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(54) SNOW GROOMING DEVICE AND SNOW GROOMER

(57) A snow grooming device and a snow groomer. The snow grooming device (1) comprises: a frame (2), which can move along a first direction (x) and comprises a first side (S1) and second side (S2) that are provided opposite one another along the first direction (x); and a snow-breaking and shaping apparatus (3), which is located at the bottom of the frame (2) and is connected to the frame (2) and which is configured to be able to move along the first direction (x) together with the frame (2).

The snow-breaking and shaping apparatus (3) comprises a snow-breaking structure (31) and a shaping structure (32), the snow-breaking structure (31) is close to the first side (S1) of the frame (2), and the shaping structure (32) is close to the second side (S2) of the frame (2). The described snow-grooming device (1) can simultaneously break and shape snow, which increases snow-breaking efficiency, while also being low-cost and having strong environmental adaptability.

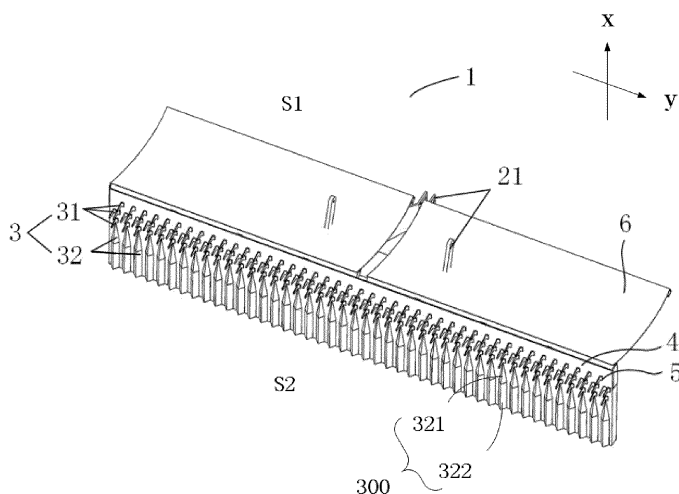


FIG. 2

Description

CROSS-REFERENCE OF RELATED APPLICATION

[0001] For all the purposes, the present application claims priority to Chinese patent application No. 201911378224.5, filed on December 27, 2019, the entire disclosure of which is incorporated herein by reference as part of the present application.

TECHNICAL FIELD

[0002] Embodiments of the present disclosure relate to a snow grooming device and a snow groomer.

BACKGROUND

[0003] With the rapid development of China's ski industry, mechanical devices applied to the ski industry are also developed gradually. For ski resorts, it is very important to evenly smooth the snow and standardize the shaping of the snow in various gathered forms on the snow trails, especially the treatment for hardened ice and snow has become a tough problem for the ski resorts. A snow groomer is an important tool for smoothing the snow trails in the snow resorts.

SUMMARY

[0004] Embodiments of the present disclosure provide a snow grooming device and a snow groomer including the snow grooming device, which are capable of shaping the snow while crushing the snow and have the characteristics of low cost and good environmental adaptability.

[0005] According to first aspect of the present disclosure, it is provided a snow grooming device, comprising:

a support frame, configured to move along a first direction and comprising a first side and a second side that are opposite to each other in the first direction; and

a snow crushing and shaping apparatus, located at the bottom of the support frame and connected to the support frame, the snow crushing and shaping apparatus are configured to move along with the support frame in the first direction and comprising a snow crushing structure proximal to the first side of the support frame and a snow shaping structure proximal to the second side of the support frame.

[0006] For example, in the afore-mentioned snow grooming device, the snow crushing and shaping apparatus further comprises a knife board connected to the bottom of the support frame; and the snow crushing structure and the snow shaping structure are both disposed on a side of the knife board facing away from the support frame.

[0007] For example, in the afore-mentioned snow

grooming device, the snow crushing structure comprises a plurality of snow crushing knives arranged in a second direction, and the second direction is parallel to a plane where the knife board is located and perpendicular to the first direction; and the snow shaping structure comprises a plurality of shaping members, the plurality of shaping members are arranged in the second direction and parallel to one another.

[0008] For example, in the afore-mentioned snow grooming device, the snow crushing structure comprises a plurality of snow crushing knife groups arranged in the first direction, and each of the snow crushing knife groups comprises the plurality of snow crushing knives; the plurality of snow crushing knife groups are arranged into a plurality of rows, and the snow crushing knives in two adjacent rows of the snow crushing knife groups are staggered with one another in the second direction.

[0009] For example, in the afore-mentioned snow grooming device, the plurality of snow crushing knife groups comprise odd rows of snow crushing knife groups and even rows of snow crushing knife groups, and the snow crushing knives in two adjacent odd rows of snow crushing knife groups are staggered with one another in the second direction; the even rows of snow crushing knife groups comprise a plurality of snow crushing knife sub-groups, and each of the snow crushing knife sub-groups comprises at least two of the snow crushing knives and is located in a center line between two of the snow crushing knives in the snow crushing knife group of the odd row most proximal to the first side of the support frame.

[0010] For example, in the afore-mentioned snow grooming device, each of the snow crushing knives comprises a knife tail, a knife body, and a knife edge disposed on the knife body; the knife tail is connected to the knife board, the knife body is connected to the knife tail, and a plane where the knife body is located is perpendicular to the plane where the knife board is located.

[0011] For example, in the afore-mentioned snow grooming device, the knife body comprises a first knife surface and a second knife surface disposed opposite to each other, and a side surface connecting the first knife surface and the second knife surface; and the knife edge is disposed on one of the first knife surface, the second knife surface and the side surface.

[0012] For example, in the afore-mentioned snow grooming device, the snow crushing structure comprises a plurality of snow crushing knife groups arranged in the first direction, and each of the snow crushing knife groups comprises the plurality of snow crushing knives; and the plurality of snow crushing knife groups are arranged into a plurality of rows, and in at least one row of snow crushing knife group, the snow crushing knife having the knife edge on the first knife surface are alternated with the snow crushing knife having the knife edge on the second knife surface.

[0013] For example, the afore-mentioned snow grooming device further comprises a snow shoveling appara-

tus, the snow shoveling apparatus is located on the first side of the support frame and connected to the support frame, and the snow shoveling apparatus comprises a snow shoveling board; and each of the snow crushing knives is more proximal to the snow shoveling board than each of the shaping members.

[0014] For example, in the afore-mentioned snow grooming device, in the case that the plurality of snow crushing knives are arranged into a single row, the plurality of snow crushing knives are in one-to-one correspondence with and connected to the plurality of shaping members; and in the case that the plurality of snow crushing knives are arranged into a plurality of rows, the snow crushing knives, in one row of snow crushing knives that is most proximal to the shaping members, are in one-to-one correspondence with and connected to the plurality of shaping members.

[0015] For example, in the afore-mentioned snow grooming device, each of the shaping members comprises a guide portion and a shaping portion; the guide portion is proximal to the first side of the support frame and configured to guide ice or snow to the shaping portion, the shaping portion is proximal to the second side of the support frame and configured to shaping the ice or the snow, and the guide portion and the shaping portion are connected to each other.

[0016] For example, in the afore-mentioned snow grooming device, the guide portion is cone-shaped, and the shaping portion is column-shaped; and each of the snow crushing knives has a length greater than a thickness of each of the shaping members.

[0017] For example, in the afore-mentioned snow grooming device, the length of each of snow crushing knives is 2 times to 10 times the thickness of each of the shaping members.

[0018] According to second aspect of the present disclosure, it is provided a snow groomer, comprising:

the afore-mentioned snow grooming device; and
a power apparatus, connected to the snow grooming device and configured to supply driving power to the snow grooming device such that the snow grooming device moves in the first direction.

