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C. H. BATZLE

2,307,013

METHOD AND APPARATUS FOR PRODUCING DRY ICE

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Fig. 1

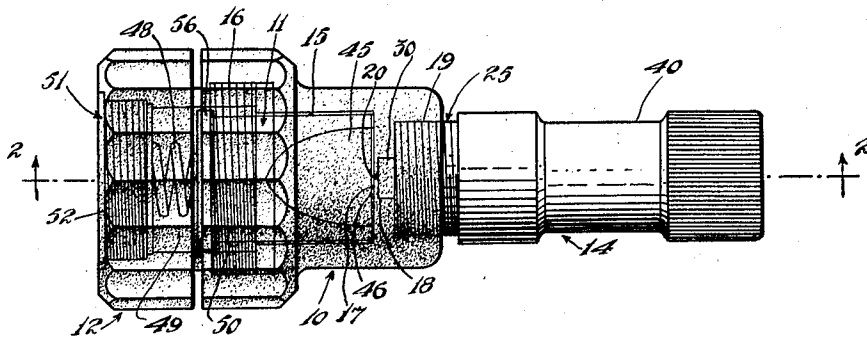


Fig. 2

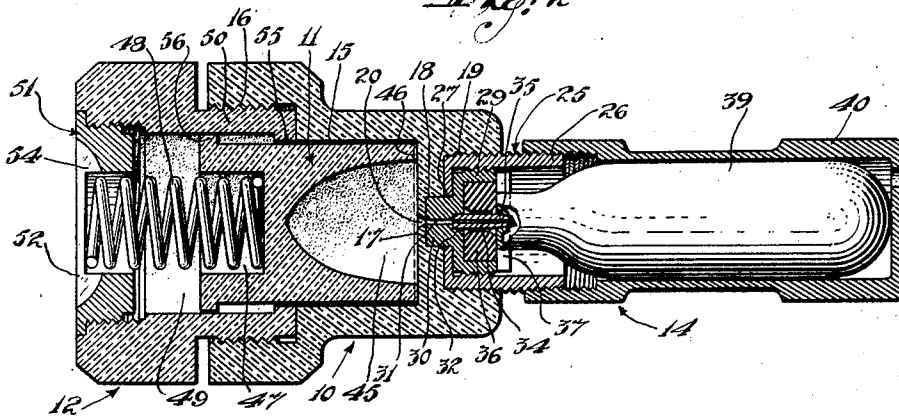


Fig. 3

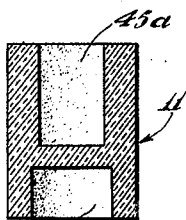


Fig. 4

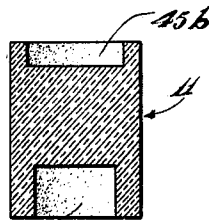
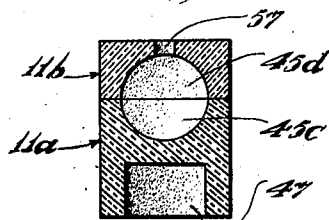


Fig. 5



INVENTOR
Charles Harvey Batzle
BY Ernest A. Jervan
ATTORNEY

UNITED STATES PATENT OFFICE

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METHOD AND APPARATUS FOR PRODUCING DRY ICE

Charles Harvey Batzle, East Orange, N. J., assign-
or to Specialties Manufacturing Company, Inc.,
Bloomfield, N. J., a corporation of Delaware

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19 Claims. (Cl. 62-121)

The present invention relates to the production of dry ice, and more particularly to an improved apparatus and a method for producing relatively small bodies of carbon dioxide ice.

Carbon dioxide ice, usually called dry ice, has been found useful in surgery for removing moles, warts, skin blemishes, birth marks and the like. It has also been found useful for various scientific or laboratory purposes as a refrigerant or cooling medium. In most cases, when dry ice is used for the foregoing purposes, it is desirable to use only a small amount at a time and at infrequent and indeterminate intervals.

It has not been found feasible to use commercial dry ice, because it must be purchased in quantities which are larger than necessary, and because commercial dry ice may not be readily available at the place and time it may be required. Also, commercial dry ice is usually sold in solid slabs, blocks or bricks which are relatively hard and cannot be readily broken up or shaped into the forms desired for surgical or other special purposes.

