

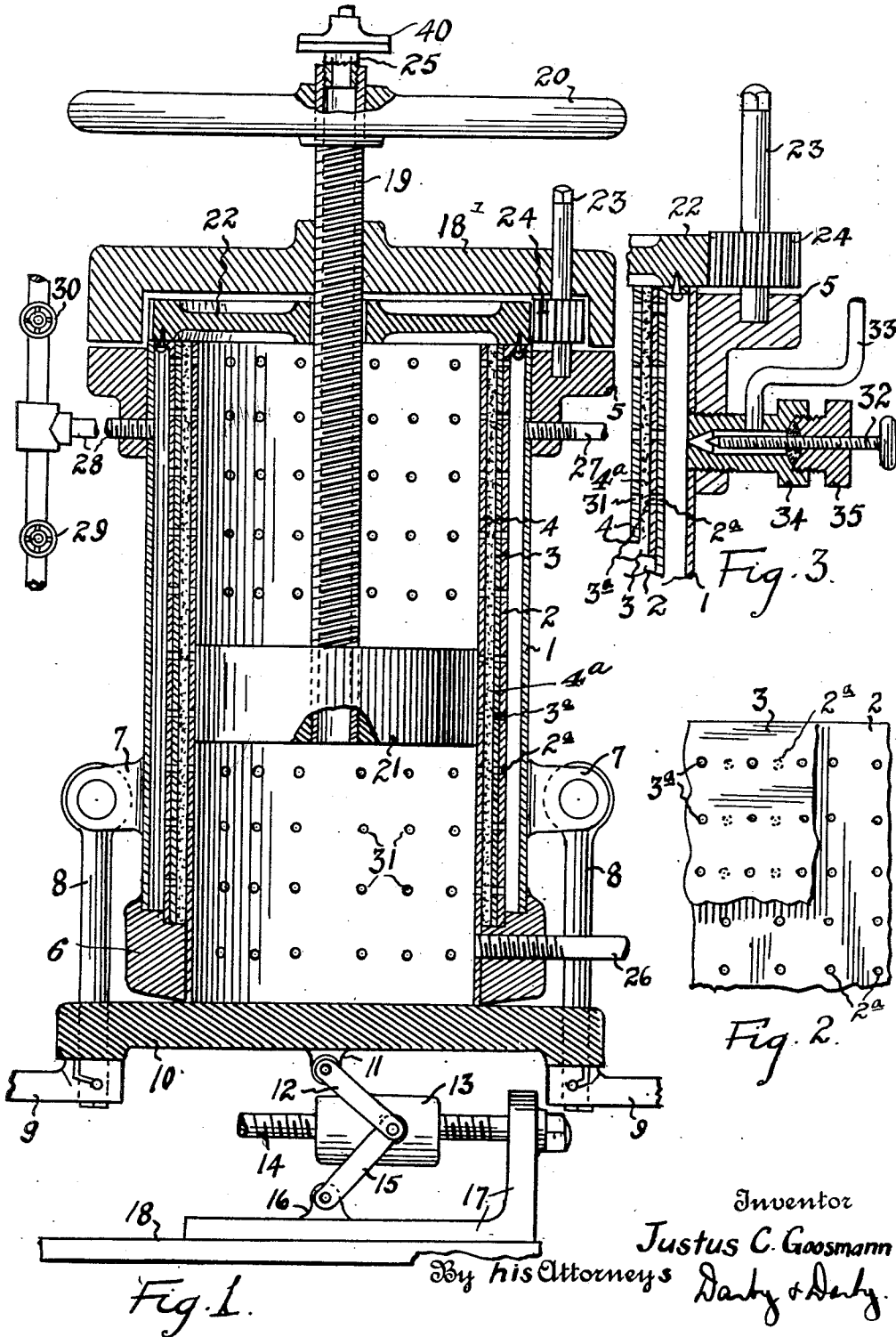
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MACHINE AND METHOD FOR MAKING SOLID CARBON DIOXIDE

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UNITED STATES PATENT OFFICE

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MACHINE AND METHOD FOR MAKING SOLID CARBON DIOXIDE

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One of the objects of this invention is the provision of a machine of this type in which the liquid carbon dioxide may be admitted under counter pressure to a confined space and the pressure suddenly dropped on a major portion of the area of the liquid body to permit evaporation from its surface to secure rapid and even freezing of the liquid body.

10 A further object of this invention is the provision of a chamber for confining a body of liquid carbon dioxide under pressure constructed so that the pressure may be quickly dropped on the liquid body.

