Nov. 1, 1949. H. V. WILLIAMSON 2,486,624

DISCHARGE APPARATUS FOR FIREFIGHTING WITH CARBON DIOXIDE

Filed Nov. 21, 1945 2 Sheets-Sheet 1

Fig. 1.

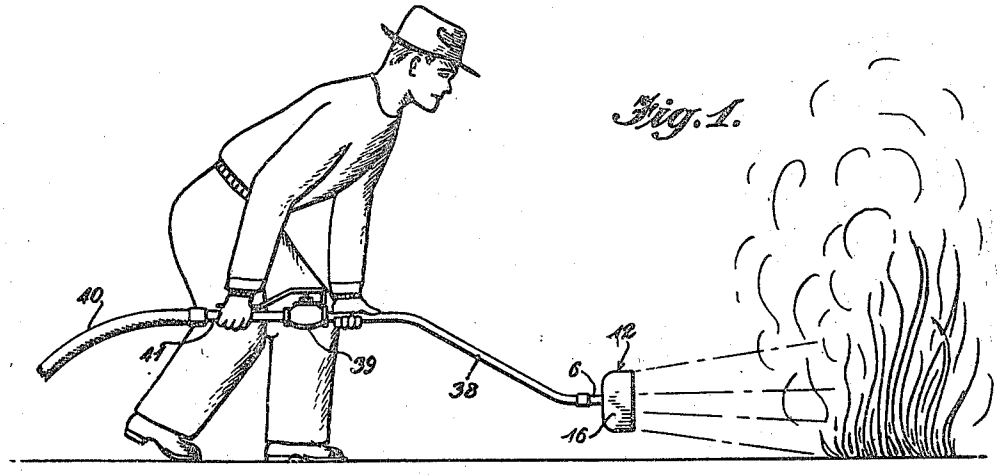


Fig. 4.

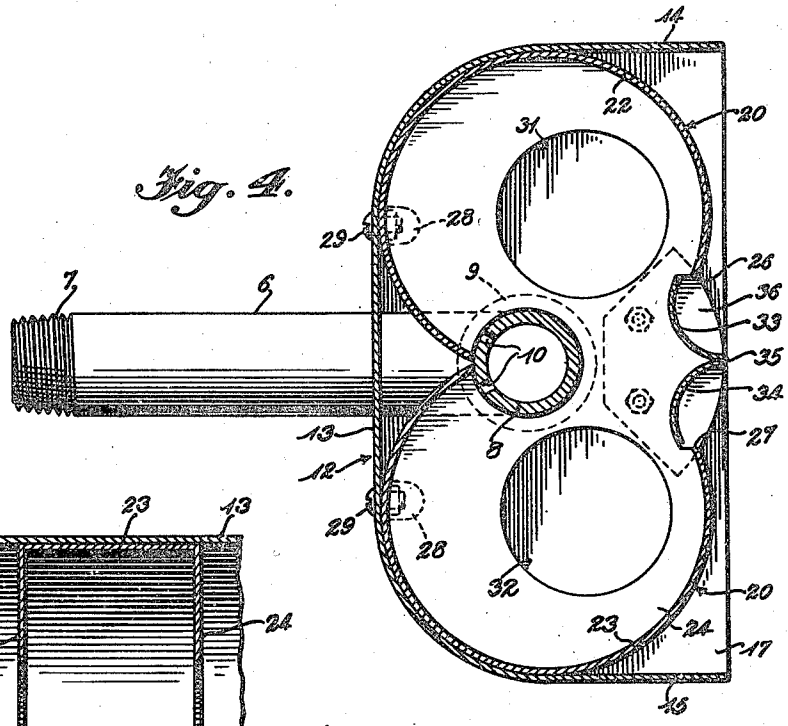
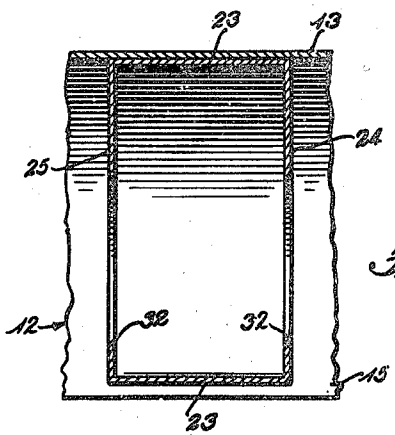


Fig. 5.



