has been found, for example, that the vibration and vacuum filling method may be successfully employed in filling small cylinders of the type used with inflatable life vests or belts which have neck openings on the order of $\frac{3}{8}$ inch in diameter.

Of particular significance, it is to be noted that the method in question may be accomplished without the cumbersome and expensive equipment previously associated with carbon dioxide charging operations. The equipment required is structurally simple, easy to operate, and easy to maintain.

While the invention has been described in relation to the operation of a particular apparatus, it is apparent that its scope is not limited to the use of this particular equipment. The charging member of the apparatus, although disclosed as a separate elongate tube, might well be an integral portion of the charge receiving receptacle. While the illustrated member is elongate in character to prevent the passage of solid carbon dioxide into the vacuum creating line, it is apparent that the charge hopper may be arranged such that its discharge passage or outlet communicates directly with the vacuumized interior of cylinders to be charged.

Where desired, the transfer of finely ground carbon dioxide to a charging unit may be mechanized such that a continuous flow of charging material is provided. With such an arrangement, a measured charge transfer may be accomplished by timing the period of engagement of cylinders with the unit.

It is likewise evident that a variety of structures and techniques may be employed in securing cylinders in communication with charging units. In this connection, a variety of sealing arrangements may be employed between cylinders and the units.

In lieu of the electro-mechanical device described for agitation of the powdered carbon dioxide, other transducers or mechanical agitators may be employed. For

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example, vibrators may be utilized to impart a multi-direction vibration to the charge receiving receptacles and attached cylinder or direct mechanical agitators may be located within the mass of charged material.

Other modifications of the invention will readily occur to those skilled in the art, the scope of which is defined in the appended claims.

I claim:

1. A method of charging a receptacle comprising the passing of a charge of finely ground particles of solid carbon dioxide into said receptacle through a restricted passage while concurrently agitating said particles and exposing said passage to vacuum to assist in the movement of said particles and to concurrently withdraw sublimed carbon dioxide gas.

2. A method of charging a narrow necked CO₂ cylinder comprising the steps of passing a charge of finely ground particles of solid carbon dioxide into said cylinder through a hollow charging member while concurrently agitating said particles and exposing the discharge end of said charging member to vacuum to assist in the movement of said particles and to concurrently withdraw sublimed carbon dioxide gas, and subsequently sealing said cylinder.

3. A method of charging a narrow necked CO₂ cylinder comprising the steps of placing a measured charge of finely ground particles of solid carbon dioxide within a charge receiving receptacle, transferring said charge into said cylinder from said receptacle member while concurrently agitating said particles and exposing the interior of said cylinder to vacuum to assist in the movement of said particles and to concurrently withdraw sublimed carbon dioxide gas, and subsequently sealing said cylinder.

4. A method of charging a narrow necked CO₂ cylinder comprising the steps of placing a measured charge of finely ground particles of solid carbon dioxide within a charge receiving receptacle, transferring said charge into said cylinder from said receptacle while concurrently vibrating said receptacle and said cylinder and exposing the interior of said cylinder to vacuum to assist in the movement of said particles and to concurrently withdraw sublimed carbon dioxide gas, and subsequently sealing said cylinder in the presence of atmospheric pressure.

5. A method of conveying solid carbon dioxide through a conduit comprising the steps of introducing small particles of solid carbon dioxide into said conduit, and vibrating said conduit and exposing said particles to vacuum to assist in the movement of said particles through said conduit and to concurrently withdraw sublimed carbon dioxide gas from said conduit.

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