[0019] For example, in the afore-mentioned snow groomer, the snow grooming device further comprises a connection structure and a snow shoveling apparatus; the power apparatus is connected to the snow grooming device through the connection structure, the connection structure is located on at least one of the snow shoveling apparatus and the support frame, and the power apparatus is mounted on a front side or a rear side of the snow grooming device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] In order to clearly illustrate the technical solution of the embodiments of the disclosure, the drawings of

the embodiments will be briefly described in the following; it is obvious that the described drawings are only related to some embodiments of the disclosure and thus are not limitative of the disclosure.

FIG. 1 illustrates an oblique top view of a snow grooming device from an observing angle according to an embodiment of the present disclosure;

FIG. 2 illustrates an oblique bottom view of a snow grooming device according to an embodiment of the present disclosure;

FIG. 3 illustrates an oblique top view of a snow grooming device from another observing angle according to an embodiment of the present disclosure;

FIG. 4 illustrates a schematically structural diagram of a snow crushing and shaping apparatus according to an embodiment of the present disclosure;

FIG. 5 illustrates a schematically partial enlarged diagram of a snow crushing and shaping apparatus according to an embodiment of the present disclosure;

FIG. 6 illustrates a schematic diagram of a snow crushing knife according to an embodiment of the present disclosure;

FIG. 7 illustrates a cross-sectional diagram of a shaping member according to an embodiment of the present disclosure;

FIG. 8 illustrates a partially cross-sectional diagram of a knife edge according to an embodiment of the present disclosure;

FIG. 9 illustrates a partially cross-sectional diagram of a knife edge according to another embodiment of the present disclosure; and

FIG. 10 illustrates a schematic diagram of a snow groomer according to an embodiment of the present disclosure.

DETAILED DESCRIPTION

[0021] In order to make objects, technical details and advantages of the embodiments of the disclosure apparent, the technical solutions of the embodiments will be described in a clearly and fully understandable way in connection with the drawings related to the embodiments of the disclosure. Apparently, the described embodiments are just a part but not all of the embodiments of the disclosure. Based on the described embodiments herein, those skilled in the art can obtain other embodiment(s), without any inventive work, which should be within the scope of the disclosure.

[0022] Unless otherwise specifically defined, the technical terms or scientific terms used in the present disclosure shall have ordinary meanings understood by people having ordinary skills in the art to which the present disclosure pertains. In the description of the present disclosure, the terms such as "length," "width," and "thickness," and the orientations or position relationships indicated by "on," "below," "front," "rear," "left," "right," "vertical,"

"horizontal," "top," "bottom," "inner," and "outer" are those shown based on the accompanying drawings, which are merely intended to facilitate the description of the present disclosure or simplify the description, rather than indicating or implying that the described units or components must have specific orientations or must be constructed or operated in the specific orientations, and therefore they cannot be construed as limitations to the present disclosure. Moreover, the terms such as "first" and "second" are merely used for the purpose of description and shall not be construed as indicating or implying any order, quantity or importance. In the description of the present disclosure, "a plurality of" means two or more, unless otherwise specifically defined. The terms "connect with" and "connect to" shall be understood in a broad sense, which are not restricted to physical or mechanical connections and may include electrical connections, whether direct or indirect. For example, the connection may be a fixed connection, a detachable connection, or an integral connection. For another example, the connection may be a mechanical connection, an electrical connection, or intercommunication. For another example, the connection may be a direct connection, or an indirect connection through an intermediate medium, or internal communication between two components, etc. A person having ordinary skills in the art may understand specific meanings of the foregoing terms in the present disclosure based on a specific situation.

[0023] The following disclosure provides many different embodiments or examples for implementing different structures of the present disclosure. In order to simplify the present disclosure, the components and configurations of specific examples are described below. It is understood that the descriptions are only examples and are not intended to limit the present disclosure. In addition, reference numerals and/or reference letters may be reused in different examples of the present disclosure, and such reusing is for the purpose of simplification and clarity and is not indicative of relationships between the embodiments and/or configurations discussed. In addition, the present disclosure provides examples of various specific processes and materials, a person having ordinary skills in the art may be aware of applications of other processes and/or use of other materials.

[0024] In the present disclosure, a large-sized snow groomer is equipped with a hydraulic rotation motor and powered by the motor to crush and shape snow. Such a snow groomer is huge in size and requires high output power, which results in high energy consumption and is extremely expensive. In addition, the snow groomer has poor adaptability to snow trails and high fault rate, which not only leads to high purchase cost and maintenance cost, but also requires relatively high technical level of operators, thus increasing the cost of personnel training and salary payment. Due to the large temperature difference between day and night in ski resorts, the surface of snow is prone to freeze, which increases the difficulty of crushing snow on snow trails. Accordingly, it is neces-

sary to design a kind of snow groom device, which not only crushes and shapes snow, but also has the performance of low cost and strong environmental adaptability.

[0025] Embodiments of the present disclosure provide a snow grooming device and a snow groomer including the snow grooming device that grooms snow while crushing snow and have the characteristics of low cost and good environmental adaptability.

[0026] An embodiment of the present disclosure provides a snow grooming device including: a support frame configured to move along a first direction and including a first side and a second side opposite to each other in the first direction; and a snow crushing and shaping apparatus located at a bottom of the support frame and connected to the support frame. The snow crushing and shaping apparatus is configured to move along with the support frame in the first direction and includes a snow crushing structure proximal to the first side of the support frame and a snow shaping structure proximal to the second side of the support frame.

[0027] Another embodiment of the present disclosure provides a snow groomer including a snow grooming device and a power apparatus. The snow grooming device includes: a support frame configured to move along a first direction and including a first side and a second side opposite to each other in the first direction; and a snow crushing and shaping apparatus located at a bottom of the support frame and connected to the support frame. The snow crushing and shaping apparatus is configured to move along with the support frame in the first direction and includes a snow crushing structure proximal to the first side of the support frame and a snow shaping structure proximal to the second side of the support frame. The power apparatus is connected to the snow grooming device and configured to provide driving power to the snow grooming device such that the snow grooming device moves in the first direction.

[0028] Embodiments of the present disclosure will be described below with reference to the accompanying drawings. It should be understood that the preferred embodiments described herein are merely used to illustrate and explain the present disclosure and not intended to limit the present disclosure.

[0029] FIG. 1 illustrates an oblique top view of a snow grooming device 1 from an observing angle according to an embodiment of the present disclosure. As shown in FIG. 1, the snow grooming device 1 includes a support frame 2 configured to move along a first direction (e.g., the x-direction shown in the figure). The support frame 2 includes a first side S1 and a second side S2 opposite to each other in the first direction. The snow grooming device 1 further includes a snow crushing and shaping apparatus 3 which is located at a bottom of the support frame 2 and connected to the support frame 2. The snow crushing and shaping apparatus 3 is configured to move along with the support frame 2 in the first direction. For example, the support frame 2 includes a mounting frame 201 and a frame 202 connected to the mounting frame

201, and the mounting frame is movable. The snow crushing and shaping apparatus 3 is connected to the frame 202. Because the frame 202 is fixedly connected to the bottom of the mounting frame 201 and the snow crushing and shaping apparatus 3 is fixedly connected to the bottom of the frame 202, stable connections are formed among the frame 202, the mounting frame 201 and the snow crushing and shaping apparatus 3. In the case that the mounting frame 201 moves under the application of an external force, the frame 202 and the snow crushing and shaping apparatus 3 move together with the mounting frame 201 in the same direction. The embodiments of the present disclosure have no particular limitation on the specific connection manner between components or parts, which, for example, may be a welded connection, a threaded connection, a riveted connection, or a fastened connection.

[0030] FIG. 2 illustrates an oblique bottom view of the snow grooming device 1 according to an embodiment of the present disclosure. As shown in FIG. 2, the snow crushing and shaping apparatus 3 includes a snow crushing structure 31 and a snow shaping structure 32. The snow crushing structure 31 is configured to crush snow in the ski resort or on snow trails and break hardened snow into soft snow to achieve the purpose of loosening snow. The snow shaping structure 32 is configured to shape the crushed snow again. The first side S1 of the support frame 2 is a front side of the snow grooming device 1 when crushing snow along the traveling direction, while the second side S2 is an opposite side, namely a rear side of the snow grooming device 1. Relative to the snow shaping structure 32, the snow crushing structure 31 is more proximal to the first side S1 of the support frame 2; the snow shaping structure 32 is proximal to the second side S2 of the support frame 2, so that the snow crushed by the snow crushing structure 31 is capable of directly entering the snow shaping structure 32 so as to be reshaped by the snow shaping structure 32.