INVENTOR.
Hilding V. Williamson
BY
L. Powell
ATTORNEY

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Fig. 2.

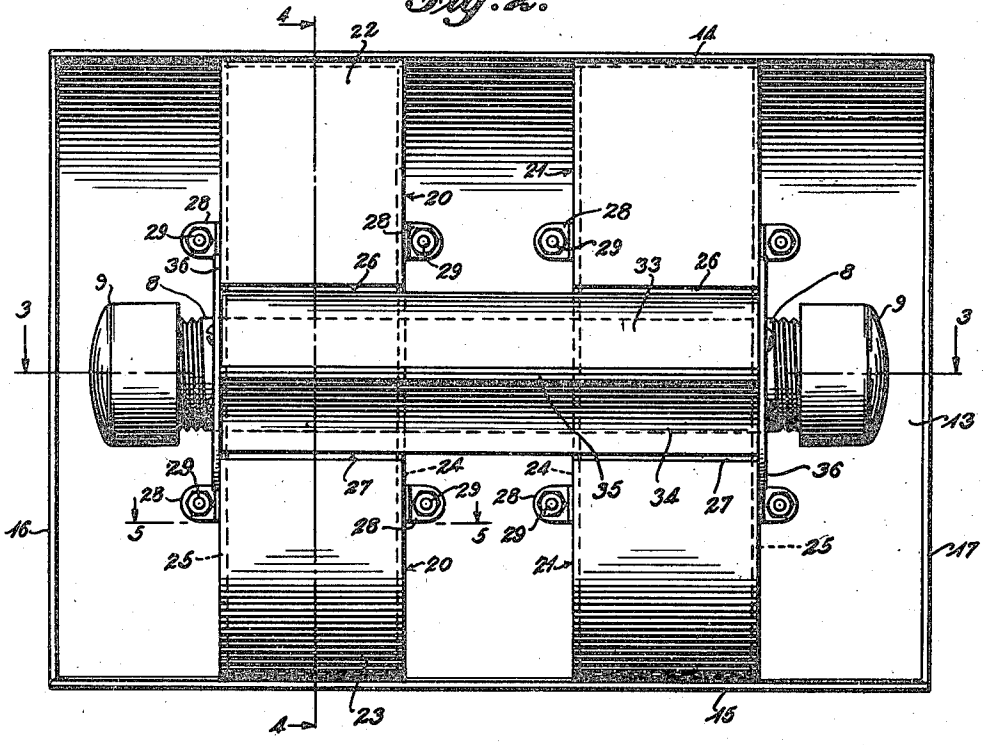
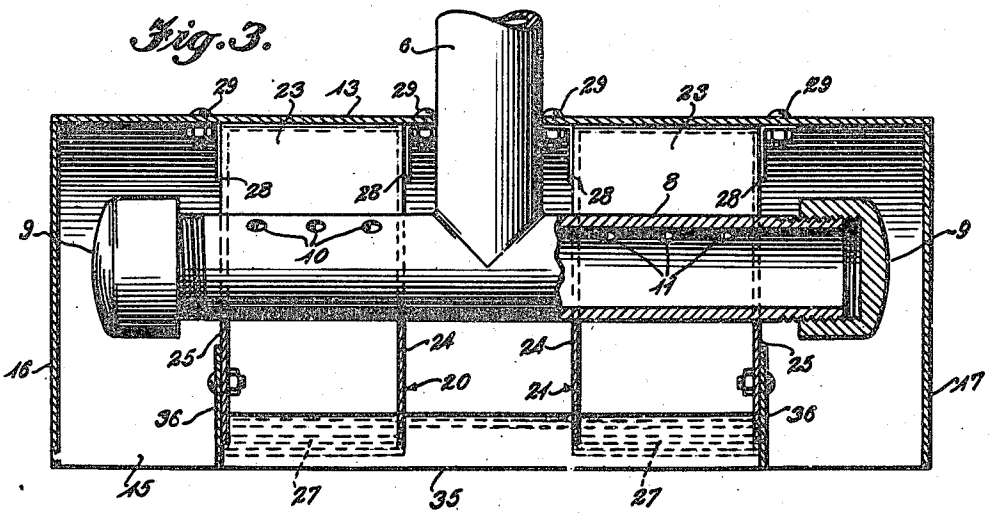


Fig. 3.