15 A further object of the invention is the provision in a device of this type of means for returning that part of the liquid which is formed into gas by evaporation to a suitable source.

20 A still further object of this invention is the provision of a machine of this type in which exceedingly cold carbon dioxide gas or snow may be supplied to the exterior of the chamber in which the liquid is to be frozen to render the contents much colder than they normally would be.

A further object of this invention involves the idea of freezing a body of liquid carbon dioxide by suddenly reducing the pressure thereon while it is surrounded by a wall of carbon dioxide snow.

30 A further object of the invention is to deliver liquid carbon dioxide into a confined space against a counter pressure so as to maintain it in liquid form during the filling of the chamber.

A further object of the invention involves the idea of forming carbon dioxide snow within a confined space and compressing it into a block.

Another object of this invention is the provision of novel methods of solidifying liquid carbon dioxide.

45 These and many other objects as will ap-

pear from the following disclosure are secured by means of this invention.

This invention resides substantially in the combination, construction, arrangement, relative location of parts, steps and series of steps all as will be pointed out more fully hereinafter.

This application is a continuation in part of my copending application, Serial No. 333,507, filed January 18, 1929.

Referring to the figures:

Figure 1 is a vertical cross sectional view through the device of this invention;

Fig. 2 is an enlarged detail view showing the relative arrangement of openings in the two concentric cylinders;

Fig. 3 is an enlarged detail cross sectional view showing a modified arrangement.

A detail description of the invention in connection with the drawing will render its construction and method of operation clear.

As shown the device comprises an outer casing 1 which may be of any cross sectional configuration but has been disclosed as a cylinder. This casing sets within the large reinforcing ring 6 and telescopes with another large ring 5 at the other end. Seated within the ring 6 are the two concentric perforated cylinders 2 and 3 having the perforations 2a and 3a respectively. Arranged concentrically within the cylinder 3 is another perforated cylinder 4 spaced apart therefrom and having the perforations 31. In the space between cylinders 3 and 4 is a layer of suitable porous packing material indicated at 4a. This layer of material may for instance be made up of several thicknesses of porous cloth. The purpose of the packing is to retain the snow crystals on their respective side and allow only the dry gas to pass through.

Secured to the exterior of casing 1 near the lower end are the lugs 7 providing pivotal supports for the rods 8. The rods 8 are engaged at their free ends by handles 9

which are secured thereto by bayonet pins and bayonet slots, as is well known. The rods 8 lie within peripheral slots on the cover plate 10, which is adapted to fit over the open end at the inner cylinder 4 to close it. Pivotaly secured to the lug 11 integral with the plate 10 is a lever 12 which is pivotaly secured to the nut 13 at its other end. This nut 13 engages the threads on the shaft 14 rotatably supported in the brackets 17. Another lever 15 is pivotaly secured to the nut 13 at one end and to the lug 16 at the other which lug is secured to the bracket 17. The bracket 17 is adapted to slide on the supporting guides 18.

The upper ends of the casings are closed by means of the removable cover 18' through which passes in engagement therewith the threaded hollow piston rod 19 adapted to be rotated by the hand wheel 20. A piston 21 of approximately the same diameter as the internal diameter of cylinder 4 is secured to the lower end of piston rod 19. Lying within the cover 18' is a large gear wheel 22 meshing with the pinion 24 secured to the short rotatable shaft 23 journaled in the cover 18' and the ring 5. As is apparent in the drawing the cylinder 2 is secured at its upper end by means of an annular flange to the lower surface of the gear wheel 22. Pipes 25 and 26 connected to the hollow piston rod 19 and to the ring 6 respectively open into the interior of cylinder 4. A valve 40 is provided in the pipe 25 which is of the type known as a pressure controlling valve. Valves of this construction are well known in the art and are adapted to maintain a predetermined maximum pressure behind them and to permit the escape of some gas when this predetermined value is exceeded.

A pipe 27 secured to the ring 5 opens into casing 1. A pipe 28 likewise secured to ring 6 opens into casing 1 and is provided with branches having the valves 29 and 30. In the arrangement shown in Fig. 3 in place of pipe 27 a needle valve has been substituted having the body 34 and the gland nut 35. The needle valve stem 32 is rotatably mounted in the gland nut 25. A pipe 33 connects with and opens into the space within the valve body 34.

