United States Patent [19]

Coggins, Jr.

[11] **3,762,176**

[45] **Oct. 2, 1973**

[54] **METHOD AND APPARATUS FOR MAKING SNOW**

[76] Inventor: **Burton Frank Coggins, Jr.**, P.O. Box 250, Elberton, Ga. 30635

[22] Filed: **Sept. 18, 1969**

[21] Appl. No.: **859,110**

[52] **U.S. Cl.** **62/74,** 239/2

[51] **Int. Cl.** **F25c 3/04**

[58] **Field of Search** 62/74, 121, 347; 239/25

[56] **References Cited**

UNITED STATES PATENTS

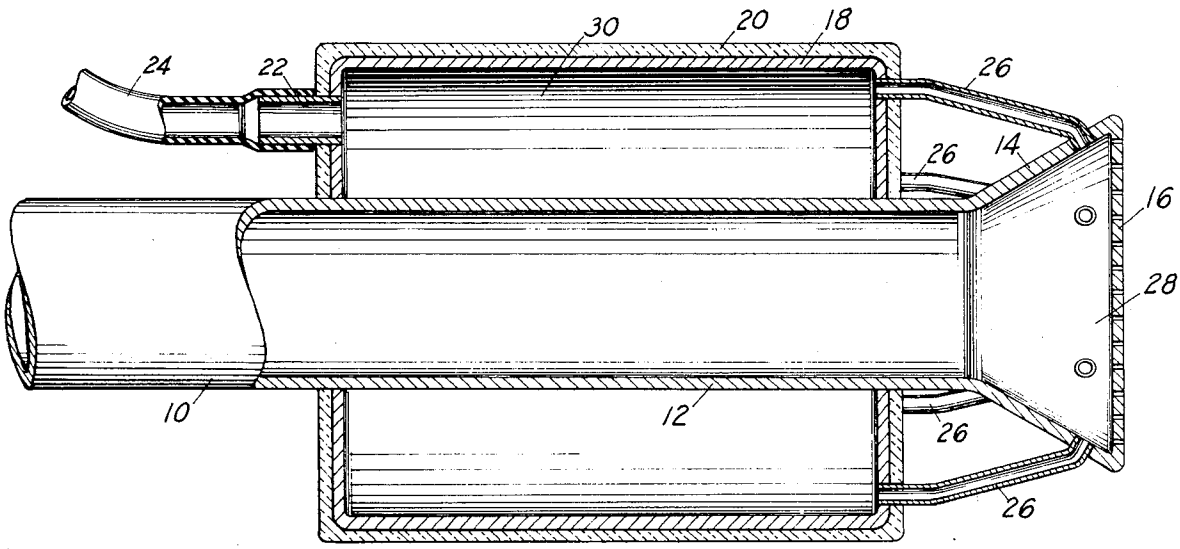
1,976,204	10/1934	Voorhees et al.	62/74
2,020,719	11/1935	Bottoms	62/74
3,068,105	12/1962	Morrison	99/136
3,301,485	1/1967	Tropeano et al.	62/74 X