INVENTOR.
Hilding V. Williamson
BY
ATTORNEY.

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2,486,624

DISCHARGE APPARATUS FOR FIREFIGHTING WITH CARBON DIOXIDE

Hilding V. Williamson, Chicago, Ill., assignor to Cardox Corporation, Chicago, Ill., a corporation of Illinois

Application November 21, 1945, Serial No. 629,933

10 Claims. (Cl. 62—1)

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This invention relates to a discharge apparatus and more particularly to a device for directing carbon dioxide against a fire.

The general method of employing refrigerated liquid carbon dioxide as a fire extinguishing medium is disclosed and claimed in Patent 2,143,311, issued to Eric Geertz, on January 10, 1939. That method has had widespread usage because of its effectiveness in extinguishing fires.

In discharging liquid carbon dioxide for extinguishing fires by direct application, it has been found to be advantageous to discharge the resulting carbon dioxide snow and vapor in a separated or segregated condition within the discharging stream. Patents 2,357,039 and 2,357,040, issued August 29, 1944, to H. V. Williamson describe and claim the general method of and means for effecting this separation.

In the direct application of carbon dioxide to extinguish fires from playpipes, it has been found that the effectiveness is considerably greater if the carbon dioxide stream can be directed as near the base of the fire as possible. This is especially true of gasoline fires or other volatile liquid fires. The nozzle shown in Patent 2,357,039 is at somewhat of a disadvantage in applying the stream of carbon dioxide near the ground especially in smaller nozzle sizes because of its round shape.

It is an object of the present invention, therefore, to provide a discharge apparatus for refrigerated liquid carbon dioxide which will be especially suitable for extinguishing fires burning at ground level.

As another feature of the invention, a discharge apparatus is provided which, being of greater length than height, will spread out the stream of carbon dioxide to cover a wider field upon the ground or over the surface of a pool of inflammable liquid.

Another feature of the invention is the provision of a discharge apparatus of this type which will cause segregation of the carbon dioxide snow and vapor and the discharge of the snow as a core enveloped by a vapor sheath.

A still further object of the invention is to provide for the support of the dicharge apparatus in such a manner that its manipulation will require less effort on the part of the operator and the apparatus will be properly positioned for effectively extinguishing a fire.

Other features and objects of the invention will hereinafter appear.

In the drawings:

Figure 1 is an elevational view showing one manner of employing the discharge apparatus,

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Figure 2 is a front elevational view of the discharge apparatus,

Figure 3 is a sectional view on the line 3—3 of Figure 2,

Figure 4 is a sectional view on the line 4—4 of Figure 2, a portion only of the piping being in section, and

Figure 5 is a sectional view on the line 5—5 of Figure 2.

Considering first the structure of the discharge apparatus, it includes a pipe 6 which is to be attached at one end, as by screw threads 7, to a conduit leading to a source of supply of refrigerated liquid carbon dioxide. A preferred form of conduit to which pipe 6 may be attached will be discussed hereinafter as its advantages will then be more apparent. It is immaterial whether the source of carbon dioxide is a stationary tank such as is disclosed in Patent 2,143,311 issued to Eric Geertz on January 10, 1939, or is a mobile tank such as is disclosed in Patent 2,352,379 issued to Eric Geertz on June 27, 1944.

Pipe 6 is connected to a cross pipe 8, preferably at its mid-point, as is shown. The cross pipe 8 preferably is perpendicular to the pipe 6, and may be attached thereto in any convenient manner, as by welding. Cross pipe 8 is closed at its ends, as by caps 9 and escape from the cross pipe is permitted only through two sets of openings 10 and 11 in the side wall of the cross pipe 8. These sets of openings 10 and 11 are symmetrical about pipe 6, as will be explained.

Each of the sets of openings 10 and 11, includes an upper row of holes and a lower row of holes as best appears from Figure 4. The upper row of holes is directed on an upwardly and rearwardly direction, and the lower row of holes is directed in a downwardly and rearwardly direction. These holes therefore are directed generally backwardly toward the pipe 6, but incline upwardly and downwardly away from a plane passing through the axes of pipe 6 and cross pipe 8.