Heretofore apparatus has been designed for producing dry ice for the foregoing purposes. Usually this apparatus comprised a large cylinder of carbon dioxide, an expansion valve for producing carbon dioxide snow and means for receiving the snow. The snow has to be molded into the shape desired. The objections to such apparatus was that it required a substantial initial investment, was bulky, and had to be permanently installed in a laboratory, clinic or doctors' office. Also, the apparatus did not provide uniform amounts of snow or bodies of dry ice of a predetermined shape. The amount of snow produced depended upon the judgment of the operator, who invariably would make more snow than required and thus would waste substantial quantities of carbon dioxide.

An object of the present invention is to provide a simple inexpensive device for producing relatively small bodies of dry ice.

Another object is to provide a device which is compact and of minimum size and weight, whereby it can be readily carried from place to place.

Another object is to provide a device for economically producing bodies of dry ice of a predetermined size and shape.

Another object is to provide a device which produces dry ice adapted to be used for surgical, scientific or other purposes.

Another object is to provide a device adapted

to be used in schools or similar institutions for demonstrating the production of dry ice.

Another object is to provide a device which can be safely operated by an inexperienced operator and can withstand any rough usage to which it may be subjected.

Another object is to provide an improved method of producing relatively small bodies of dry ice.

A further object consists in the construction and arrangement of the parts of the device, whereby the foregoing objects may be accomplished.

Other and further objects, not specifically enumerated above, will be apparent when described in greater detail in connection with the accompanying drawing, wherein:

Figure 1 is an elevational view of a device for producing bodies of dry ice, illustrating an embodiment of the invention.

Figure 2 is a slightly enlarged sectional view taken along the line 2-2 on Figure 1.

Figures 3, 4 and 5 are sectional views of modified receptacles for forming bodies of dry ice of various shapes.

Referring to the drawing, and more particularly to Figures 1 and 2 thereof, there is shown a device for producing small bodies of carbon dioxide ice. Generally, the device comprises a casing member 10, a receptacle 11 in the casing member wherein the bodies of dry ice or snow are formed, a closure member 12 for retaining the receptacle 11 in the casing member 10, and means 14 on the casing member for supplying carbon dioxide to the receptacle. These parts are of such size and shape that the device may be readily carried in a coat pocket or a doctor's instrument kit and may be stored in any suitable place without requiring much room.

The casing member 10 is substantially tubular and preferably has a cylindrical bore providing a chamber 15. One end of the casing member is open for placing the receptacle 11 in the chamber, and the interior of the casing member adjacent the open end is provided with screw threads 16, or other suitable attaching means adapted to cooperate with corresponding attaching means of the closure member, whereby the closure and casing members may be secured together. The other end of the casing member 10 is provided with an end wall 17 which has a cylindrical recess 19 on the exterior for mounting the carbon dioxide supplying means 14, about to be described. The recess 19 has a well portion 18 provided with an inlet aperture 20 for conducting the carbon dioxide into the chamber 15.

The aperture 20 has a relatively small diameter and diverges towards the chamber 15 at an angle of about 20°, to facilitate expanding liquid carbon dioxide.

The carbon dioxide supplying means 14, illustrated herein, may be similar to the conventional arrangement used for charging soda syphons at home. These means may comprise a cup-shaped insert 25 mounted and secured in the recess 19 of the casing member and having a tubular threaded cylindrical portion 26 projecting outwardly from the casing member. The end of the insert 25 seated in the recess 19 has a centrally located aperture 27, preferably in registry with the well portion 18 and the inlet aperture 20 in the end wall 17 of the casing member 10. The insert is adapted to receive a piercing pin assembly body 29 which has a stem portion 30 projecting through the aperture 27 and into the well portion 18. The stem portion 30 is provided with a relatively small aperture 31, preferably of capillary dimensions, which extends to the aperture 20 of the casing member, and the opposite end of the stem portion is provided with a recess 32 for mounting a piercing pin 34 having a longitudinally extending bore or groove 35 in registry with the aperture 31 of the stem portion 30. A sealing ferrule 36 for the neck of a cartridge 39 extends about the piercing pin 34 and is retained in the body 29 by an inwardly extending flange 37 at the upper end of the body 29 or in any other suitable manner.

Carbon dioxide is adapted to be supplied to the chamber by positioning the neck of a conventional cartridge or bulb 39, containing liquid carbon dioxide under pressure, in the insert 25 and causing the sealing disc of the cartridge to be pierced by the pin 34. To accomplish this, a cartridge holder 40 is telescoped over the cartridge and is threaded on the threaded tubular portion 26 of the insert to force the sealing disc of the cartridge against the piercing pin 34.

