March 19, 1957 K. CROCE ET AL 2,785,482

ROTARY TYPE SNOW REMOVAL DEVICE

Filed May 17, 1950 3 Sheets-Sheet 1

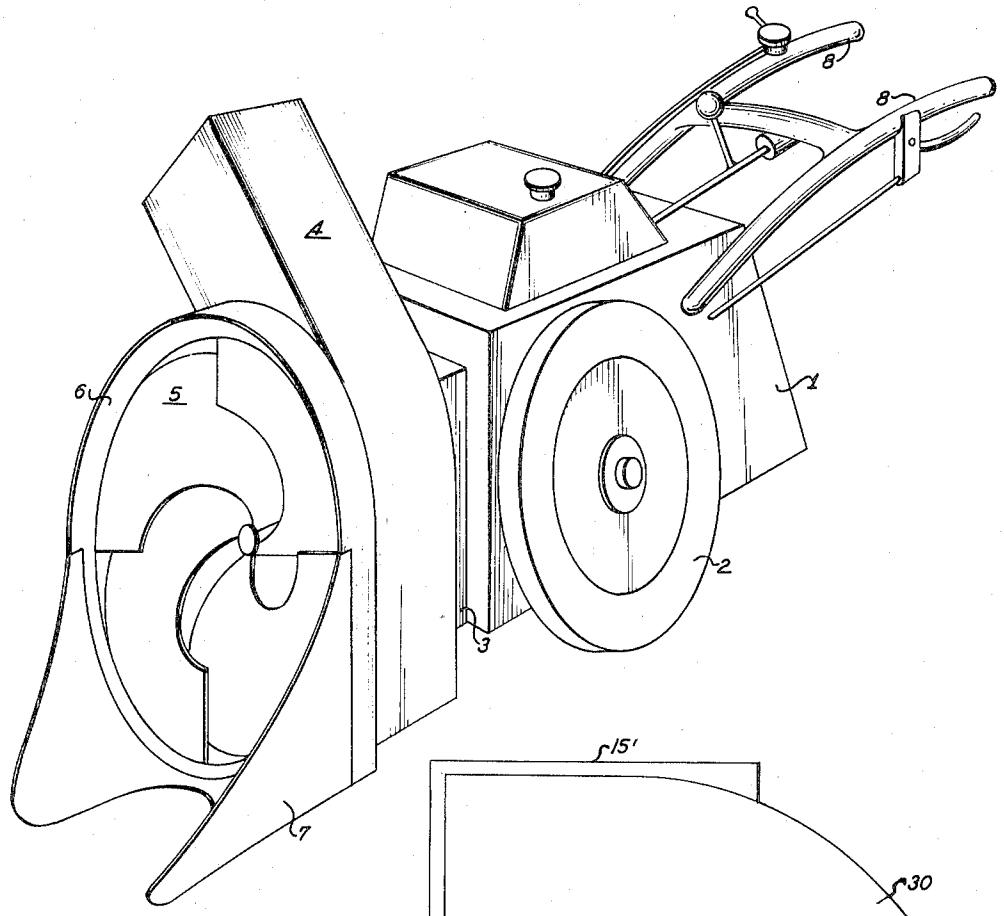



Fig. 1

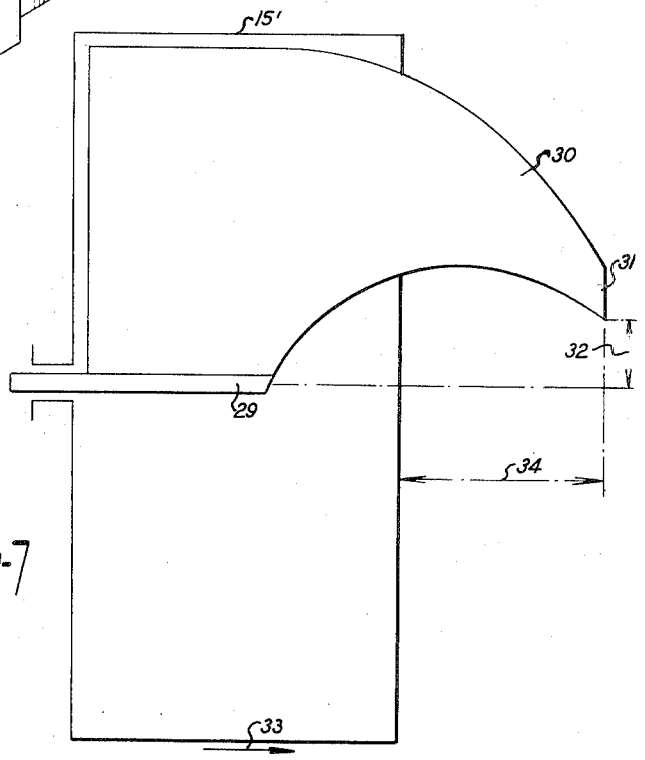



Fig. 7

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ROTARY TYPE SNOW REMOVAL DEVICE