[0031] In some embodiments, the snow grooming device further includes a connection structure. A power apparatus is connected to the snow grooming device through the connection structure to drive the snow grooming device to move. As shown in FIG. 2, the support frame 2 is provided with a connection structure 21. The connection structure 21 is connected to the power apparatus, for example, a hydraulic motor, or a tractor (e.g., a wheeled tractor or a caterpillar tractor). The power apparatus provides driving power for the snow grooming device 1 to enable the snow grooming device 1 to move. Meanwhile, the power apparatus further provides snow grooming driving power to increase the pressure of the snow grooming device 1 on the snow surface, which is conducive to enhancing the crushing effect of the snow grooming device 1 on snow. Alternatively, the connection structure 21 may be further connected to a control apparatus which controls the snow grooming device 1 through the connection structure 21.

[0032] In some embodiments, the snow grooming de-

vice 1 further includes a snow shoveling apparatus 6. For example, the snow shoveling apparatus 6 is disposed on a side of the support frame 2, i.e., on the first side S1 of the support frame 2 proximal to the snow crushing structure. The snow shoveling apparatus 6 is connected to the support frame 2. For example, the snow shoveling apparatus 6 is fixedly connected to the frame 202. The snow shoveling apparatus 6 is configured to shovel the uneven snow surface to provide a flat snow surface and play a role of smoothing snow, which is conducive to enhancing the crushing effect of the snow crushing structure 31 on the snow and the shaping effect of the snow shaping structure 32 on snow. As shown in FIG. 1, the snow shoveling apparatus 6 includes a snow shoveling board. To improve the stability of the snow shoveling board, the snow shoveling board is fixedly connected to the support frame 2 through a plurality of (for example, six connecting rods as shown in the figure) connecting rods. For ease of pushing crushed snow, the snow shoveling board has a concave surface, that is, a bending surface.

[0033] In some embodiments, the connection structure is located on at least one of the snow shoveling apparatus and the support frame. FIG. 3 illustrates an oblique top view of the snow grooming device 1 from another observing angle according to an embodiment of the present disclosure. As shown in FIG. 2 and FIG. 3, the connection structures 21 are disposed on top of the support frame 2 and on the concave surface of the snow shoveling apparatus 6. The power apparatus and/or the control apparatus may be connected to the snow grooming device 1 through the connection structures 21. For example, the power apparatus is located on the front side of the snow grooming device 1, in this way, the snow grooming device 1 is driven under a pulling force produced by the power apparatus to move in the first direction. In addition, according to practical requirements, the power apparatus may also be located on the rear side of the snow grooming device 1, and the snow grooming device 1 is driven by a pushing force produced by the power apparatus to move in the first direction. Thus, the embodiments of the present disclosure have no particular limitation on the location of the power apparatus.

[0034] In this embodiment, with the connection structures 21 fixed to the support frame 2 and the snow shoveling apparatus 6, the strength and stability of the connection between the power apparatus and the snow grooming device 1 is increased. It will be understood that in other embodiments of the present disclosure, the connection structures 21 may be mounted only on the support frame 2 or only on the snow shoveling apparatus 6, and the connection between the power apparatus and the snow grooming device 1 can also be achieved. For example, the connection structures 21 are a hook-like member or a ring-shaped member, thereby allowing for easy connection or removal of the power apparatus.

[0035] In some embodiments, the snow crushing and shaping apparatus 3 further includes a knife board 4. As

shown in FIG. 2, the snow crushing structure 31 and the snow shaping structure 32 are both disposed on the knife board 4, and the knife board 4 is connected to the bottom of the support frame 2. For example, the knife board 4 is substantially parallel to the ground, thereby facilitating the insertion of snow crushing knives 5 on the knife board 4 into snow. For example, the snow crushing structure 31 and the snow shaping structure 32 are both disposed on the side of the knife board 4 facing away from the support frame 2. In this way, when the snow grooming device 1 works, the snow crushing structure 31 and the snow shaping structure 32 are oriented to the ground, which facilitates the crushing and shaping of snow accumulated on the ground. The effect of the knife board 4 is to not only connect the snow crushing and shaping apparatus 3 with the support frame 2, but also increase the overall weight of the snow grooming device 1 so as to increase the pressure of the snow grooming device 1 on the snow surface, thus enhancing the crushing effect of the snow grooming device 1 on snow. For example, the knife board 4 is a rectangular steel plate. Alternatively, the snow crushing and shaping apparatus 3 is directly connected to the bottom of the support frame 2.

[0036] In some embodiments, as shown in FIG. 2, the snow crushing structure 31 includes a plurality of snow crushing knives 5. The plurality of snow crushing knives 5 are arranged in a second direction (e.g., the y-direction shown in the figure) which is parallel to the plane of the knife board 4 and perpendicular to the first direction. As shown in FIG. 2, the snow shaping structure 32 includes a plurality of shaping members 300, the plurality of shaping members 300 are arranged in the second direction and parallel to one another. In this way, while the snow grooming device 1 moves in the first direction, the snow on the ground is crushed by the plurality of snow crushing knives 5 located at the bottom of the support frame 2. The crushed snow directly enters gaps between the shaping members 300 and thus is reshaped. As such, the effects of crushing and shaping snow are both achieved. After the snow reshaping, the snow trails is uniformly distributed and flat.

[0037] In some embodiments, the snow crushing structure includes a plurality of snow crushing knife groups arranged in the first direction. Each of the snow crushing knife groups includes a plurality of snow crushing knives. The plurality of snow crushing knife groups are arranged into a plurality of rows, and the snow crushing knives in two adjacent rows of the snow crushing knife groups are staggered with one another in the second direction. In this way, the blocks of snow are crushed for multiple times into smaller pieces, thereby achieving the purpose of loosening snow.

[0038] FIG. 4 illustrates a schematically structural diagram of the snow crushing and shaping apparatus 3 according to an embodiment of the present disclosure. As shown in FIG. 4, the snow crushing structure 31 includes a first snow crushing knife group 311, a second snow crushing knife group 312, and a third snow crushing

knife group 313. The first snow crushing knife group 311, the second snow crushing knife group 312 and the third snow crushing knife group 313 are sequentially arranged in a direction from the first side S1 to the second side S2 of the support frame 2. While the snow grooming device 1 travels forwards to crush snow, the snow successively undergoes the first snow crushing knife group 311, the second snow crushing knife group 312 and the third snow crushing knife group 313, thus causing the snow in the ski resort to be crushed for three times (i.e., three-level crushing), which is more sufficiently to crush the snow.

[0039] In some embodiments, the snow crushing knives 5 of the first snow crushing knife group 311 are arranged in a straight line, and the snow crushing knives 5 of the second snow crushing knife group 312 and the snow crushing knives 5 of the third snow crushing knife group 313 are also arranged in straight lines, respectively.

[0040] Further, as shown in FIG. 4, the second snow crushing knife group 312 includes a plurality of snow crushing knife sub-groups 400 each including two snow crushing knives 5. It will be understood that each snow crushing knife sub-group 400 may also include more than two snow crushing knives 5. The embodiments of the present disclosure have no particular limitation on the number of snow crushing knives in each snow crushing knife group or the number of snow crushing knives in each snow crushing knife sub-group.