The carbon dioxide released from the cartridge is adapted to be conducted to the receptacle 11, which has a space 45 at one end for receiving the carbon dioxide and has a rim or end surface 46 adapted to abut the end wall 17 in the chamber to substantially confine the space 45. Preferably, the other end of the receptacle has a well portion or recess 47 therein for receiving one end of a cylindrical helical spring 48 or other suitable resilient means for urging the rim 46 against the end wall 17. The receptacle 11, preferably, fits snugly in the chamber 15 with sufficient clearance at the side walls to permit the passage of carbon dioxide gas, as will be described hereafter.

The closure member 12 serves to retain the receptacle 11 in the casing member 10 and for this purpose is provided with a bore 49 for receiving the bottom portion of the receptacle. In effect, the bore 49 is a continuation of the chamber 15 and cooperates with the chamber 15 to provide a chamber for the receptacle 11. One end of the closure member is provided with a threaded tubular portion 50 of reduced diameter adapted to be threaded into the threaded portion 16 of the casing member. The other end of the closure member has a cap 51 threaded into the bore 49 which is provided with a cover part 52 for engaging the other end of the spring 48 and compressing it against the receptacle. The cover part 52 has an aperture or slit 54 or other suitable venting means for bleeding off or relieving pressure in the bore 49.

If desired, the closure member and the receptacle may be slidably assembled as a unit so that the receptacle 11 and spring 48 cannot fall out of the closure member and be lost. To accomplish this, the free end of the tubular portion 50 of the closure member is provided with an inwardly extending flange 55 adapted to be engaged by an outwardly extending flange 56 on the lower or bottom end of the receptacle.

It may also be desirable to form bodies of carbon dioxide snow or ice which vary in size or shape. In such cases the flanges 55 and 56 are omitted so that the receptacle can be removed and replaced by other receptacles having a space 45 designed to form bodies of carbon dioxide ice of any other shape desired.

For example, as illustrated in Figure 2, the space for forming the body of carbon dioxide ice or snow may be in the shape of a blunt or substantially parabolic cone, whereby the body formed will have a similar shape. The shape of the space 45 may be modified to form pyramids of any number of sides; truncated pyramids or cones; sticks, rods, blocks, discs or wafers having a circular or polygonal cross-section; or spherical, semi-spherical or ovoid bodies of any suitable or desired size. In Figures 3, 4 and 5 several modified receptacles are shown which illustrate a few of the many spaces which may be used for providing bodies of various shapes.

Referring to Figure 3, there is shown a receptacle 11 having a space 45a in the shape of a cylinder. In Figure 4 the space 45b is shaped to form a circular disc or wafer.

In Figure 5 a slightly modified receptacle is illustrated which comprises a lower member 11a having an upwardly facing hemi-spherical recess 45c and an upper member 11b having a downwardly facing hemi-spherical recess 45d. The upper and lower receptacle members 11a and 11b are adapted to be arranged in the chamber 15 (Figure 2) so that the respective recesses 45c and 45d are adapted to provide a space for forming a spherical body. The upper member 11b has an aperture 57 in the top thereof adapted to register with the inlet aperture 20 of the wall 17 to facilitate supplying carbon dioxide to the space. The lower member 11a may be provided with a well 47 for receiving the spring 48.

While the parts of the device may be formed of any suitable materials, the casing member, the closure member and the receptacle, preferably, are formed of a transparent thermo-plastic or thermo-setting molding compound, for example, cellulose acetate or poly-styrene compositions or the like. If desired, the receptacle could be formed of glass. By using a transparent material for these parts the formation of the snow or ice in the receptacle can be observed. This enables the device to be used in educational institutions for demonstrating the formation of carbon dioxide snow or ice.

It may also be desirable to form the receptacle of a slightly porous material such as unsized papier-mâché or other pulp-like material, or unglazed porous ceramic material. By making the receptacle slightly porous, the pressure within the space is permitted to be relieved gradually so that the liquid carbon dioxide turns into ice or snow.

In operation of the device, the receptacle 11 is placed in the chamber with the opening 15 of the space 45 facing the carbon dioxide inlet, and the closure member 12 is threaded to the casing member 10, so that the spring 48 urges the upper

edge 46 of the receptacle against the end wall 17. A bulb or cartridge 39 is placed in the holder 40 and the holder is threaded on the threads 26 of the insert 25. By screwing the holder towards the casing member, the piercing pin 34 pierces the sealing disc of the bulb and carbon dioxide in the bulb flows through the bore or groove 35 of the pin and is conducted to the space in the receptacle by way of the aperture 31 in the stem 36 and the aperture 20 in the wall 17.