It is preferable that for every upper hole there be a corresponding lower hole to equalize the discharge. As here shown there are three upper holes and three lower holes in the set of openings 10 and the holes in the set of openings 11 are similarly arranged but more or fewer holes may be in each set. The upper and lower row of holes in each set are therefore arranged in pairs, each pair having an upper and a low[illegible] hole.

The cross pipe 8 is disposed within and lengthwise of an elongated, generally rectangular shell

or housing 12 and the pipe 6 enters perpendicularly through a hole in the flat rear wall 13 of this housing. Above and below the rear wall 13, the housing curves over and under the cross pipe 8 and extends forwardly beyond pipe 8 in substantially flat or straight upper and lower horizontal walls 14 and 15. These walls 14 and 15 preferably are substantially parallel to each other and to a plane passing through the axes of pipes 6 and 8, and the cross pipe 8 is midway between them.

The ends of the housing 12 are closed by side walls 16 and 17 and these walls are spaced beyond the caps 9 as the housing 12 is longer than cross pipe 8. The front edges of these side walls 16 and 17 terminate flush with the front edges of housing walls 14 and 15. As a consequence, the cross pipe is enclosed within the housing 12 and a discharge opening is presented from the housing forwardly of the cross pipe 8.

The cross pipe 8 is spaced from the rear wall 13 of housing 12 and, as appears from Figure 4, the openings at 10 and 11 are directed toward this rear wall. The discharge from the openings at 10 and 11, however, does not reach the housing wall at these points, due to the interposition of flow controlling and directing units 20 and 21. These units 20 and 21 are identical in construction but the unit 20 is disposed to receive the discharge from the set of openings at 10, and the unit 21 is disposed to receive the discharge from the set of openings at 11.

Each of the flow controlling and directing units 20 and 21 is made up of an upper curved wall 22, a lower curved wall 23, and end walls 24 and 25. The curved walls 22 and 23 are portions of cylindrical surfaces of about 270° in arcuate extent. They preferably are of about the same radius as the curved portions of housing 12 so as to fit the inner surface as appears from Figure 4. The rearward edges of curved walls 22 and 23 bear against the rearward surface of cross pipe 8 and their forward edges at 26 and 27, respectively, are disposed close to the front face of housing 12. The curved walls 22 and 23 should be of sufficient arcuate length to have their forward portions slightly reentrant into the housing 12 so as to direct material flowing along the curved walls 22 and 23 slightly toward the interior of the housing as it leaves the edges 26 and 27.

The side walls 24 and 25 conform to the shape of the curved walls 22 and 23 and are secured thereto at their meeting edges as by welding. Openings are formed in these walls for the passage of cross pipe 8 and this serves to support the directing units 20 and 21. Also, clips or angle pieces 28 are secured to the side walls 24 and 25 as by welding and they are secured to the rear wall 13 of the housing 12 by bolts and nuts 29.

Through the side walls 24 and 25 are upper openings 31 and lower openings 32. The upper openings 31 are disposed close to the forward portion of curved wall 22 and the lower openings 32 are disposed close to the forward portion of curved wall 23. Vapor escapes from within the directing units 20 and 21, through these openings 31 and 32, as will later be explained.

Bridging the gap between the edges 26 and 27 of the directing units 22 and 23, is a double deflector or scoop having an upper portion 33 and a lower portion 34. These deflectors are of curved shape and are reversely curved from the curvatures of the associated directing units 20 and 21. The deflectors 33 and 34 meet at an edge

35 which is in the plane through the axes of pipes 6 and 8 and midway between the edges 26 and 27. The edge 35 preferably lies flush with the front opening of the housing; that is, it comes forwardly as far as the front edges of upper and lower walls 14 and 15 and side walls 16 and 17.

The rearward edges of deflectors 32 and 33 lie just inwardly from the adjacent edges 26 and 27, as appears from Figure 4, so that there is a gap between these pairs of companion edges. Thus, these companion edges should be so related to each other that tangents to the adjacent surfaces of the directing units 20 and 21 and deflectors 33 and 34 are substantially parallel to each other. Due to this arrangement, the material moving over the inner surface of curved wall 22, for example, and leaving its edge 26 will pass directly to the deflector 33 and be guided forwardly to the edge 35.