Filed May 17, 1950 3 Sheets-Sheet 2

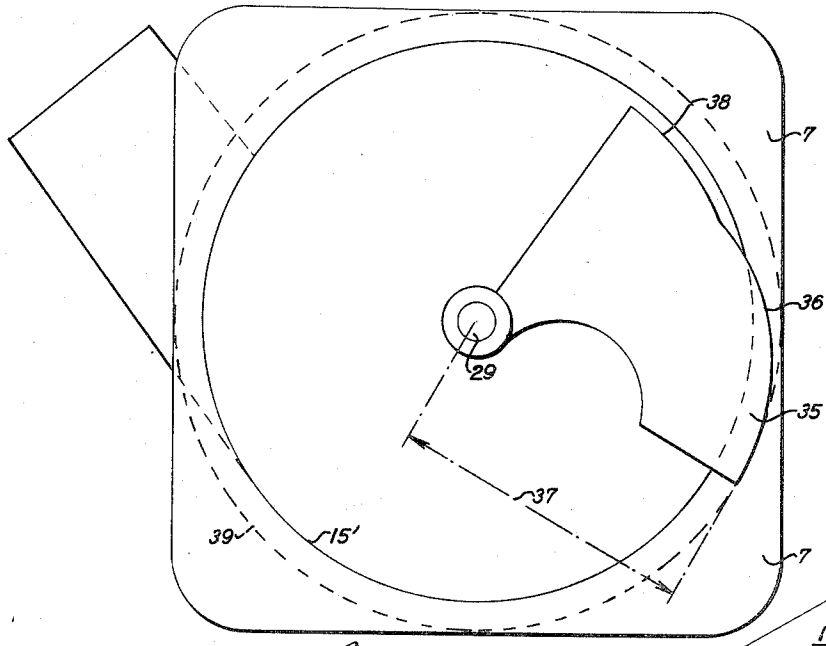



Fig. 1

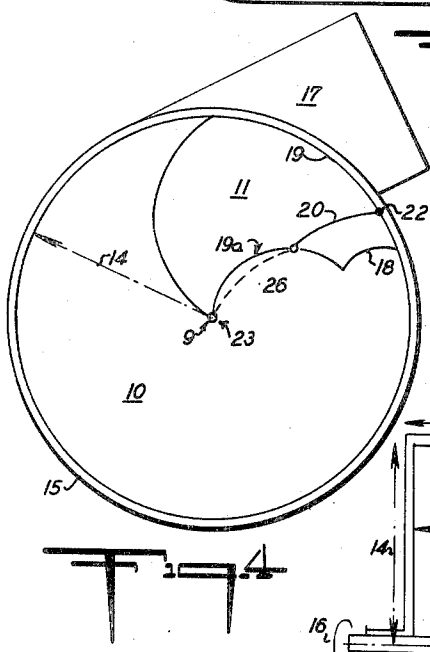



Fig. 4

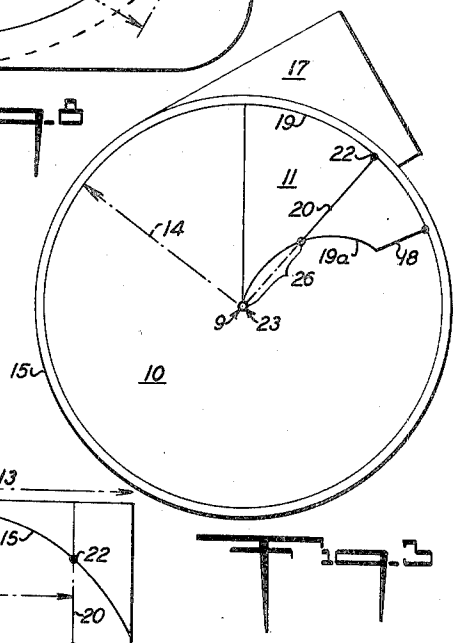



Fig. 3

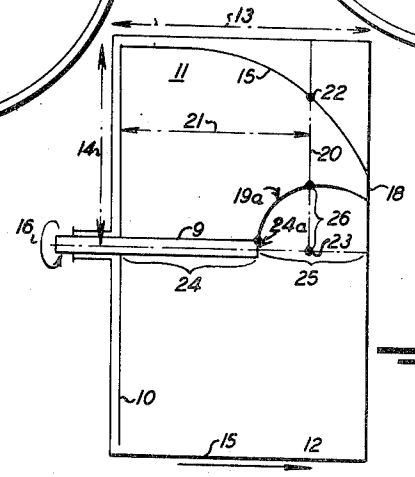



Fig. 2

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ROTARY TYPE SNOW REMOVAL DEVICE