[0041] Further, as shown in FIG. 4, the snow crushing knives 5 in the first snow crushing knife group 311 and the snow crushing knives 5 in the second snow crushing knife group 312 are staggered with one another in the second direction. For example, each snow crushing knife sub-group 400 in the second snow crushing knife group 312 is located at a center line ala_2 between two snow crushing knives 5 in the first snow crushing knife group 311 (i.e., the snow crushing knife group of the odd row that is most proximal to the first side S1 of the support frame 2). Further, each snow crushing knife sub-group 400 has a width smaller than a distance between two snow crushing knives 5 in the first snow crushing knife group 311. In this way, the snow passing through the gap between two snow crushing knives 5 in the first snow crushing knife group 311 is crushed by the snow crushing knives 5 in the second snow crushing knife group 312, thereby improving the snow crushing efficiency.

[0042] Further, as shown in FIG. 4, the snow crushing knives 5 in the first snow crushing knife group 311 and the snow crushing knives 5 in the third snow crushing knife group 313 are staggered with one another in the second direction. In this way, the blocks of snow are crushed into smaller pieces, thereby achieving the purpose of loosening snow.

[0043] In some embodiments, in the case that the plurality of snow crushing knives are arranged into a single row, the plurality of snow crushing knives are in one-to-one correspondence with the plurality of shaping members and are connected to the plurality of shaping mem-

bers. In the case that the plurality of snow crushing knives are arranged into a plurality of rows, the snow crushing knives, in the row of snow crushing knives most proximal to the shaping members, are in one-to-one correspondence with the plurality of shaping members and are connected to the plurality of shaping members. As shown in FIG. 4, the snow crushing knives in the third snow crushing knife group 313 are in one-to-one correspondence with the plurality of the shaping members 300 and are connected to the plurality of the shaping members 300, which is conducive to guiding and shaping the crushed snow.

[0044] FIG. 5 illustrates a partially enlarged schematic diagram of the snow grooming unit 3 according to an embodiment of the present disclosure. As shown in FIG. 5, in some embodiments, a distance between the first snow crushing knife group 311 and the second snow crushing knife group 312 (in the x-direction shown in FIG. 5) is 20 mm to 60 mm, and a distance between the second snow crushing knife group 312 and the third snow crushing knife group 313 (in the x-direction shown in FIG. 5) is 20 mm to 60 mm. In the embodiments of the present disclosure, the plurality of snow crushing knife groups may be arranged at equal interval, or arranged at unequal interval. In the case that the plurality of snow crushing knife groups are arranged at equal interval, the manufacturing process is simplified and better snow crushing effect is achieved, and therefore it is preferred.

[0045] In the embodiments of the present disclosure, the snow crushing knives in each snow crushing knife group may be arranged at equal interval, or may be arranged at unequal interval. In the case that the plurality of snow crushing knives are arranged at equal interval, better snow crushing effect can be achieved, and therefore it is preferred. In some embodiments, a gap between the snow crushing knives 5 in the first snow crushing knife group 311 (in the y-direction shown in FIG. 5) is 20 mm to 60 mm, and a gap between the snow crushing knives 5 in the third snow crushing knife group 313 (in the y-direction shown in FIG. 5) is 20 mm to 60 mm. A gap between the snow crushing knives 5 in the second snow crushing knife group 312 (in the y-direction shown in FIG. 5) is 10 mm to 50 mm.

[0046] Further, for example, the gap between the first snow crushing knife group 311 and the second snow crushing knife group 312 is 40 mm, and the gap between the second snow crushing knife group 312 and the third snow crushing knife group 313 is also 40 mm. For example, the snow crushing knives 5 of the first snow crushing knife group 311 are arranged at equal interval of 40 mm, and the snow crushing knives 5 of the third snow crushing knife group 313 are also arranged at equal intervals of 40 mm. In the second snow crushing knife group 312, the gaps between the snow crushing knives 5 are alternated. For example, the gap between the two snow crushing knives 5 in the second snow crushing knife sub-group 400 is 16 mm, and the gap between the two second snow crushing knife sub-groups 400 is 24 mm, thus, the

gap of 16 mm and the gap of 24 mm are alternated provided in the second snow crushing knife group 312.

[0047] While the snow grooming device 1 travels forwards to crush snow, hardened snow on the snow trail is first crushed by the snow crushing knives 5 of the first snow crushing knife group 311 to undergo preliminary level crushing. As the snow grooming device 1 moves forward, the preliminary crushed snow is crushed by the snow crushing knives 5 of the second snow crushing knife group 312 to undergo secondary level crushing. Because the gap of 16 mm and the gap of 24 mm are alternated provided between the snow crushing knives 5 in the second snow crushing knife group 312, a large portion of the secondarily crushed snow enters the gap of 24 mm, while a small portion of the snow enters the gap of 16 mm. Finally, the secondarily crushed snow is crushed again by the snow crushing knives 5 in the third snow crushing knife group 313 to undergo tertiary level crushing. The hardened snow on the snow trail is crushed into soft snow for three times, thereby achieving the purpose of loosening snow.

[0048] In actual application, the width of the snow grooming device 1 affects the adaptation to the snow trails and the snow surface. In the case that the width of the snow grooming device 1 is from 4 m to 10 m, the snow grooming device 1 covers wider snow surface while travels forwards, so it crushes snow with high snow crushing efficiency. In the case that the snow grooming device 1 is from 2 m to 4 m, the snow grooming device 1 is adaptable to more various conditions of the snow surface and operated more flexibly. For example, in the case that the snow grooming device 1 has the width of 3 m to 6 m, the snow grooming device 1 can not only achieve high snow crushing efficiency but also adaptable to more various conditions of the snow surface.

[0049] FIG. 6 illustrates a schematic diagram of the snow crushing knife 5 according to an embodiment of the present disclosure. As shown in FIG. 6, the snow crushing knife 5 includes a knife tail 51, a knife body 52, and a knife edge 53. The knife edge 53 is disposed on the knife body 52. The knife body 52 is connected to the knife tail 51. The knife tail 51 is connected to the knife board 4. The plane where the knife body 52 is located is perpendicular to the plane where the knife board 4 is located.

[0050] In embodiments of the present disclosure, the knife tail 51 and the knife body 52 may be made of the same or different materials. In the case that the knife tail and the knife body are made of the same material, the manufacturing process is simplified, and therefore it is preferred. In this embodiment, the knife tail 51 and the knife body 52 are made of a metal or alloy material, and the knife tail 51 is welded to the knife board 4, thereby improving the strength and wear resistance of the snow crushing knife and reducing the damage rate of the snow crushing knife.

[0051] As shown in FIG. 6, the knife body 52 includes a first knife surface 521 and second knife surface 522

disposed oppositely to each other, and a side surface 523 connecting the first knife surface 521 with the second knife surface 522. The first knife surface 521 and the second knife surface 522 are both perpendicular to the horizontal plane (as shown in the figure, the horizontal plane is parallel to the plane where the knife board 4 is located).

[0052] In some embodiments, the snow crushing knife has a length greater than a thickness of the shaping member. FIG. 7 illustrates a sectional diagram of a shaping member according to an embodiment of the present disclosure. As shown in FIG. 6 and FIG. 7, the length L (substantially equal to the length of the knife body 52) of the snow crushing knife 5 is greater than the thickness T of the shaping member 300. Thus, the snow crushing knife 5 can deeply insert into the snow to crush snow at a great depth. The thickness T of the shaping member 300 is smaller than the depth, which is conducive to shaping the crushed snow. In an example, the length of the snow crushing knife is 2 to 10 times the thickness of the shaping member. For example, the length L of the snow crushing knife 5 is from 20 mm to 100 mm, and the thickness T of the shaping member 300 is from 10 mm to 40 mm. In an example, the length L of the snow crushing knife 5 is 70 mm, and the thickness T of the shaping member 300 is 30 mm.