The operation of the device will now be described in connection with several processes which may be used therewith. The bracket 17 is slid along the supports 18 until cover 10 is in proper alignment with the cylinders. Shaft 14 is then rotated to draw nut 13 to the left causing the toggle levers to tend to straighten out thereby forcing the cover into contact with the cylinder. The rods 8 are swung into place and the handles 10 rotated to firmly hold the plate 10 in place and form an air tight connection with the cylinder. The piston 21 is then adjusted to the proper height to give

the desired size of block. Gas pressure is then admitted from any suitable source to pipe 28 by opening valve 29 which gas flows into the casing 1 through pipe 28. During this operation the outer shell 2 is rotated so that the openings 2a therein are in alignment with the openings 3a in cylinder 3. When the proper gas pressure has been built up within the device, valve 29 is closed and shaft 23 is rotated causing gears 24 and 22 to revolve and as a result causes shell 2 to revolve on shell 3. Sufficient movement of shell 2 is effected to cause the openings 2a thereof to move out of alignment with the openings 3a of shell 3.

Liquid carbon dioxide is then delivered through pipe 26 to the inner cylinder 4 to fill the space below the piston 21. The entrance of the liquid into this space tends to compress the gas therein which gas is gradually forced out against the checking action of the pressure control valve 40. This operation is continued until the space is completely filled with liquid. This step of providing a counter pressure of gas controlled by a pressure control valve represents a very important feature of this invention. It is only by such a procedure that it is possible to deliver the carbon dioxide in liquid form to the inner space because if the liquid were permitted to flow into the cylinder at atmospheric pressure most of it would return to a gaseous state. When the space is filled the supply of liquid is cut off. Outer shell 2 is then rotated to bring its openings in alignment with the openings in shell 3 to effect a complete collapse in pressure on the liquid and to expose a substantial surface thereof to evaporation. This effect of completely collapsing the pressure on the liquid is to permit evaporation from the surface thereof with a resultant cooling of the main body of the liquid and solidification thereof. The gas formed during the evaporation is drawn off through pipe 27 to a suitable storage source such as a gasometer. Cover 10 is then removed and the solidified block forced out by means of the piston 21. For best results the openings or apertures 31, 3a and 2a are relatively small in size. From the above description it will be seen that concentric cylinders 2 and 3 form in effect a valve. At this point it may be well to indicate that the device need not necessarily be of cylindrical form since the shell 2, if desired, can be moved longitudinally with respect to shell 3 when they are of noncylindrical form to secure the same valving action.

A further feature is pointed out here. If desired the space between shells 1 and 2 may be filled with carbon dioxide snow by providing a nozzle structure of the arrangement as shown in Fig. 3. In this case the liquid is supplied first through pipe 33 and

sprayed from nozzle valve 34 to fill the space with carbon dioxide snow. The openings 2a and 3a being in alignment, the gas formed can be drawn off through pipe 28 and valve 30. When this space is filled with snow, the openings 2a and 3a may be moved out of alignment and the liquid then supplied as before to the space below the piston against a counter pressure. Then when the pressure on the liquid is permitted to collapse, the liquid body is cooled not only by evaporation but by the chilling action of the cold snow in the space between cylinders 1 and 2. It may be well to point out here that the outer casing 2 may be covered with any suitable heat insulating material to increase the efficiency of the device in operation.

The apparatus is also adapted to be used in making carbon dioxide snow in which case cylinder 2 is moved so that the openings therein are in alignment with the openings in cylinder 3. Carbon dioxide liquid is then sprayed into the space below piston 21, through pipe 26 for example and the gas drawn off through pipe 27. When the space is full of snow, the liquid is cut off and the snow compressed into a block of the desired density by moving piston 21 downwardly. Here again the space between shells 1 and 2 if desired can be filled with snow to help in the formation of snow below piston 21.

When desired as for instance in loosening a block of solid carbon dioxide should it be frozen fast to the cylinder 4 warm carbon dioxide gas may be delivered through pipe 28 by opening valve 29, the gas being returned to the holder through pipe 27.

From the foregoing disclosure it will be apparent that I have embodied certain principles of construction and operation in a device for making solid carbon dioxide. The physical form of the device given in the disclosure is for illustrative purposes only and I do not desire to be strictly limited thereto since those skilled in the art will readily appreciate modification and variations within the scope of this invention without departing from the principles thereof. I prefer therefore to be limited to the appended claims when interpreted in the light of this disclosure.

What I seek to secure by United States Letters Patent is:

1. In a method of solidifying liquid carbon dioxide, the steps of confining a quantity of liquid carbon dioxide under pressure, subjecting the liquid to the cooling action of carbon dioxide snow and suddenly exposing a substantial surface of the liquid body to effect reduction in pressure thereon and evaporation of a portion of the liquid from the body to solidify the remainder.

