

Jan. 17, 1961

A. W. HANSON

2,968,164

METHOD OF GENERATING SNOW

Filed Feb. 24, 1958

3 Sheets-Sheet 1

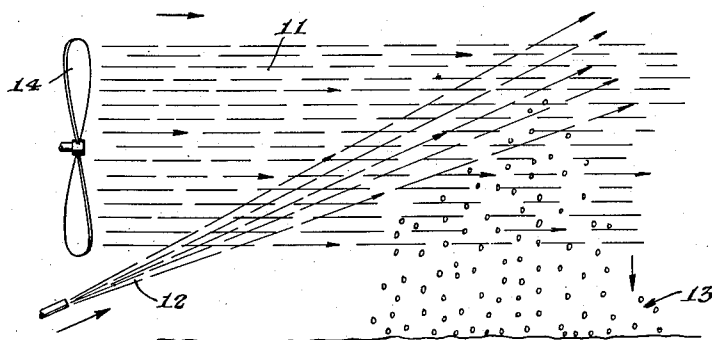


Fig. 1

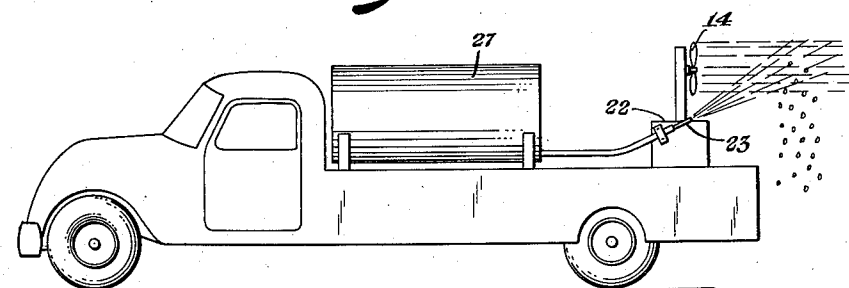


Fig. 6

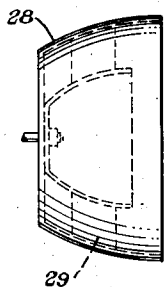


Fig. 4

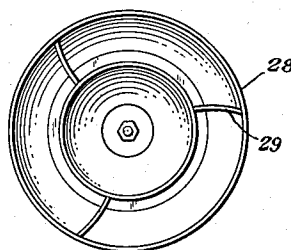


Fig. 4A

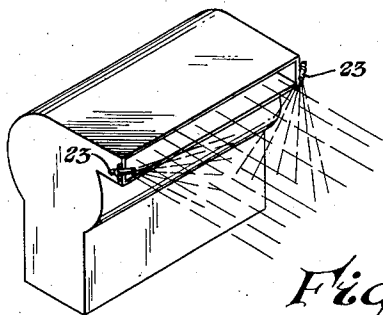


Fig. 7

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3 Sheets-Sheet 2

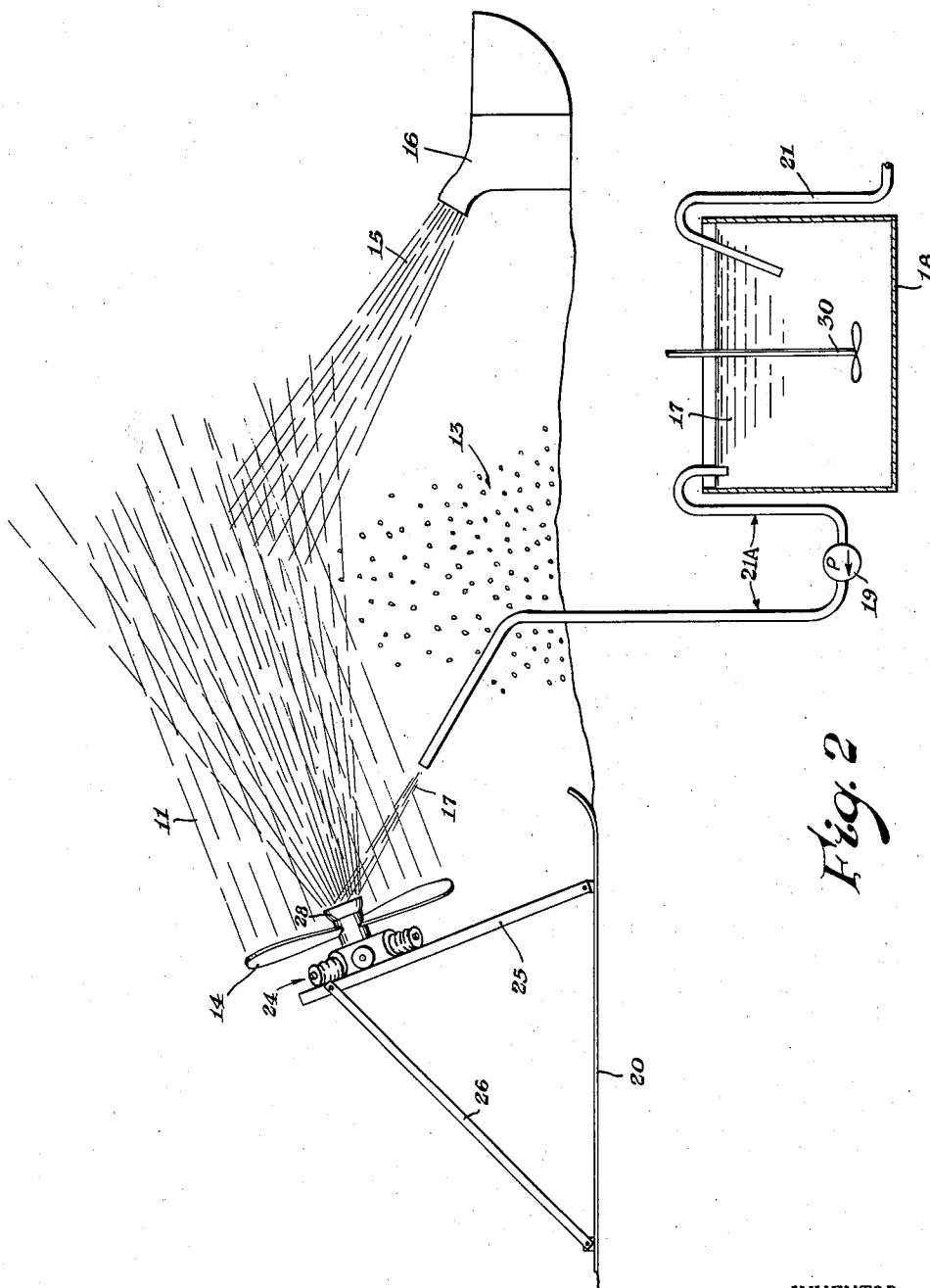


Fig. 2

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3 Sheets-Sheet 3

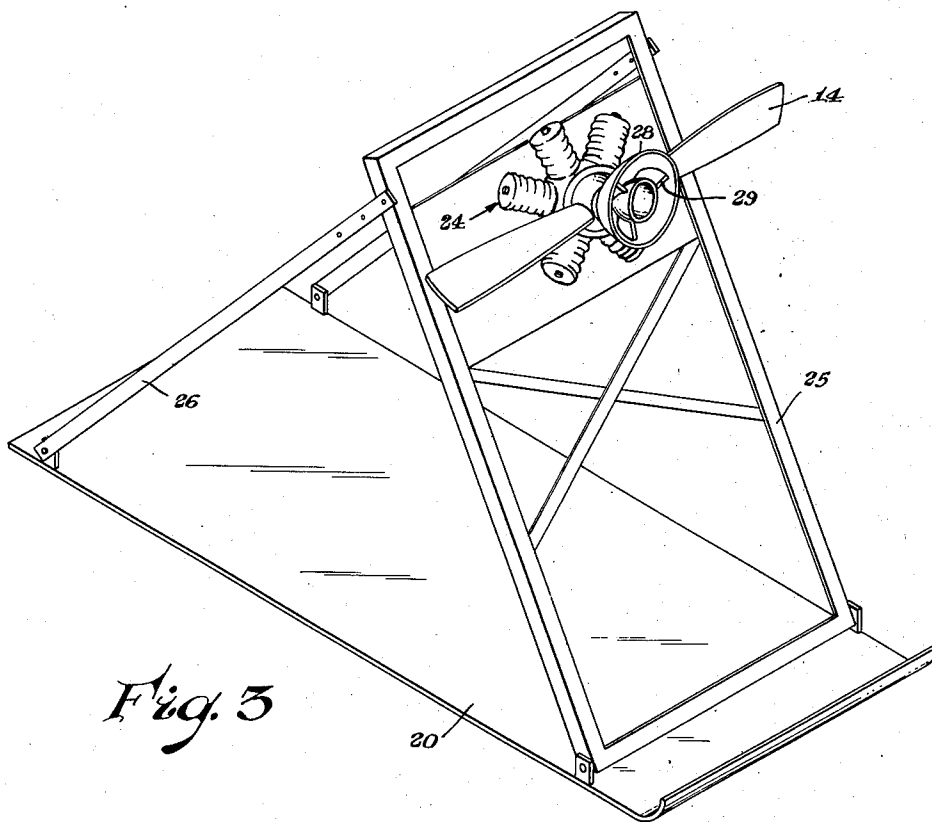


Fig. 3

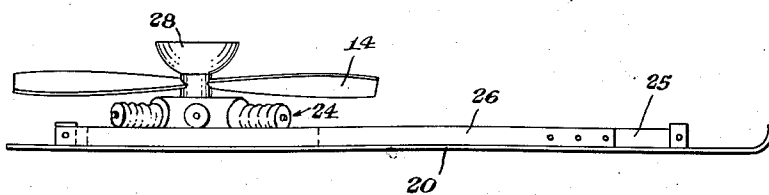


Fig. 5

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2,968,164

METHOD OF GENERATING SNOW

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7 Claims. (Cl. 62—74)

This invention relates to a method of providing snow and more particularly to a technique for forming, distributing, and depositing snow as a covering for ski trails or the like.