[0053] In some embodiments, the knife edge 53 includes a first knife edge 531 and a second knife edge 532. The first knife edge 531 is located at an end of the knife body 52 facing towards the traveling direction, while the second knife edge 532 is located at an end of the knife body 52 far away from the knife tail 51. An included angle α between the first knife edge 531 and the horizontal plane ranges from 0 degree to 90 degrees. In the case that the included angle α between the first knife edge 531 and the horizontal plane is from 45 degrees to 80 degrees, the snow crushing knife 5 achieves better crushing effect on hardened snow. For example, the included angle α between the first knife edge 531 and the horizontal plane is 75 degrees.

[0054] In some embodiments, the knife edge 53 is disposed on one of the first knife surface 521, the second knife surface 522, and the side surface 523. In some embodiments, as shown in FIG. 6, the knife edge 53 is disposed on the side surface 523. Further, a perpendicular distance from the knife edge 53 on the side surface 523 to the first knife surface 521 is equal to a perpendicular distance from the knife edge 53 to the second knife surface 522.

[0055] In other embodiments, the knife edge may also be located on the first knife surface or the second knife surface. FIG. 8 illustrates a partial sectional diagram of a knife edge according to an embodiment of the present disclosure. As shown in FIG. 8, the knife edge 53 is disposed on the second knife surface 522. FIG. 9 illustrates a partial sectional diagram of a knife edge according to another embodiment of the present disclosure. As shown in FIG. 9, the knife edge 53 is disposed on the first knife

surface 521.

[0056] For example, the knife edge 53 of each snow crushing knife 5 in the first snow crushing knife group 311 is located on the side surface 523. The knife edge 53 of each snow crushing knife 5 in the second snow crushing knife group 312 is disposed on the first knife surface 521 or the second knife surface 522, and the snow crushing knife having the knife edge 53 on the first knife surface 521 is alternated with the snow crushing knife having the knife edge 53 on the second knife surface 522. The knife edge 53 of each snow crushing knife 5 in the third snow crushing knife group 313 is located on the side surface 523. With this configuration, the snow grooming device 1 not only achieves multi-level snow crushing but also has an increased snow crushing effect.

[0057] As shown in FIG. 5, the shaping member 300 includes a guide portion 321 and a shaping portion 322. For example, the guide portion 321 is in one-to-one correspondence with the shaping portion 322, alternatively, a gap is formed between the guide portion 321 and the shaping portion 322. As shown in FIG. 4 and FIG. 5, the shaping portion 322 is more proximal to the second side S2 of the support frame 2 than the guide portion 321.

[0058] In some embodiments, the guide portions 321 are arranged in a straight line, and the shaping portions 322 are also arranged in a straight line, so that the soft snow crushed by the snow crushing structure 31 can be guided into the space between two downstream adjacent shaping portions 322 by the guide portions 321.

[0059] In some embodiments, two adjacent shaping portions 322 may be in direct contact with each other or have a gap formed therebetween. In an example, a distance between two adjacent shaping portions 322 (in the y-direction shown in FIG. 5) is from 0 mm to 100 mm. In the case that the distance between two adjacent shaping portions 322 is from 0 mm to 10 mm, soft snow is better shaped by the shaping portions 322. For example, the distance between two adjacent shaping portions 322s is 5 mm.

[0060] In some embodiments, the shaping portion 322 has a length (in the x-direction shown in FIG. 5) greater than that of the guide portion 321 (in the x-direction shown in FIG. 5). In an example, the length of the shaping portion 322 is 1.25 to 2.5 times that of the guide portion 321. For example, the length of the guide portion 321 is from 100 mm to 200 mm, while the length of the shaping portion 322 is from 150 mm to 250 mm. In an example, the length of the guide portion 321 is 150 mm, and the length of the shaping portion 322 is 200 mm.

[0061] In some embodiments, the guide portion 321 is cone-shaped, while the shaping portion 322 is column-shaped. In an example, the guide portion 321 is triangular pyramid-shaped, and the shaping portion 322 is triangular prism-shaped. For example, the edges of the shaping portion 322 are parallel to the horizontal plane, and a shape of the cross-section of the shaping portion 322 perpendicular to the edges is triangular. In the case that the distance between two adjacent shaping portions 322

is zero, soft snow is shaped into a triangular prism shape after passing through the space between the two adjacent shaping portions 322. In the case that the distance between two adjacent shaping portions 322 is greater than zero, soft snow is shaped into a quadrangular prism shape after passing through the space between the two adjacent shaping portions 322. In addition, the guide portions 321 are in one-to-one connection with the snow crushing knives 5 in the third snow crushing knife group 313, so that the soft snow crushed by the snow crushing structure 31 can enter the space between two adjacent guide portions 321 and thereby smoothly entering the space between two adjacent shaping portions 322.

[0062] The working process of the snow grooming device 1 provided in the embodiments of the present disclosure is as follows: the snow shoveling apparatus 6 firstly shoveling uneven snow on the snow trail. Then, the snow crushing structure 31 of the snow crushing and shaping apparatus 3, which is proximal to the first side S1 of the support frame 2, loosens the snow to change hardened snow on the snow trail into soft snow. The first snow crushing knife group 311, the second snow crushing knife group 312 and the third snow crushing knife group 313 of the snow crushing structure 31 successively crush the hardened snow to achieve three-level crushing. While the snow grooming device 1 travels forwards to crush snow, the snow shaping structure 32 moves to the soft snow fully crushed by the snow crushing structure 31, the soft snow is guided through the guide portions 321 to enter the space between two adjacent shaping portions 322 and then shaped as a strip shape or a strip shape with edges.

[0063] In the snow grooming device provided in the embodiments of the present disclosure, the snow shoveling apparatus is configured to shoveling uneven snow so as to have a smooth surface, thereby being conducive to improving the snow crushing and shaping effects of the snow crushing and shaping apparatus. Multi-level snow crushing knives are utilized to crush snow, thereby improving the snow crushing efficiency. In addition, the snow crushing structure is integrated with the snow shaping structure, thus hardened snow on the snow trail is first crushed by the snow crushing structure to be changed into soft snow, and then the crushed snow directly enters the snow shaping structure and reshaped by the snow shaping structure into a strip shape or a strip shape with edges. With this process, crushing and shaping of hardened snow is simultaneously achieved. Each component used in the snow grooming device provided in the embodiments of the present disclosure has low cost and high wear resistance, thereby saving the cost and avoiding of damage. Because the size of the snow grooming device may be set according to an actual situation, it has good environmental adaptability.

[0064] FIG. 10 illustrates a schematic diagram of a snow groomer according to an embodiment of the present disclosure. As shown in FIG. 10, in an embodiment of the present disclosure, the snow groomer in-

cludes a snow grooming device 10 and a power apparatus 20. The power apparatus 20 is connected to the snow grooming device 10 and configured to provide driving power to the snow grooming device 10 such that the snow grooming device 10 moves in the first direction. For example, in this embodiment, the specific structures and connection types of the snow grooming device 10 and the power apparatus may be as described in foregoing embodiments, which will not be redundantly described herein.

[0065] The snow groomer provided in the embodiments of the present disclosure are not only simple in structure and prone to production and maintenance, but also low in manufacturing cost. Any power apparatus for providing driving power may be used in the snow groomer provided in the embodiments of the present disclosure, for example, a tractor (e.g., a wheeled tractor or a tracked tractor). Moreover, in the case that the snow grooming device and power apparatus are detachably connected to each other, a single snow grooming device may be connected to various power apparatus according to the actual snow surface conditions of the ski resort so as to achieve snow crushing and shaping. As such, the snow grooming device has good environmental adaptability. Furthermore, the snow groomer described above is simple to operate and has low requirement on the skill of operators, and therefore the costs of personnel training and salary payment can be saved.

[0066] In the disclosure, the following should be noted:

(1) The accompanying drawings involve only the structure(s) in connection with the embodiment(s) of the present disclosure, and other structure(s) can be referred to common design(s).

(2) For the purpose of clarity only, in accompanying drawings for illustrating the embodiment(s) of the present disclosure, the thickness and a size of a layer or area may be enlarged or narrowed, that is, the drawings are not drawn in a real scale.