The carbon dioxide flowing into the receptacle by being under compression, has a tendency to expand, and the pressure established in the space 45 will tend to move the receptacle and the edge or rim 46 thereof slightly away from the end wall 17 to permit gaseous carbon dioxide to escape by way of the clearance between the outer walls of the receptacle and the inner walls of the casing and closure members and out through the aperture or vent 54, in the cap 51. The relatively great reduction in pressure of the carbon dioxide expanding rapidly into the space of the receptacle causes a reduction in its temperature and the formation of snow particles within the space. After pressure in the space has decreased by leakage and solidification of the carbon dioxide, the spring 48 is again effective to urge the rim 46 of the receptacle against the end wall to confine the space. As more carbon dioxide expands into the space, more snow will be formed, and pressure will again be established therein which effects a venting action. The venting and resealing or confining cycle may thereafter be repeated several times before all of the liquid carbon dioxide is discharged into the space.

The periodic reciprocating movement of the receptacle can be advantageously utilized for compacting or compressing the carbon dioxide snow formed in the space, particularly where the size of the body to be formed is somewhat smaller than the size of a body or the amount of snow which a given quantity of liquid carbon dioxide is adapted to provide. This is accomplished when the space of the receptacle is substantially filled with snow and additional carbon dioxide is introduced. As the space is vented and additional snow is formed the space becomes slightly overfilled, so that upon the return movement of the receptacle towards the end wall 17, due to the tension of the spring 48, the snow is packed into the space. This packing action together with the pressure of the expanding carbon dioxide, either in liquid or gaseous form, serves to form substantially firm bodies of snow or ice corresponding to the shape of the space.

In some instances, the pressure of the carbon dioxide entering the space serves to compact the snow already formed therein, without relying on the compressing action of the receptacle when returned by the spring 48. This is particularly feasible where the receptacle is formed of a porous material adapted to bleed off the pressure gradually. The pressure of additional carbon dioxide is then effective to compress the snow already formed.

From the foregoing description it will be seen that the present invention provides an improved and practical device and method for making carbon dioxide bodies of any suitable or predetermined size and shape. The device is economical to manufacture and can be readily operated even by unskilled or inexperienced persons. The device has many advantageous uses, is rugged in construction, and can readily withstand any rough usage to which it may be subjected.

While my invention resides in certain principles of construction and operation which have been illustrated and described in connection with the accompanying drawing, it will be apparent to those skilled in the art that the invention may be embodied in other forms of construction without departing in any manner from the spirit and scope of the invention, and I therefore do not wish to be strictly limited to the disclosure, but rather to the scope of the appended claims.

I claim:

1. In a device of the class described, the combination of a pair of members adapted to be attached together and having cooperating interior portions providing a chamber, a receptacle in said chamber having an inlet at one end and a surface adjacent the inlet adapted to abut one of said pair of members, means on said member of said pair of members in abutting relation with said surface for supplying liquid carbon dioxide to the inlet of said receptacle, and resilient means on the other of said pair of members for urging the surface of said receptacle into abutting relation.

2. In a device of the class described, the combination of a pair of members adapted to be attached together and having cooperating interior portions providing a chamber, a receptacle in said chamber having an inlet at one end and a surface adjacent the inlet adapted to abut one of said pair of members, means on said member of said pair of members in abutting relation with said surface for supplying liquid carbon dioxide to the inlet of said receptacle, and resilient means on the other of said pair of members for urging the surface of said receptacle into abutting relation and adapted to yield to permit said surface to move out of abutting relation in response to an excessive pressure in the receptacle, one of said pair of members having venting means for relieving the excessive pressure whereby the liquid carbon dioxide is adapted to expand.

3. In a device of the class described, the combination of a pair of members adapted to be attached together and having cooperating interior portions providing a chamber, a receptacle in said chamber having an inlet at one end and a surface adjacent the inlet adapted to abut one of said pair of members, means on said member of said pair of members abutting said surface for supplying liquid carbon dioxide to the inlet of said receptacle, resilient means associated with the other of said pair of members for urging the surface of said receptacle into abutting relation, and means for slidably connecting said receptacle with one of said pair of members.