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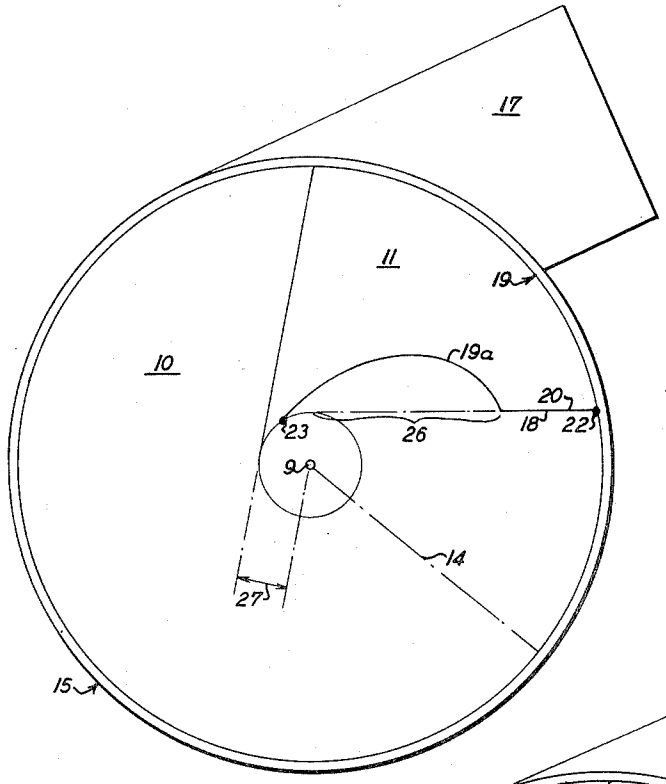



FIG. 5

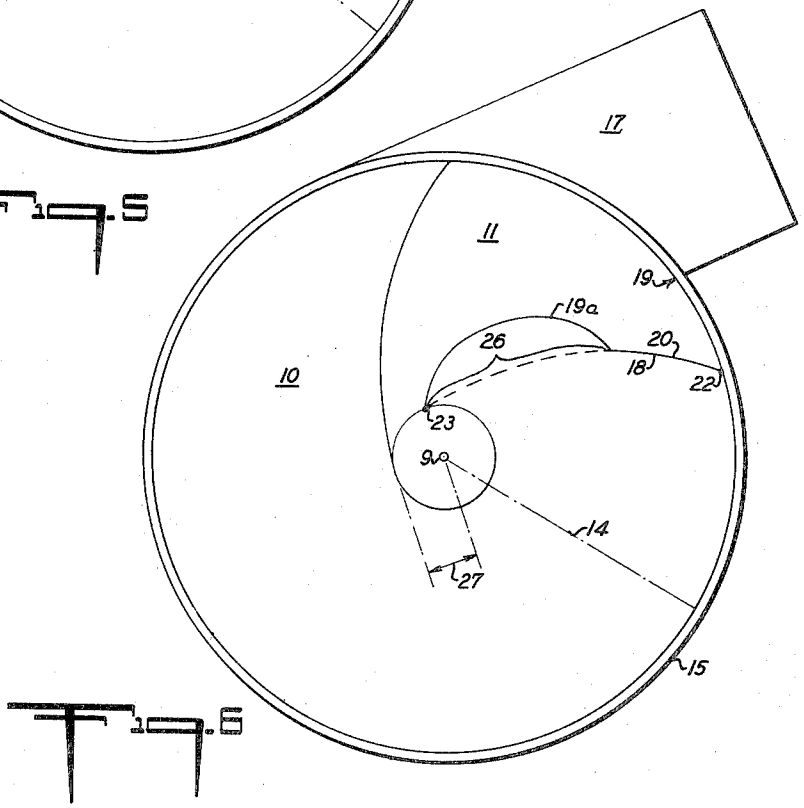



FIG. 6

United States Patent Office 2,785,482 Patented Mar. 19, 1957



2,785,482

# ROTARY TYPE SNOW REMOVAL DEVICE

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Application May 17, 1950, Serial No. 162,455

Claims priority, application Switzerland May 19, 1949

11 Claims. (Cl. 37—43)

The present invention relates to snow removal devices, and particularly to improved snow removal devices of the kind wherein the snow is removed and hurled radially away or broadcast from the path of travel of the device by a rotated shovelling wheel.