As appears from Figure 2, the deflectors or scoops 33 and 34 extend from the outer walls 25—25 of the directing units 20 and 21, and do not extend to the side walls 16 and 17 of the housing. To support the deflectors 33 and 34, they are attached at their ends, as by welding, to plates 36. These plates 36 are secured, as by bolts, to the side walls 25—25. It may be noted that the side walls 25—25 are cut away to permit the deflectors 33 and 34 to be set inwardly.

When liquid carbon dioxide is delivered to pipe 6, it passes into cross pipe 8 and out through openings 10 and 11, at opposite extremities of the cross pipe. On escaping through openings 10 and 11, the resulting expansion and consequent cooling effect causes a portion of the liquid to turn into carbon dioxide snow and some of the liquid becomes vaporized. Openings 10 are all pointed into the directing unit 20 and openings 11 are all pointed into directing unit 21. Since the same action occurs in each directing unit, only that in one of them need be described.

Considering the directing unit 20, the upper row of the holes at 10 project the liquid from pipe 8 onto the curved surface 22 and the lower row of the holes at 10 project the liquid from pipe 8 onto the curved surface 23. As has been stated, a portion of this liquid is changed to snow and this snow, due to its greater density closely hugs the curved surfaces 22 and 23 in passing over them to the discharge edges 26 and 27. The carbon dioxide vapor is consequently forced inwardly away from the curved surfaces 22 and 23. This action is due to the centrifugal forces set up as a result of forcing the carbon dioxide to move in a curved path, as is more fully explained in Patent 2,357,039, issued to Hilding V. Williamson, on August 29, 1944.

Due to the segregation which is caused by the curved surfaces 22 and 23, an outer dense layer of carbon dioxide snow moves over these surfaces while the segregated carbon dioxide vapor is arranged inwardly of the snow and may be considered as forming a separate layer. When these segregated layers reach and pass beyond the edges 26 and 27, the outermost layer of snow is scooped or skimmed off by the deflectors 33 and 34, respectively. The deflectors 33 and 34 turn this collected snow forwardly of the housing 12 so that the two layers mingle into one stream of forwardly flowing snow.

The carbon dioxide vapor, since it is not scooped up by the deflectors 33 and 34, continues around within the directing unit 20 and is forced out through upper and lower openings 31 and 32 in side walls 24 and 25.

This action which takes place in the directing unit 20, also takes place in the directing unit 21, and consequently a single stream of carbon dioxide snow is formed and is directed forwardly by the deflectors 33 and 34 in front of the directing unit 21. The vapor escaping from the openings in the side wall 24 of directing unit 21, merges with the vapor from the openings in the side wall 24 of directing unit 20 so that the space between the walls 24—24 is filled with carbon dioxide vapor. This vapor is forced forwardly by the walls 24—24 and the top and bottom walls 14 and 15 of the housing.

The vapor escaping from the openings in the outer walls 25 of the directing units 20 and 21, passes into the spaces between them and the side walls 16 and 17 of the housing 12. This vapor is forced forwardly by these walls and the top and bottom walls 14 and 15 of the housing.

It will, therefore, be seen that two streams of carbon dioxide snow emerge from the discharge apparatus, in front of the directing units 20 and 21 and that they are side-by-side and located centrally of the height of the front opening of the housing. These two streams are surrounded by the vapor emerging from the end space between walls 16 and 25, the central space between walls 24—24, and the end space between walls 17 and 25. The two streams of carbon dioxide snow, therefore, appear as cores surrounded by enveloping sheets of carbon dioxide vapor.

As is explained in Patent 2,357,039, the concentration of the carbon dioxide snow into a fairly compact stream causes it to carry further than if it were mingled with the carbon dioxide vapor. The enveloping sheaths of carbon dioxide vapor serve to reduce heat transmission to the inner cores of snow so that vaporization of the carbon dioxide snow is retarded.

As the housing 12 is of elongated form and the discharge is thereby spread out over a greater horizontal distance than the height of the stream, a greater coverage over the ground is obtained with this discharge apparatus. It is, therefore, of especial value in extinguishing fires on the ground or on a floor, such, for example, as a gasoline fire. To use the discharge apparatus for this purpose, it should be held close to the ground and be played back and forth.

A suitable means for supporting the discharge apparatus is shown in Figure 1. It consists of a pipe 38 having two spaced bends therein, the ends of the pipe being substantially parallel. The discharge apparatus is screwed at 7 into a coupling at one end of the pipe 38, and the other end of pipe 38 is preferably screwed into a valve 39. A hose line 40 is connected to the valve 39 through a short straight pipe 41, and this may receive liquid carbon dioxide from any suitable source.