4. In a device of the class described, the combination of a pair of members adapted to be attached together and having cooperating interior portions providing a chamber, a receptacle in said chamber having an inlet end and a surface adjacent the inlet adapted to abut one of said pair of members, means on said member of said pair of members adjacent the inlet end for supplying liquid carbon dioxide to said receptacle, resilient means associated with the other of said pair of members for urging the surface of said receptacle into abutting relation, means associated with said receptacle and one of said pair of members for slidably connecting the receptacle to said last member, and venting means in one of said pair of members.

5. In a device of the class described the combination of a pair of members adapted to be attached together and having cooperating interior

portions providing a chamber with an end wall at one end, a substantially cup-shaped member in said chamber having a space therein and having a rim portion adapted to abut the end wall of said chamber to substantially confine said space, means on one of said pair of members adjacent the end wall for supplying liquid carbon dioxide to said space, and a spring member associated with the other of said pair of members for urging the rim portion of said cup-shaped member against the end wall.

6. In a device of the class described, the combination of a casing member having a chamber provided with an open end and an end wall at the other end, said end wall having an inlet therein, means for supplying carbon dioxide through said inlet, a receptacle in said chamber having a space therein adjacent the inlet for receiving carbon dioxide, a closure member adapted to be secured to the open end of said casing member and adapted to retain said receptacle in said chamber, and resilient means associated with said closure member for urging said receptacle against the end wall of said casing member.

7. In a device of the class described, the combination of a casing member having a chamber provided with an open end and an end wall at the other end, said end wall having an inlet therein, means for supplying carbon dioxide through said inlet, a receptacle in said chamber having a space therein adjacent the inlet for receiving carbon dioxide, a closure member adapted to be secured to the open end of said casing member and adapted to retain said receptacle in said chamber, resilient means associated with said closure member for urging said receptacle against the end wall of said casing member, means for slidably connecting said closure member and said receptacle, and venting means in said closure member.

8. A method of forming a substantially solid body of carbon dioxide ice from liquid carbon dioxide, which method comprises discharging a predetermined uniform quantity of liquid carbon dioxide from a cartridge, expanding the liquid carbon dioxide to form carbon dioxide snow, receiving and confining the snow in a receptacle, periodically moving the receptacle by the pressure of the carbon dioxide being expanded in opposition to resilient means, relieving the pressure in the receptacle by bleeding off a portion of the carbon dioxide, and moving the receptacle in the opposite direction by the resilient means to compact the snow into a substantially solid body of carbon dioxide ice.

9. A method of forming relatively small bodies of dry ice, which comprises discharging a substantially uniform and predetermined quantity of liquid carbon dioxide from a cartridge, expanding the liquid carbon dioxide to form carbon dioxide snow, and compacting the snow while expanding the liquid carbon dioxide to form a body of carbon dioxide ice of substantially uniform and predetermined size and shape.

10. In a portable device for producing relatively small bodies of carbon dioxide ice or snow, the combination of a pair of members adapted to be attached together and having cooperating interior portions providing a chamber, receptacle means in said chamber having an open end and a carbon dioxide receiving space, a surface in said chamber adapted to be abutted by the open end of said receptacle means to substantially confine said space, means carried on one member of said pair of members for discharging a cartridge

of liquid carbon dioxide and conducting it into said space, and resilient means for urging the open end of said receptacle means and said surface into abutting relation.

11. In a portable device for producing relatively small bodies of carbon dioxide ice or snow, the combination of a pair of members adapted to be attached together and having cooperating interior portions providing a chamber with an end wall portion at one end, receptacle means in said chamber having a space therein and having a rim portion adapted to abut the end wall portion of said chamber to substantially confine said space, means carried on one member of said pair of members for discharging a cartridge of liquid carbon dioxide and conducting it into said space, resilient means for urging the rim portion of said receptacle means and said end wall portion into abutting relation, and venting means in one member of said pair of members.

12. In a device of the class described, the combination of a pair of members adapted to be attached together and having cooperating interior portions providing a chamber with an end wall at one end; a substantially cup-shaped member in said chamber having a space therein, a rim portion at one end adapted to abut the end wall to substantially confine said space, and an outwardly extending flange at the other end; means on one member of said pair of members adjacent the end wall for supplying liquid carbon dioxide to said space; resilient means associated with the other of said pair of members for urging the rim portion of said cup-shaped member against the end wall; and an inwardly extending flange on said last member of said pair of members cooperating with the flange of said cup-shaped member to slidably connect said cup-shaped member with said last member of said pair of members.