(3) In case of no conflict, features in one embodiment or in different embodiments can be combined as a new embodiment.

[0067] The foregoing embodiments merely are exemplary embodiments of the disclosure, and not intended to define the scope of the disclosure, and the scope of the disclosure is determined by the appended claims.

Claims

1. A snow grooming device, comprising:

a support frame, configured to move along a first direction and comprising a first side and a second side that are opposite to each other in the first direction; and
a snow crushing and shaping apparatus, located

- at the bottom of the support frame and connected to the support frame, the snow crushing and shaping apparatus are configured to move along with the support frame in the first direction and comprising a snow crushing structure proximal to the first side of the support frame and a snow shaping structure proximal to the second side of the support frame.
2. The snow grooming device according to claim 1, wherein the snow crushing and shaping apparatus further comprises a knife board connected to the bottom of the support frame; and the snow crushing structure and the snow shaping structure are both disposed on a side of the knife board facing away from the support frame.
 3. The snow grooming device according to claim 2, wherein:

the snow crushing structure comprises a plurality of snow crushing knives arranged in a second direction, and the second direction is parallel to a plane where the knife board is located and perpendicular to the first direction; and the snow shaping structure comprises a plurality of shaping members, the plurality of shaping members are arranged in the second direction and parallel to one another.
 4. The snow grooming device according to claim 3, wherein:

the snow crushing structure comprises a plurality of snow crushing knife groups arranged in the first direction, and each of the snow crushing knife groups comprises the plurality of snow crushing knives; the plurality of snow crushing knife groups are arranged into a plurality of rows, and the snow crushing knives in two adjacent rows of the snow crushing knife groups are staggered with one another in the second direction.
 5. The snow grooming device according to claim 4, wherein:

the plurality of snow crushing knife groups comprise odd rows of snow crushing knife groups and even rows of snow crushing knife groups, and the snow crushing knives in two adjacent odd rows of snow crushing knife groups are staggered with one another in the second direction; the even rows of snow crushing knife groups comprise a plurality of snow crushing knife sub-groups, and each of the snow crushing knife sub-groups comprises at least two of the snow crushing knives and is located in a center line between two of the snow crushing knives in the
- snow crushing knife group of the odd row most proximal to the first side of the support frame.
6. The snow grooming device according to any one of claims 3 to 5, wherein:

each of the snow crushing knives comprises a knife tail, a knife body, and a knife edge disposed on the knife body; the knife tail is connected to the knife board, the knife body is connected to the knife tail, and a plane where the knife body is located is perpendicular to the plane where the knife board is located.
 7. The snow grooming device according to claim 6, wherein:

the knife body comprises a first knife surface and a second knife surface disposed opposite to each other, and a side surface connecting the first knife surface and the second knife surface; and the knife edge is disposed on one of the first knife surface, the second knife surface and the side surface.
 8. The snow grooming device according to claim 7, wherein:

the snow crushing structure comprises a plurality of snow crushing knife groups arranged in the first direction, and each of the snow crushing knife groups comprises the plurality of snow crushing knives; and the plurality of snow crushing knife groups are arranged into a plurality of rows, and in at least one row of snow crushing knife group, the snow crushing knife having the knife edge on the first knife surface are alternated with the snow crushing knife having the knife edge on the second knife surface.
 9. The snow grooming device according to any one of claims 3 to 8, further comprising a snow shoveling apparatus, wherein:

the snow shoveling apparatus is located on the first side of the support frame and connected to the support frame, and the snow shoveling apparatus comprises a snow shoveling board; and each of the snow crushing knives is more proximal to the snow shoveling board than each of the shaping members.
 10. The snow grooming device according to any one of claims 3 to 9, wherein:

in the case that the plurality of snow crushing knives are arranged into a single row, the plurality of snow crushing knives are in one-to-one correspondence with and connected to the plurality of shaping members; and

in the case that the plurality of snow crushing knives are arranged into a plurality of rows, the snow crushing knives, in one row of snow crushing knives that is most proximal to the shaping members, are in one-to-one correspondence with and connected to the plurality of shaping members.

11. The snow grooming device according to any one of claims 3 to 10, wherein:
 - each of the shaping members comprises a guide portion and a shaping portion; the guide portion is proximal to the first side of the support frame and configured to guide ice or snow to the shaping portion, the shaping portion is proximal to the second side of the support frame and configured to shaping the ice or the snow, and the guide portion and the shaping portion are connected to each other.
12. The snow grooming device according to claim 11, wherein the guide portion is cone-shaped, and the shaping portion is column-shaped; and each of the snow crushing knives has a length greater than a thickness of each of the shaping members.
13. The snow grooming device according to claim 12, wherein the length of each of snow crushing knives is 2 times to 10 times the thickness of each of the shaping members.
14. A snow groomer, comprising:
 - the snow grooming device, according to any one of claims 1 to 13; and
 - a power apparatus, connected to the snow grooming device and configured to supply driving power to the snow grooming device such that the snow grooming device moves in the first direction.
15. The snow groomer according to claim 14, wherein the snow grooming device further comprises a connection structure and a snow shoveling apparatus; the power apparatus is connected to the snow grooming device through the connection structure, the connection structure is located on at least one of the snow shoveling apparatus and the support frame, and the power apparatus is mounted on a front side or a rear side of the snow grooming device.