Due to the increasing numbers of people participating in or deriving their livelihood from outdoor winter sports, a problem has arisen with respect to the effects of year to year variations in snow fall. Heretofore, when there has been little or no snowfall, there was no opportunity to participate in such winter sports as skiing and tobogganing. Naturally, in these seasons there was a decrease in revenue for ski lift operators, resort communities, and winter sports equipment manufacture.

Investigation discloses that many factors are important to the winter sports trade. These factors include housing, transportation, proper clothing and equipment, temperature, and of course, snow. Proper transportation facilities and adequate housing facilities at the various areas have been created. A complete road, trail, and lift system has been constructed and proper equipment and clothing have been designed for complete enjoyment of this outdoor activity. There are below freezing temperatures for prolonged periods of time. In short, all of those factors necessary to participation in winter sports have been adequately provided and no longer present a problem. There remains one variable factor—snow. As yet no satisfactory method has been devised to turn the variable factor of snow into a constant factor that can be controlled and provided whenever and wherever necessary.

Various methods have been devised to simulate natural snow conditions on slopes and thus free the ski industry from the whims of nature. One method has been the use of straw or sand on slopes, which for obvious reasons was unsatisfactory. A second method is the use of crushed ice by manually spreading it over the desired surface. This is more satisfactory, but it is expensive and the end result still is not snow. A third method is the use of compressed air and water through a system of nozzles, producing a spray which crystallizes thereby providing snow. This technique has many drawbacks including the fact that the nozzles freeze because of the very fine apertures therein and continual adjustment is required. Also, coordination of the compressed air and water is seldom properly achieved. Further, this system pre-supposes a more or less permanent system of piping and the resultant problems of maintenance, particularly freezing and bursting. Overall, a critical limitation in every method has been a limited rate of application of snow to the desired surface.