13. In a device of the class described, the combination of a casing member having a chamber provided with an open end and an end wall at the other end, said end wall having an inlet therein; means for supplying carbon dioxide through said inlet; a receptacle in said chamber having a space therein adjacent the inlet for receiving carbon dioxide and having an outwardly extending flange; a closure member adapted to be secured to the open end of said casing member and adapted to retain said receptacle in said chamber end having an inwardly extending flange cooperating with the flange of said receptacle to slidably connect said receptacle with said closure member; and resilient means associated with said closure member for urging said receptacle against the end wall of said casing member.

14. In a portable device for producing relatively small bodies of carbon dioxide ice or snow, the combination of a casing member having a chamber provided with an open end and an end wall at the other end, said end wall having an inlet therein; means on said casing member for discharging a cartridge of liquid carbon dioxide and conducting it to said inlet; a cup-shaped receptacle in said chamber having a space therein for receiving the carbon dioxide conducted through said inlet, a rim portion at one end adapted to abut said end wall, and an outwardly extending flange at the other end thereof; a closure member adapted to be secured to the open end of said casing member and adapted to retain said receptacle in said chamber, said closure member having an inwardly extending

flange cooperating with the flange of said receptacle to slidably connect said receptacle with said closure member; venting means in said closure member; and resilient means in said closure member for urging the rim portion of said receptacle against the end wall of said casing member.

15. In a portable device for producing relatively small bodies of carbon dioxide ice or snow, the combination of a receptacle adapted to receive liquid carbon dioxide and having an edge adapted to be sealed; sealing means adapted to overlap said edge to seal said receptacle; means for yieldably urging said receptacle sealing means and said edge into sealing relationship; and means for discharging a cartridge of liquid carbon dioxide and for conducting it into said receptacle; whereby carbon dioxide ice or snow is formed upon the expansion of the liquid carbon dioxide in said receptacle and carbon dioxide gas is discharged from said receptacle under its own pressure against the force of the means yieldably urging said sealing means and said edge into sealing relationship.

16. In a device of the class described, the combination of a pair of members adapted to be attached together and having cooperating interior portions providing a chamber, a receptacle in said chamber having an inlet at one end and a surface adjacent the inlet adapted to abut one of said pair of members, means on said member of said pair of members in abutting relation with said surface for supplying carbon dioxide under pressure to the inlet of said receptacle, and means for urging the surface of said receptacle into abutting relation and for permitting expansion and escape of the carbon dioxide supplied to said receptacle, whereby carbon dioxide snow is produced.

17. In a portable device for producing relatively small bodies of carbon dioxide ice or snow, the combination of a pair of members adapted to be attached together and having co-operating in-

terior portions providing a chamber, receptacle means in said chamber having an open end and a carbon dioxide receiving space, a surface in said chamber adapted to be abutted by the open end of said receptacle means to substantially confine said space, means carried on one member of said pair of members for discharging a cartridge of liquid carbon dioxide and conducting it into said space, and means for urging the open end of said receptacle means and said surface into abutting relation and for permitting expansion and escape of the carbon dioxide conducted into space, whereby carbon dioxide snow is produced.

18. In a device of the class described, the combination of casing means providing a chamber, a receptacle movably positioned in said chamber having a recess and being adapted to abut the inside of said casing means adjacent said recess to provide a confined space in said receptacle, means on said casing means adjacent said recess for introducing a fluid medium under pressure into the confined space, and resilient means operatively associated with said receptacle for urging the same into abutting relation with the inside of said casing means.

19. In a device of the class described, the combination of casing means providing a chamber, a receptacle movably positioned in said chamber having a recess and being adapted to abut the inside of said casing means adjacent said recess to provide a confined space in said receptacle, means on said casing means adjacent said recess for introducing a fluid medium under pressure into the confined space, and means operatively associated with said receptacle for urging the same into abutting relation with the inside of said casing means and for permitting expansion and escape of the carbon dioxide supplied to said receptacle, whereby carbon dioxide snow is produced.

CHARLES HARVEY BATZLE.

CERTIFICATE OF CORRECTION.

Patent No. 2,307,013.

January 5, 1943.

CHARLES HARVEY BATZLE.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, first column, line 29, for "has" read --had--; page 2, second column, line 72, for "chamber with the opening 15" read --chamber 15 with the opening--; page 4, first column, line 65, claim 10, for "devide" read --d  vice--; page 5, second column, line 13, claim 17, after the word "into" insert --said--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 2nd day of March, A. D. 1943.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.