Primary Examiner—William E. Wayner
Attorney—Newton, Hopkins & Ormsby

[57] **ABSTRACT**

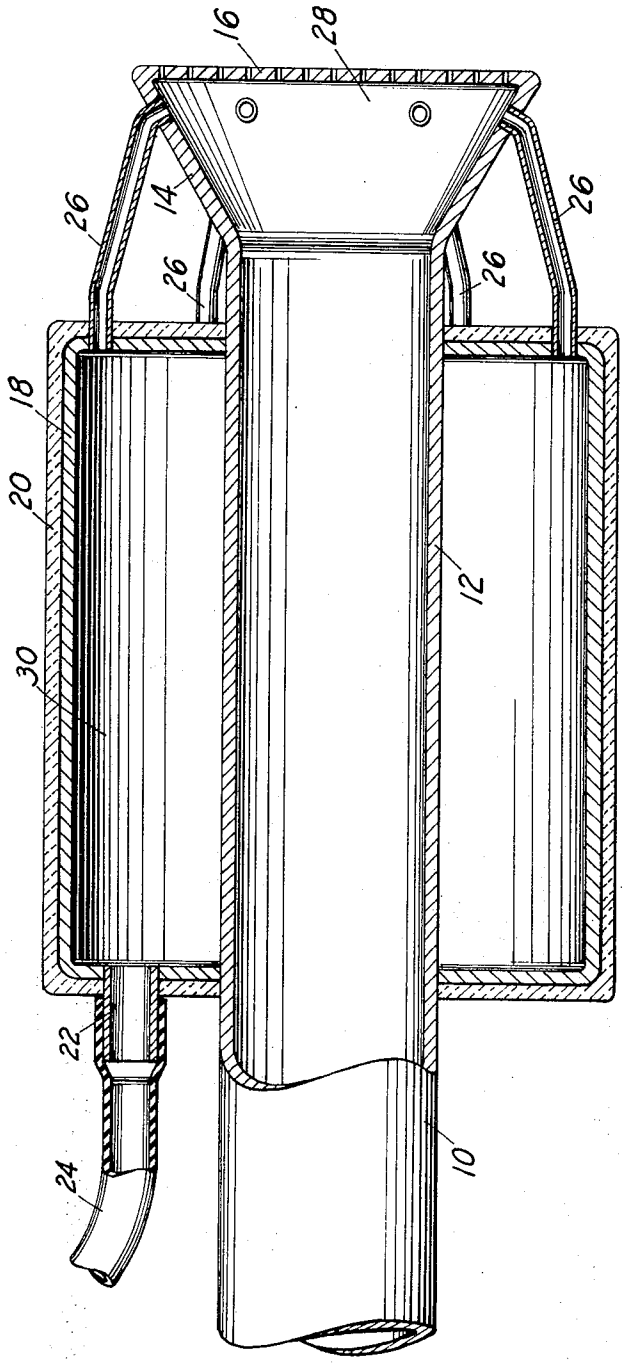
A method for making artificial snow independent of ambient temperature conditions by pre-cooling water through heat exchange with a cryogenic fluid and then discharging the water through a nozzle with physical contact with the cryogenic fluid. The nozzle includes a pre-cooling portion surrounded by a housing connected to a source of cryogenic liquid and a perforate head wherein the cryogenic liquid and water are mixed just prior to discharge through the perforations of the head.

1 Claim, 1 Drawing Figure



PATENTED OCT 2 1973

3,762,176



INVENTOR
B. FRANK COGGINS

BY: Newton, Hopkins, & Ormsby
ATTORNEYS

METHOD AND APPARATUS FOR MAKING SNOW

BACKGROUND OF THE INVENTION

The sport of skiing has, and continues to enjoy increasing popularity with the result that favorable sites cannot rely solely upon natural snow fall to provide the requisite slope conditions for enjoyable skiing. Consequently, artificial snow-making machines have been developed for supplementing natural snow fall and to maintain the slopes in condition for skiing.

The artificial snow-making machines of the prior art rely upon the presence of sufficiently cold ambient atmosphere in which to introduce a mist or fog of water droplets which will freeze and form the artificial snow. Unfortunately, machines of this type which are capable of producing large volumes of artificial snow produce it in rather wet or slushy form so that it has become common practice to utilize one type of nozzle for laying a rather wet or slushy base and then to utilize another type of nozzle, incapable of producing large quantities of snow, but in which the snow is relatively dry and fine for producing a topping on the base.

BRIEF SUMMARY OF THE INVENTION

The present invention is directed to a method for making artificial snow and a nozzle assembly for practising the method wherein large quantities of the snow may be produced which is of dry and perfectly usable form so as to lay not only a good base of substantial thickness, but to provide a quality of artificial snow which is also functional as the topping.

The method according to this invention involves the pre-cooling of a flowing stream of water by indirect heat exchange with a cryogenic fluid followed by discharge of the water as a spray. The freezing of the water and formation of the artificial snow is effected by creating a zone of physical contact between the water and the cryogenic fluid at the region of discharge.

The nozzle assembly according to the present invention has a pre-cooling portion followed by a mixing portion in which the pre-cooling is effected by a cryogenic liquid which is thereafter mixed with the incoming water immediately prior to discharge of the mixture through a perforate head whereat the final freezing takes place so that a large quantity of aritificial snow emanates as a shower from the perforate head.