It is therefore an object of the present invention to provide a method and an apparatus whereby snow can be economically formed, distributed, and deposited on a desired surface or surfaces, such as ski areas, ski trails, toboggan runs, and sleigh trails, in such quantities as to be useful in winter sports.

A further object is to provide an apparatus which is simple in design, principle, use, and capable of high production and economical maintenance.

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A still further object is to provide an apparatus that is mobile and does not have maintenance problems such as freezing.

Another object of the present invention is to provide a method for generating snow not subject to problems of compressed air supply, necessity for very fine sprays and the concomitant freezing of nozzles, a very portable and flexible system not requiring a large capital outlay, and whose rate of application is limited only by the pumpability of the liquid.

Other objects and advantages of the invention will become apparent hereinafter.

In the drawings:

Figure 1 is a schematic drawing illustrating the basic theory of the invention which comprises spraying finely divided water into a mechanically produced large volume movement of air having an ambient temperature below about 30° F.

Figure 2 is a general view illustrating the preferred embodiment of the invention utilizing a motor-driven propeller having a deflector mounted thereon, a mixing tank for preparing a mixture of ice and water, means for projecting such mixture into the deflector, and a rotary blower for directing a stream of snow.

Figure 3 is an isometric view illustrating the construction of the portable unit, utilizing two collapsible frames mounted on a platform and a motor-driven propeller mounted on one of the frames.

Figure 4 is a side and 4(a) a front view of a deflector adapted to be mounted at the hub of the propeller.

Figure 5 is a side view elevation of the portable unit shown in Figure 3, collapsed and ready for transport.

Figure 6 is a side schematic view illustrating an apparatus mounted on a truck and provided with an integrated source of water.

Figure 7 is a side schematic view of an optional device to provide the method of the present invention utilizing a centrifugal blower and water sprays located at the outlet thereof.

By practicing the present invention, I am able to produce, distribute, and deposit snow upon a surface in quantities that are useful for skiing or other winter sports.

In this method of generating snow, a large volume movement of air 11 is mechanically provided at atmospheric pressure and a stream of water 12 is introduced into this movement of air in an amount and at a rate such that substantially all of the water is crystallized prior to depositing and covering a surface with snow 13. The water may be introduced into the large volume movement of air by the use of an ordinary garden hose nozzle or a conventional fire-fighting nozzle. Surprisingly, the use of dirty water or water containing crushed ice results in more efficient operation, whereby the dirt and ice particles serve as crystallizing nuclei thereby aiding in the formation of snow crystals. In fact, a mixture up to 65 percent solids can be utilized. For every gram of water sprayed up to two grams of crushed ice or more may be added. These ice crystals are preferably pumped along with the water and sprayed through a nozzle with the water. Or, they may be introduced by other methods into the moving air. If snow is available, a stream of snow 15 can also be introduced in the movement of air by a rotary auxiliary blower 16 such as is used by snow removal devices.

An optimum amount of snow can be produced by introducing snow and a mixture of water and crushed ice into the large volume movement of air. In a preferred embodiment of the invention as shown in Figure 2, a motor-driven propeller 14 is utilized to provide a large volume movement of air 11. A stream of snow 15 from a rotary blower 16 is introduced into the large volume of air simultaneously with a stream of a mixture of crushed

ice and water 17. The mixture 17 is created by having large tank 18 into which water from an independent source is supplied. Crushed ice in the desired amount is continually mixed, as by the stirrer 30 or other agitating means, into the tank 18 to maintain a desired ratio of ice to water. From this tank 18, the mixture is pumped by pump 19 through conduit pipe 21A and directed into the large volume of air 11. The resultant combination of the large volume movement of air 11, the stream of snow 15, thrown as by a rotary plow blower 16, and the stream 17 comprising a mixture of crushed ice and water produces an optimum amount of snow on any desired surface. This optimum output is due to the presence of added particles of snow and crushed ice in the large volume movement of air which gives the water an added opportunity to crystallize about these nuclei and form snow.