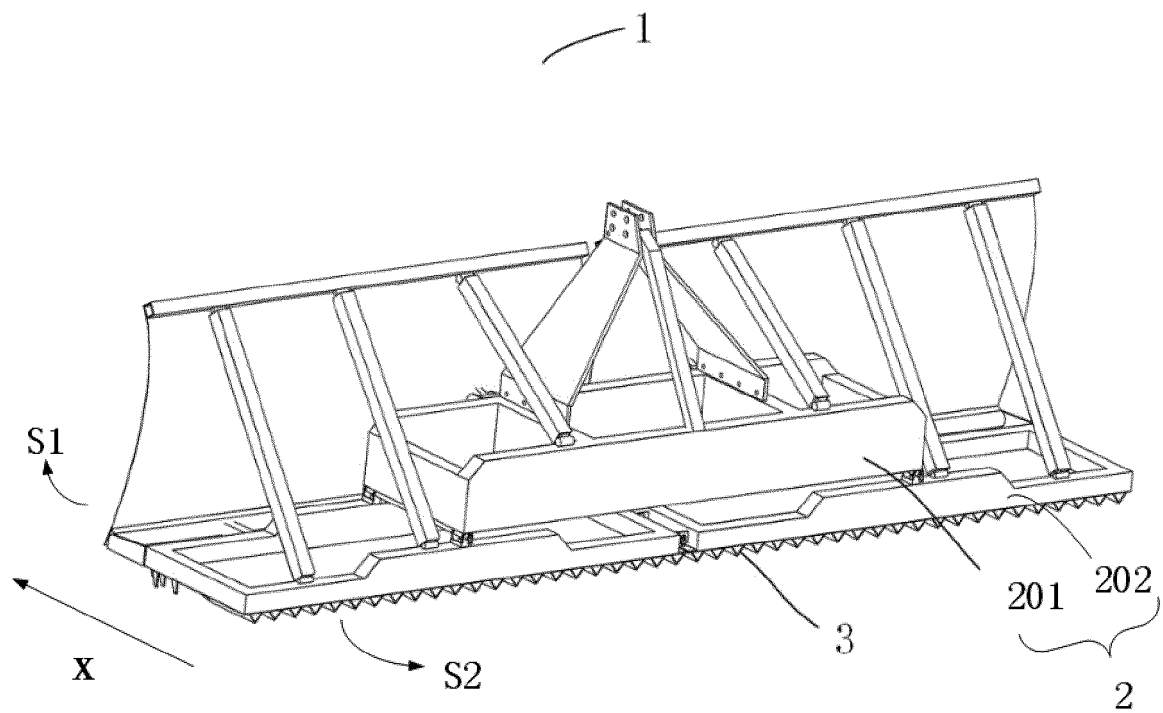


FIG. 1

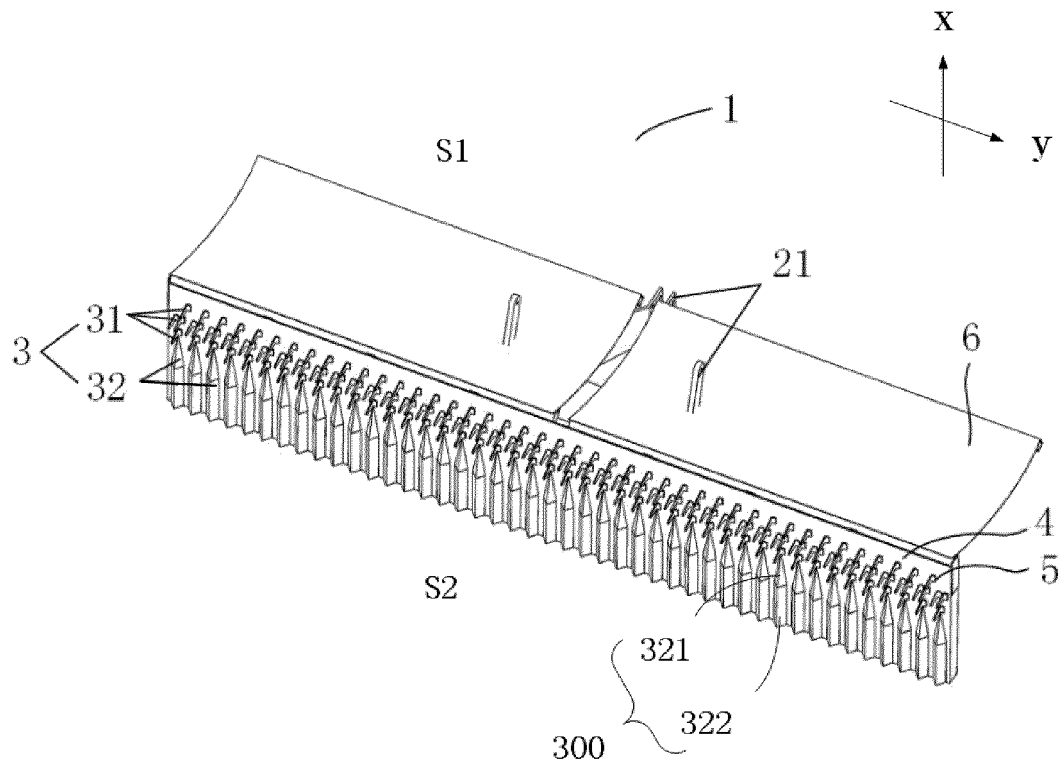


FIG. 2

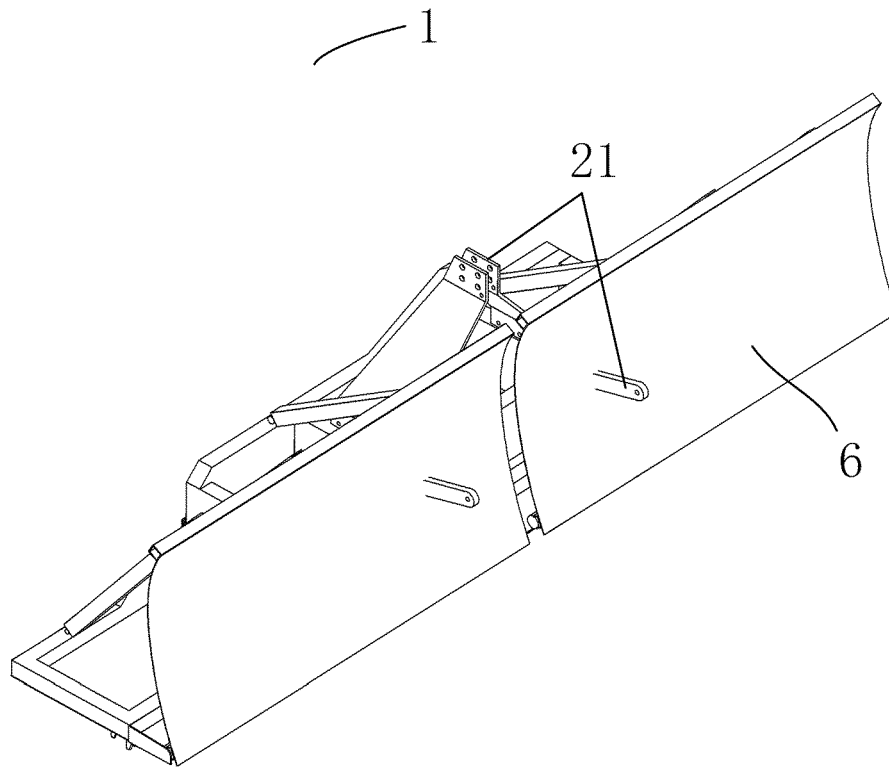


FIG. 3

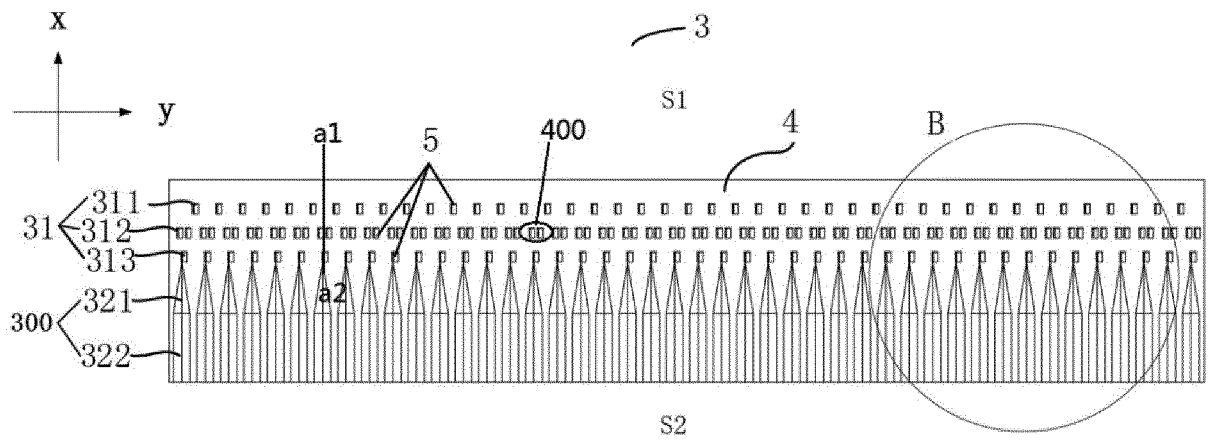


FIG. 4

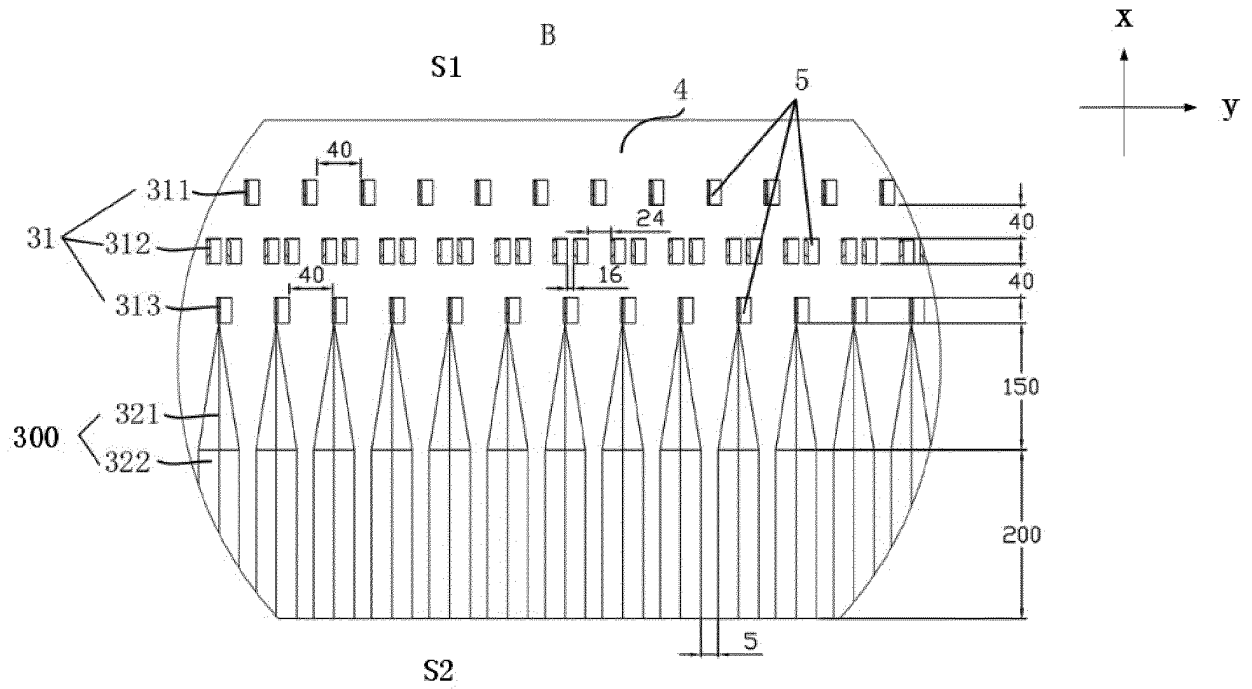


FIG. 5

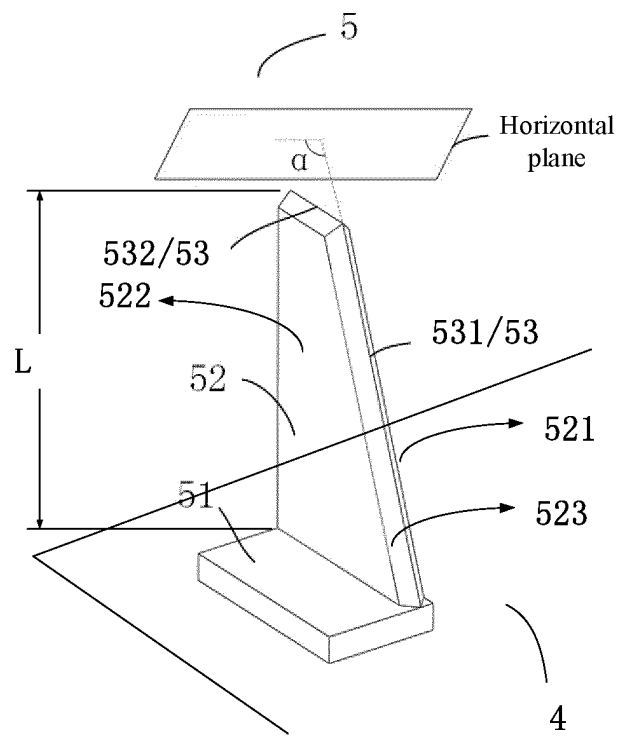


FIG. 6

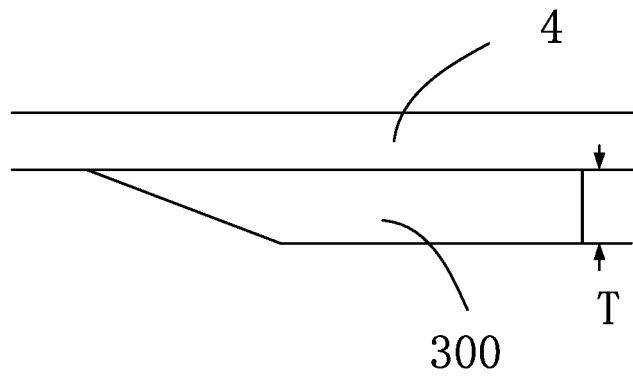


FIG. 7

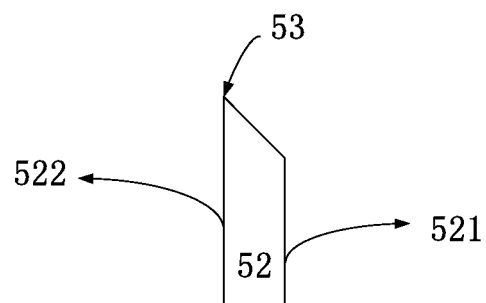


FIG. 8

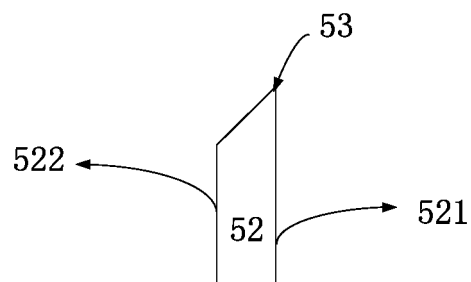


FIG. 9

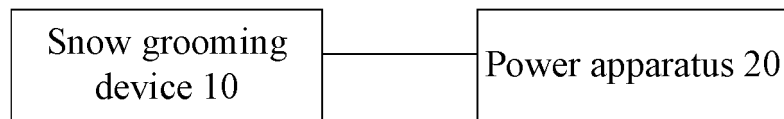


FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2020/139320

A. CLASSIFICATION OF SUBJECT MATTER

E01H 4/02(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

E01H, E01C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNABS, CNTXT, DWPI, SIPOABS, EPTXT, USTXT, JPTXT, 中国期刊网全文数据库, 孙云山, 压雪, 雪, 冰, 塑型, 成型, 塑雪, 破雪, 碎雪, 刀, 雪场, 雪道, 滑雪, SNOW, ICE, PRESS+, TYP+, SHAP+, BROKEN, KNI+, SNOW W TRACK?, SNOW W FIELD?, SKI+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN 106087841 A (ZHENG, Zhouchao et al.) 09 November 2016 (2016-11-09) description paragraphs 0015, 0017, 0018, figures 1, 2	1-15
Y	CN 206352278 U (RIGHT WING FRONT BANNER HUACHENG AGRICULTURAL MACHINERY MANUFACTURING CO., LTD.) 25 July 2017 (2017-07-25) description paragraphs 0003-0005, figures 1, 2	1-15
Y	CN 205954551 U (ZHENG, Zhouchao et al.) 15 February 2017 (2017-02-15) description paragraphs 0015, 0017, 0018, figures 1, 2	1-15