2. In an apparatus of the type described,

the combination comprising a casing, three perforated telescoped casings within said casing, porous material between two of said perforated casings, the third of said perforated casings forming a sliding fit with one of the others, means for moving the third perforated casing with respect to the other perforated casings, and means for supplying liquid carbon dioxide to the interior of the innermost casing.

3. In a device of the type described, the combination comprising three concentric casings closed at each end, said casings being perforated, means for moving one of said casings with respect to the others, a movable piston within the inner casing, porous material between the two inner casings, an outer container for all of said casings, and means for supplying a liquid to the inner casing.

4. In a device of the type described, the combination of three concentric, perforated cylinders, means for rotating one of said cylinders with respect to the others, a casing surrounding said cylinders, closure members for each end of said casing and means for supplying liquid carbon dioxide to the innermost cylinder, said arrangement being adapted to expose a large portion of the surface of the liquid to evaporation when said movable cylinder is rotated with respect to the other cylinder.

5. In a device of the type described the combination comprising a casing, a closure member for one end of said casing and a removable cover for the other end of said casing, three concentric perforated cylinders within said casing, means for moving one cylinder with respect to the others, a longitudinally movable piston within the inner cylinder, means for supplying liquid carbon dioxide to the innermost cylinder, porous packing between the two inner perforated cylinders, said outer casing being spaced from said concentric cylinders and connections to said outer casing, a body of liquid within the inner cylinder being exposed to evaporation when the movable cylinder is rotated with respect to the others to bring the openings therein in alignment with the openings in the other cylinders.

6. In a device of the type described the combination comprising a casing, a closure member for one end of said casing and a removable cover for the other end of said casing, three concentric perforated cylinders within said casing, means for moving one of said cylinders with respect to the others, a longitudinally movable piston within the inner cylinder, means for supplying liquid carbon dioxide to the innermost cylinder, porous packing between the two inner perforated cylinders, said casing being spaced from said concentric cylinders, connections to said outer casing, a body of liquid within the inner cylinder being exposed to evapora-

tion when the movable cylinder is rotated with respect to the others to bring the openings therein in alignment with the openings in the other cylinders, and means for supplying cold carbon dioxide gas and snow to the space between the casing and the perforated cylinders.

7. In a method of solidifying liquid carbon dioxide, the steps of delivering a body of liquid carbon dioxide under pressure to a confined space of fixed volume against a substantially constant counter pressure and exposing the body of liquid over a substantial area thereof to effect sudden and complete reduction of pressure on the liquid and evaporation of some of the liquid from the surface of the body to solidify it.

8. A method of solidifying liquid carbon dioxide comprising the steps of creating a predetermined gas pressure within a confined space, delivering liquid carbon dioxide to the space against said pressure while maintaining it substantially constant and suddenly reducing the pressure on the confined liquid by exposing a substantial surface thereof to permit evaporation of a portion of the liquid to solidify the remainder.

9. In a method of solidifying liquid carbon dioxide, the steps of creating a predetermined gaseous pressure within a confined space, delivering liquid carbon dioxide to said space against said pressure while maintaining it substantially constant, surrounding the liquid within said space with carbon dioxide snow and suddenly exposing a substantial surface of the liquid body to a low pressure to permit a collapse in pressure thereon to effect evaporation of a portion of the liquid from the body to solidify the remainder.

10. In an apparatus of the type described, the combination comprising a closed chamber of fixed volume, means for exposing the closed chamber to atmospheric pressure over a substantial area thereof, means for delivering fluids to said chamber against a substantially constant back pressure of gas, and means for removing fluids from said chamber.

11. In an apparatus of the type described, the combination comprising a closed chamber, means for exposing the closed chamber to atmospheric pressure over a substantial area thereof, means for delivering fluids to said chamber, a movable piston in said chamber for varying the volume thereof, and means forming part of said piston through which gases may be removed from the chamber.

12. A compressor comprising a cylinder open at one end, a perforated container located within said cylinder, means for closing the open end of said cylinder, means for admitting matter to be compressed into the

perforated container, and means for compressing matter into the container.

13. A compressor comprising a cylinder open at one end, a container located within said cylinder, means for closing the open end of said cylinder, means for admitting matter to be compressed into said container, and means for compressing the matter into the container.

In testimony whereof I have hereunto set my hand on this 28th day of April A. D., 1930.

JUSTUS C. GOOSMANN.

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