BRIEF DESCRIPTION OF THE DRAWING FIGURE

The drawing illustrates a longitudinal section taken through a nozzle assembly constructed according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The nozzle assembly shown comprises an elongate tube **10** adapted for connection to a source of water under pressure and includes a pre-cooling portion **12** leading to a divergent portion **14** terminating in a transverse perforate head **16.** The pre-cooling portion **12** is surrounded by a housing **18** which may be suitably covered with insulation material **20** and which housing is provided with an inlet conduit **22** which may be connected as by the flexible conduit **24** to a source of cryogenic liquid such as liquid nitrogen. The housing is provided with a plurality of individual conduits **26** which lead therefrom through the divergent portion **14** and into the interior of the expansion chamber **28** immediately behind the perforate head **16** so as to introduce small quantities of the cryogenic liquid into the water just before it passes through the perforate head **16.**

The formation of the artificial snow according to the present invention takes place in discrete stages as may be explained best by a description of the method.

The method according to the present invention involves pre-cooling the water as it flows to the discharge region by indirect heat exchange with a cryogenic fluid. The pre-cooling is effected to a degree such that the water will pass from the liquid stage to the solid stage very rapidly as the water is discharged as a spray into the ambient atmosphere, the solidification of the water being effected by creating a zone at the region of discharge within which the cryogenic fluid and the water are physically contacted. This zone may be either just before or just after the discharge point and the amount of the cryogenic fluid contacted with the water is, in any event, sufficient to effect the freezing thereof even when the ambient temperature is above 32° F. It is preferred to utilize a cryogenic liquid and to introduce it in contact with the water just before discharge since the boiling of the cryogenic liquid and consequent expansion as a gas will aid in breaking up and dispersing the freezing water to produce a fine, dry snow of excellent quality.

To make artificial snow with the nozzle shown, the source of water is first turned on to issue as a shower of liquid into the ambient atmosphere emanating from the perforate plate of head **16** whereafter the source of cryogenic liquid is turned on to fill the chamber **30.** The extent of the chamber **30** should be sufficient to extract sufficient heat from the water flowing through the tube portion **12** as to place it very close to a condition at which freezing will take place so that when the water flows into the chamber **28** and is thereat mixed with the small amount of cryogenic liquid through the conduit **26,** freezing of the water will take place just after it passes through the perforations of the head **16** under the rapid expansion of the liguid which takes place as same is discharged from the perforate head **16.** Thus, the water within the nozzle remains liquid until it is discharged through the head **16,** the flow of water being sufficiently rapid as to prevent freezing within the nozzle but carrying along sufficient of the cryogenic liquid as to assure complete freezing of the shower as it emanates from the perforate head **16.** It will be appreciated, of course, that the liquid nitrogen or other cryogenic liquid will positively assure freezing of the snow particles even under ambient temperature conditions at which conventional snow-making machines would be incapable of producing any snow at all. Thus, the invention allows the making of artificial snow in large quantities and of good quality irrespective of the ambient temperature so that the condition of the slopes may be maintained in favorable condition without reliance upon ambient weather conditions.

What is claimed as invention:

1. The method of making artificial snow which comprises flowing water through a conduit to a point of discharge, pre-cooling the flowing water in a portion of said conduit near the discharge point by circulating a cryogenic liquid around it, introducing said cryogenic liquid, after such circulation, into the cooled water at a point adjacent the discharge point but sufficiently far therefrom to permit the mixture of the cryogenic liquid and water in liquid form, such introduction being effected by conducting the cryogenic liquid transversely

into the water at a plurality of circumferentially spaced points to ensure prompt and uniform mixing, the rate of water flow and the temperature of the cryogenic liquid being such that freezing will not take place prior to discharge but the atomized spray will freeze completely upon discharge, the discharge outlet being in the form of a perforated nozzle through which the liquid mixture passes in a number of streams, and the temperature and amount of cryogenic liquid being such as to ensure freezing on discharge even though the ambient temperature is above the freezing point of water.

* * * * *