Y	CN 204875439 U (WUHU BOBCAT ENGINEERING MACHINERY CO., LTD.) 16 December 2015 (2015-12-16) description, paragraphs 0017-0024, figure 1	1-15
Y	CN 206512662 U (RIGHT WING FRONT BANNER HUACHENG AGRICULTURAL MACHINERY MANUFACTURING CO., LTD.) 22 September 2017 (2017-09-22) description paragraphs 0003-0005, figures 1, 2	1-15
PX	CN 110952491 A (SUN, Yunshan) 03 April 2020 (2020-04-03) claims 1-12	1-15

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search

19 February 2021

Date of mailing of the international search report	
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24 March 2021

Name and mailing address of the ISA/CN

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2020/139320

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 211547583 U (SUN, Yunshan) 22 September 2020 (2020-09-22) claims 1-12	1-15
PX	CN 305867924 S (SUN, Yunshan) 23 June 2020 (2020-06-23) drawings or photographs of the design	1-15
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A	CA 2120207 A1 (MILBURN C.L. et al.) 18 December 1995 (1995-12-18) entire document	1-15
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2020/139320

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CN 206352278 U	25 July 2017	None	
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CN 206512662 U	22 September 2017	None	
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Form PCT/ISA/210 (patent family annex) (January 2015)

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