The ambient temperature of the air must be at or below about 30 degrees Fahrenheit as a maximum. As the temperature of the air decreases, the volume of the mixture being applied can be increased. This ratio is critical inasmuch as care must be taken to avoid the introduction of excess water into the movement of air which would result in the formation of a glazed ice surface not conducive to skiing. Another critical ratio is that the amount of water introduced into the volume movement of air is directly related to the volume of air being moved. In addition to the air directly moved by the propeller, natural convection currents set up by the propelled air will enhance the total volume movement.

According to one embodiment of the invention, a motor-driven propeller 14 is mounted on a platform 20 and a stream of water 12, preferably containing ice crystals, is directed into the movement of air 11 created by the propeller 14. This water is supplied by a conduit 21 which is connected to an independent source. As shown in Figure 6 the apparatus may be self-contained in that it carries its own water supply. A preferred embodiment of the apparatus presupposes the presence of an adequate supply of water at the location deliverable by a flexible conduit 21.

The propeller 14 may also serve as the propelling force of the platform 20 or only have the purpose of creating a movement of air. The platform 20 can have its own means of propulsion as shown in Figure 6. The propeller assembly may be mounted on a swivel 22 as shown in Figure 6 to direct the stream of air to any side of the platform covering any strip of land with snow by moving the platform parallel to it. In all of the modifications as shown, a nozzle 23 is presupposed at the end of the conduit carrying the water. The nozzle 23 breaks the water down into a spray that can be varied to produce the type of snow desired. However, it has been found that the nozzle is not critical and that snow will be produced by introducing a stream of water into the movement of air not utilizing a nozzle to create a spray, but less water may be introduced when a stream is used.

If desired, the introduction of water into the large volume movement of air may be combined with compressed air snow-making devices to greatly increase the capacity of these conventional devices.

From the foregoing description it will be seen that the basic necessities for the practicing of the invention consist of a supply of water, a conduit 21 to deliver a stream of water 12, and a motor-driven propeller 14 to produce a large volume movement of air 11 drawn from the ambient atmosphere having a temperature of 30 degrees Fahrenheit or less. The crux of the invention lies in the fact that water particles introduced into a stream of air will, under proper atmospheric conditions, be converted into at least partially crystallized crystals. However, sufficient water must be introduced to preclude total evaporation of all the introduced water, but an excess of water results in incomplete crystallization of some of the introduced water, with result that upon contacting the frozen surface, the excess water freezes and a glazed ice

surface results. A hose such as is used by fire-fighting apparatus is attached to the independent water supply and an operator, standing to one side of the propeller, directs a stream of water 12 into the movement of air 11 producing snow 13 on the desired area. Naturally the water must come from a source that has enough pressure to carry the water up the hill on which the ski trail is constructed.

An important feature of the apparatus is its portability due to the fact that the frame may be collapsed into the narrow platform as shown in Figure 5 for transportation to any area by a station wagon or small pick-up truck. Once the toboggan has reached the area that is to be covered with snow, it can be anchored by tying it to a tree, placing the nose against a large boulder, or driving anchoring pins into the ground and snow around the nose of the platform. By positioning the platform in the desired direction, a movement of air will flow over the area that is to be covered. In this manner a ski trail or toboggan run can be "repaired" by depositing snow on any worn areas, such as turns on a ski or toboggan run or landing spots on a ski jump area.

As shown in Figures 2 and 3, one form of this invention is to have a 90 horsepower Continental aircraft engine 24 mounted on an adjustable and collapsible frame 25 which rests on a narrow toboggan-like platform 20. This engine actuates a typical airplane propeller 14 at approximately 2200 r.p.m. creating a movement of air 11 very similar to that encountered behind an aircraft about to take off. A second adjustable and collapsible frame 26 provides support for the engine support frame 25. The adjustable members 25 and 26 can be adjusted in relation to each other to vary the movement of air from movement parallel to the surface to an upward movement if necessary in order to cover a greater area.