The bent pipe 38 makes it possible for the user to position the discharge apparatus close to the ground while he assumes a crouched position which will best shield him from the full blast of the radiant heat from the fire. He can then sweep the discharge apparatus over the ground and effectively play the discharge stream on the fire. It is convenient to grasp the upper horizontal portion of pipe 38 and pipe 41 and this supports the discharge apparatus in the desired nearly vertical position with one of its longer sides paralel to the ground without requiring undue effort. The curved pipe 38 has the further advantage of suggesting to the user the fact that the discharge apparatus should be positioned close to the ground.

If desired, the discharge apparatus may rest upon the ground. This has the advantage of preventing air entrainment along the under side of the stream so that the carbon dioxide reaches the fire in a more concentrated condition. Also, this is beneficial as the stream fans out over the ground where it is less affected by the air currents and wind, and where it is most effective in extinguishing fires on the ground.

What I claim is:

1. A discharge apparatus for liquid carbon dioxide comprising a chambered body having a discharge opening, means for releasing the liquid carbon dioxide into the interior of the body in spaced sets of streams, each set of streams including a pair of streams, the release of the liquid carbon dioxide forming a mixture of snow and vapor, means within the body to receive each set of streams and cause the snow and vapor thereof to become segregated while flowing therein, means for effecting separation of the snow from the vapor and directing the separated snow forwardly from the body in spaced streams through its discharge opening, and means for effecting discharge of the separated vapor from said body through its discharge opening.

2. A discharge apparatus for liquid carbon dioxide comprising a chambered body having a discharge opening, means for releasing liquid carbon dioxide into the interior of the body in spaced sets of streams, each set of streams including a pair of streams, the release of the liquid carbon dioxide forming a mixture of snow and vapor, means within the body to receive each set of streams and cause the snow and vapor thereof to become segregated while flowing therein, means for effecting separation of the snow from the vapor and directing the separated snow forwardly from the body in spaced streams through its discharge opening, and means for the discharge of the separated vapor into the chambered body from the said segregating means so that the vapor will emerge from said body through its discharge opening to substantially surround the snow streams.

3. A discharge apparatus for liquid carbon dioxide comprising a chambered body having a discharge opening, means for releasing liquid carbon dioxide into the interior of the body in spaced sets of streams, each set including diverging groups of streams, the release of the liquid carbon dioxide forming a mixture of snow and vapor, means within the body to receive each set of streams and cause the snow and the vapor thereof to become segregated while flowing therein, means for combining the segregated snow from the diverging groups of streams of each set into a single stream and effecting its discharge from the chambered body, whereby a separate stream of snow emerges through said discharge opening for each of said sets of streams, and means for effecting discharge of the segregated vapor from said body through its discharge opening.

4. A discharge apparatus for liquid carbon dioxide comprising a chambered body having a discharge opening, means for releasing liquid carbon dioxide into the interior of the body in spaced sets of streams, each set including upper and lower groups of diverging streams with the corresponding group in all sets flowing in the same general direction, the release of the liquid carbon dioxide forming a mixture of snow and vapor in each stream, means within the body to receive

each set of streams and cause the snow and vapor thereof to become segregated while flowing therein, means for collecting the segregated snow from each set of streams and combining and discharging it as a single stream from the chambered body, whereby a separate stream of snow emerges from the body through said last-mentioned means, and means for effecting discharge of the segregated vapor from said body through its discharge opening along side of said snow streams.

5. A discharge apparatus for liquid carbon dioxide comprising an elongated chambered body having a longitudinally extending discharge opening in one wall thereof, a conduit lengthwise within the body and having spaced sets of openings therealong for releasing carbon dioxide into the chambered body, each set of openings directing a pair of diverging streams from the conduit, the release of the liquid carbon dioxide forming a mixture of snow and vapor, directing means within the body to receive each stream and cause the snow and vapor thereof to become segregated while flowing therein, the directing means associated with each pair of diverging streams serving to return them in a direction toward each other, and means for separating the snow from the vapor of each stream and combining the snow from each pair of streams for emergence from the discharge opening of the body as a single stream whereby streams of snow are delivered from the body in spaced relation lengthwise of its discharge opening, and means for effecting discharge of the separated vapor from the body through its discharge opening.