Although the applicant's apparatus is very mobile, it is pointed out that snow can be generated at a central locale and subsequently distributed wherever it is needed.

Another embodiment of this technique involving a more permanent installation is an aircraft engine 24 mounted on a platform 20 in such a manner that the movement of air crosses the ski trail while the platform is pulled up the hill or mountain by a chain drive parallel to the trail. As the snow on the trail wears out, the apparatus can be moved slowly up or down the hill generating snow as it moves.

As shown in Figure 6, the propeller assembly can be mounted on a flat bed truck or snowmobile, giving the unit great mobility. With a water tank installed 27 thereon, it would be very useful in placing snow on sleigh trails that run through flat country removed from a water supply. As discussed earlier, the engine can be swivelly mounted so the movement of air can be directed over a strip while the truck is driven parallel to such strip. The conduit 21 can be fixed to the swivel in such a manner as to keep the stream of water directly in the movement of air at all times, enabling the operator to drive the truck without the need of another person to operate the apparatus.

An additional embodiment of the invention is shown in Figure 2 wherein an impeller-like deflector 28 as shown in Figure 4 is incorporated into the apparatus, by mounting it on the hub of the propeller 14 so that it rotates with the propeller. The vanes 29 of the deflector and the centrifugal force created by the rotation of the deflector will combine to throw any stream of water directed against it back into the volume movement of air in a finely dispersed state.

Although the illustrated embodiments of my invention have been limited to motor-driven propellers, any type of blower can be used to create the desired movement of air. As shown in Figure 7, a rotary blower may be employed and the water distributing means 23 attached thereto, either at the air outlet, as illustrated, or introduced at the air intake, as desired. A stream of

water can be directed into a movement of air created by any type of impeller or various types of rotary plows that use blowers and the desired amount of snow can be deposited on any given surface under proper atmospheric conditions.

On tests of the device, it was found that snow could be generated at temperatures as high as 30 degrees Fahrenheit using the specific apparatus herein described. A rule of thumb has been developed that one gallon per minute per horsepower will lead to the formation of very fine sugar-like crystals at temperatures around 30 degrees Fahrenheit. The amount of ice introduced with the water will allow the transformation of additional water into snow. By using ice in the water, rather large crystals are formed. As the ambient temperature of the air goes lower, the amount of water which can be converted to snow is larger.

Various modifications of the invention may be made without departing from the principle thereof. Each of these modifications is to be considered as included in the hereinafter appended claims unless these claims by their language expressly provide otherwise.

Having thus set forth the nature of my invention, I claim the following:

1. The method of forming, distributing, and depositing snow upon a surface, including: mechanically providing a large volume movement of air at atmospheric pressure; said movement of air created by a motor-driven propeller, said air having an ambient temperature at or below about 30 degrees Fahrenheit; and projecting water into said movement of air in an amount and at a rate such that substantially all of the water so-introduced is at least partially crystallized prior to depositing on said surface.

2. The method of forming, distributing, and depositing snow upon a surface, including: providing a directable large volume movement of air at atmospheric pressure; said movement of air created by a motor-driven propeller; said air having an ambient temperature at or below about 30 degrees Fahrenheit; and projecting a directable stream of water into said movement of air in an amount and at a rate such that substantially all of the so-introduced water is at least partially crystallized prior to depositing on said surface.

3. An apparatus for forming, distributing and depositing snow in flake form upon a surface, which apparatus comprises: a self-propelled platform provided with means for movement over the terrain; a swivelly mounted motor-driven pusher-type propeller mounted upon the rear of said platform; said swivelly-mounted propeller capable of being locked in several positions; said propeller capable of providing a large volume movement of air outwardly in several directions from rear of platform; a water tank mounted on said platform; and a flexible conduit connected to said water tank and capable of projecting a stream of water into said movement of air.

4. An apparatus for forming, distributing, and depositing snow upon a surface, which apparatus comprises:

a platform; a motor-driven propeller mounted upon said platform capable of providing a large volume movement of air at or slightly greater than atmospheric pressure; an impeller-like deflector rotatably mounted on hub of said propeller; a flexible and directable conduit capable of projecting a stream of water against said rotating deflector with sufficient force to cause the water to be swirled into the movement of air.

5. The method of forming, distributing, and depositing snow upon a surface, including: providing a large volume movement of air at atmospheric pressure; said movement of air created by a motor-driven propeller; said air having an ambient temperature at or below 30 degrees Fahrenheit; a mixture of crushed ice and water in a ratio not less than one part crushed ice to two parts of water and not more than two parts of crushed ice to one part of water; projecting said mixture into said movement of air in an amount and at a rate such that substantially all of the so-introduced water is at least partially crystallized prior to depositing on said surface.

6. The method of forming, distributing, and depositing snow upon a surface including: providing a large volume movement of air at atmospheric pressure; said air having an ambient temperature at or below 30 degrees Fahrenheit; projecting a mixture of crushed ice and water into said movement of air; said mixture and said rate of application being such that substantially all of the so-introduced water is at least partially crystallized prior to depositing on said surface.

7. The method of forming, distributing, and depositing snow upon a surface including: providing a large volume movement of air at atmospheric pressure; said movement of air created by a motor-driven propeller; said air having an ambient temperature at or below 30 degrees Fahrenheit; a directable stream of snow created by a rotary-type blower; a mixture of crushed ice and water maintained at a constant ratio and created by introducing crushed ice into a tank of water provided with a flexible conduit and capable of pumping said mixture from said tank as a directable stream; said stream of snow and mixture of crushed ice and water being simultaneously introduced into said movement of air in such a manner that substantially all of the so-introduced water is at least partially crystallized prior to depositing on said surface.

References Cited in the file of this patent

UNITED STATES PATENTS

50	1,104,920	Osborne	July 28, 1914
	1,221,054	Hyatt	Apr. 3, 1917
	1,586,997	Hull	June 1, 1926
	2,613,109	Walker	Oct. 7, 1952
	2,676,471	Pierce	Apr. 27, 1954
55	2,699,045	Bailey	Jan. 11, 1955

FOREIGN PATENTS

661,254	Great Britain	Nov. 21, 1951
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Disclaimer

2,968,164.—*Alden W. Hanson*, Midland, Mich. METHOD OF GENERATING SNOW. Patent dated Jan. 17, 1961. Disclaimer filed May 19, 1982, by the inventor.

**Hereby enters this disclaimer to claim 4 of said patent.
[Official Gazette January 11, 1983.]**

REEXAMINATION CERTIFICATE (104th)

United States Patent [19]

[11] B1 2,968,164

Hanson

[45] Certificate Issued Jul. 12, 1983

[54] METHOD OF GENERATING SNOW

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FOREIGN PATENT DOCUMENTS

623183 1935 Fed. Rep. of Germany.
661254 1951 United Kingdom.

Reexamination Request

No. 90/000,158, Feb. 12, 1982

Reexamination Certificate for:

Patent No.: 2,968,164
Issued: Jan. 17, 1961
Appl. No.: 716,906
Filed: Feb. 24, 1958

Disclaimer of claim 4, filed May 19, 1982 (1026
O.G. 278).

- [51] Int. Cl.³ F25C 1/00; A01G 15/00
[52] U.S. Cl. 62/74; 62/121; 62/239; 62/304;
62/404; 62/533; 239/2.5; 239/77; 239/420;
239/433; 239/524; 261/115
[58] Field of Search ... 62/57, 74, 121, 347, 340;
239/2.5

[56] References Cited

U.S. PATENT DOCUMENTS

1,104,920	7/1914	Osborne	62/341
1,221,054	4/1917	Hyatt	62/341
1,586,997	6/1926	Hull	239/77
1,730,866	10/1929	Sternberg	
2,571,069	10/1951	Shearman	239/2.5 X
2,613,109	10/1952	Walker	
2,676,471	4/1954	Pierce	
2,699,045	1/1955	Bailey	62/340 X

OTHER PUBLICATIONS

Rush, "The N.R.C. Icing Wind Tunnels and Some of Their Problems", Papers presented at the Seventh Meeting of Wind Tunnel and Model Testing Panel (NATO), AG19-P9, pp. 230-243, June 1955.