6. A discharge apparatus for liquid carbon dioxide comprising an elongated chambered body having a longitudinally extending discharge opening in one wall thereof, a conduit lengthwise within the body and having spaced sets of openings therealong for releasing liquid carbon dioxide into the chambered body, each set of openings directing a pair of diverging streams from the conduit, the release of the liquid carbon dioxide forming a mixture of snow and vapor, directing means within the body to receive each stream, the directing means associated with each pair of diverging streams including a curved surface of sufficient length to redirect the diverging streams toward each other and effect segregation of the snow and vapor, means for separating the snow from the vapor of each stream and combining the snow from each pair of streams for emergence from the discharge opening of the body as a single stream whereby streams of snow are delivered from the body in spaced relation lengthwise of its discharge opening, said directing means including side walls having openings therein for the escape of the segregated vapor into said chambered body for release through its discharge opening in substantially surrounding relation to the snow streams.

7. A discharge apparatus for liquid carbon dioxide which comprises spaced directing units each having a pair of oppositely facing curved surfaces and side walls, a pipe extending into each directing unit and having openings for delivering a stream of carbon dioxide against each curved surface, said curved surfaces serving to segregate the snow and vapor of the carbon dioxide stream flowing thereover, deflector means for splitting off the segregated snow as it leaves the edges of the curved surfaces and combining it into a single stream from each directing unit while causing the vapor to remain within each directing unit, said side walls having openings therein for the escape of the remaining vapor from the directing unit, and housing means in which the directing units are positioned and having an open front through which the streams of snow are discharged, said housing means acting to receive the segregated vapor escaping from the directing units and guide it to the open front for discharge in surrounding relation to the streams of snow.

8. A discharge apparatus for liquid carbon dioxide comprising a plurality of directing units supported in spaced relation, each unit including two inwardly facing opposing surfaces of partially cylindrical shape and side walls, one end portion of each of the two curved surfaces of each unit being contiguous to each other and the other end portions being spaced from each other, means for releasing liquid carbon dioxide against the contiguous portions of the curved surfaces of each unit, whereby a mixture of snow and vapor is formed and caused to flow over the curved surfaces, the flow over said surfaces effecting segregation of the snow and vapor, means disposed between the spaced end portions of said surfaces of each unit to separate the segregated snow from the vapor and deliver the snow forwardly from the unit as a stream, and means for directing the separated vapor for discharge with the snow streams in surrounding relation thereto.

9. A discharge apparatus for liquid carbon dioxide comprising a chambered body having a discharge opening, means for releasing liquid carbon dioxide into the interior of the body in spaced sets of streams, each set including two groups of diverging streams, the release of liquid carbon dioxide forming a mixture of snow and vapor in each stream, means within the body individual to and for receiving each two groups of diverging streams, each of said last mentioned means including a separate curved wall for each group of streams and apertured side walls across both sides of each curved wall, the passage of each group of streams over its associated curved wall serving to cause segregation of the snow and vapor, means for separating the segregated snow from the vapor and delivering the snow forwardly from the body, whereby snow emerges from the body through its discharge opening for each of said sets of streams, and means for directing the separated vapor through the said side wall openings into the chambered body for release through the discharge opening of the body alongside of the snow streams.

10. A discharge apparatus for liquid carbon dioxide comprising a chambered body having a discharge opening, means for releasing liquid carbon dioxide into the interior of the body in spaced sets of streams, each set including upper and lower groups of diverging streams with the corresponding group in all sets flowing in the same general direction, the release of liquid carbon dioxide forming a mixture of snow and vapor in each stream, means within the body individual to and for receiving each two groups of diverging streams, each of said last mentioned means including a separate curved wall for each group of streams and apertured side walls across both sides of each curved wall, the passage of each group of streams over its associated curved wall serving to cause segregation of the snow and vapor, means for separating the segregated snow from the vapor and combining the separated snow from each set of streams into a single stream for discharge from the body, whereby a stream of snow emerges from the body through

its discharge opening for each of said sets of streams, and means for directing the separated vapor through the said side wall openings into the chambered body for release through the discharge opening of the body alongside of the snow streams.

HILDING V. WILLIAMSON.

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