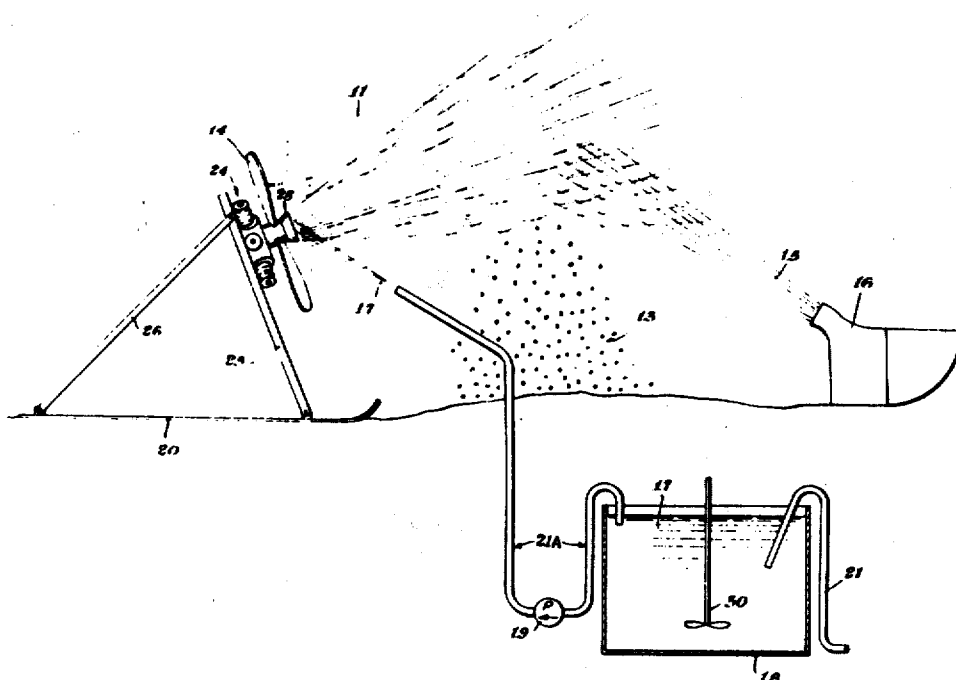
Rush and Wardlaw, "Wind Tunnel Simulation of Atmospheric Icing Conditions", Papers presented at the Seventh Meeting of Wind Tunnel and Model Testing Panel (NATO), AG19-P9, pp. 244-259, June 1955.

von Glahn, "Icing Problem—Current Status of N.A.C.A. Techniques and Research", Papers presented at the Seventh Meeting of Wind Tunnel and Model Testing Panel (NATO), AG19-P9, pp. 293-331, June 1955.

Primary Examiner—W. E. Wayner

EXEMPLARY CLAIM

1. The method of forming, distributing, and depositing snow upon a surface, including: mechanically providing a large volume movement of air at atmospheric pressure; said movement of air created by a motor-driven propeller, said air having an ambient temperature at or below about 30 degrees Fahrenheit; and projecting water into said movement of air in an amount and at a rate such that substantially all of the water so-introduced is at least partially crystallized prior to depositing on said surface.



**REEXAMINATION CERTIFICATE
ISSUED UNDER 35 U.S.C. 307.**

**NO AMENDMENTS HAVE BEEN MADE TO
THE PATENT.**

**AS A RESULT OF REEXAMINATION, IT HAS
BEEN DETERMINED THAT:**

The patentability of claims 1-3 and 5-7 is con-
5 firmed.

Claim 4 was previously disclaimed.

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