An object of the present invention is to provide shovelling wheels for snow removal devices of the rotary type that are constructed so that a maximum quantity may be removed in a minimum of time and with a minimum expenditure of power.

Another object of the present invention is to provide a snow removal device of the rotary type having a rotated shovelling wheel which is constructed so that the snow is not compacted excessively during its removal thus minimizing the resistance to movement of the wheel and the power required for its operation.

Another object is to provide a snow removal device of the rotary type wherein the shovelling wheel is mounted for rotation about an axis extending substantially parallel to the direction of travel of the device within a casing opening in said direction and includes a preferably circular base plate having a plurality of spaced apart shovelling blades extending therefrom in said direction of travel, each of the shovelling blades being formed with the end portion of its inner edge remote from the supporting base plate spaced from the axis of rotation so that, when the wheel is rotated, such inner edges define the surface of a body of revolution concentric with the axis of rotation and coming to a point within the shovelling wheel.

A further object is to provide a snow removal device of the rotary type wherein the shovelling wheel is mounted for rotation about an axis extending substantially parallel to the direction of travel of the device within a casing opening in said direction and includes a preferably circular base plate having a plurality of spaced apart shovelling blades extending therefrom in said direction of travel, each of the shovelling blades being formed with a free end portion, remote from the base plate, having its outer edge spaced from the axis of rotation and defined by a curved directrix formed as a helix having a pitch which increases from the free end portion of the blade toward the base plate, and by a substantially radially extending generatrix moving axially along the blade and angularly relative to the axis of rotation, with the inner end of the generatrix being defined by a single point on the inner edge of the blade and the outer end of the generatrix being defined by a single point of the directrix, the inner edge of the blade including a straight portion extending from the base plate along the axis of rotation and a portion curved convexly with respect to said axis and starting at the latter and increasingly distanced from the axis of rotation in the radial direction towards the free end of the blade remote from the base plate.

A still further object is to provide a snow removal device of the rotary type wherein the shovelling wheel is mounted for rotation about an axis extending substantially parallel to the direction of travel of the device within a casing opening forwardly and includes a preferably circular base plate having a plurality of spaced apart shovelling blades extending from the front face thereof, each of the shovelling blades having a free end portion remote from the base plate and extending out of the front opening of the casing and being defined at its outer end by a directrix which is spaced further from the axis of rotation at the portion of the blade extending out of the casing than at the portion thereof enclosed within the casing.

A still further object is to provide a snow removal device of the rotary type having a shovelling wheel of the described character formed with free end portions extending or protruding through the front opening of the casing, and wherein snow guiding elements are provided on the casing to plow a rectangular section of snow into the path of the rotated shovelling wheel.

The generatrix of a blade in a shovelling wheel embodying the present invention may be a straight line which, when elongated or extended in the radially inward direction, either passes through the axis of rotation or is spaced from the axis rotation, or the generatrix may be a two or three dimensionally curved line, the inner elongation of which similarly either passes through, or is spaced from, the axis of rotation.

The above and other objects, features and advantages of the present invention will be manifest in the following detailed description of illustrative embodiments which is to be read in connection with the accompanying drawings forming a part hereof and wherein:

Fig. 1 is a perspective view of a snow removal device, showing one embodiment of the invention;

Fig. 2 is a longitudinal vertical section of the casing and shovelling wheel of the device of Fig. 1 with only one blade of the shovelling wheel being shown diametrically;

Fig. 3 is a diagrammatic front view of the device of Fig. 2 showing the generatrix as a straight line passing through the axis of rotation;

Fig. 4 is a diagrammatic front view of a further embodiment of the invention, the generatrix being a curved line passing through the axis of rotation;

Fig. 5 is a diagrammatic front view of a further embodiment of the invention showing the generatrix as a straight line spaced from the axis of rotation;

Fig. 6 is a diagrammatic front view of a further embodiment of the invention showing the generatrix as a curved line spaced from the axis of rotation;

Fig. 7 is a longitudinal vertical section of the casing and the shovelling wheel of another embodiment of the invention, the shovelling wheel protruding from the front of the casing; and

Fig. 8 is a diagrammatic front view of another embodiment of the invention having the shovelling wheel protruding from the front of the casing, and the directrix of the shovelling wheel being elongated so that the distance of the elongated directrix from the axis of rotation is greater than the corresponding distance of the directrix within the casing.

Referring to the drawings in detail, and initially to Fig. 1 thereof, a snow removal device embodying the present invention is there shown. By reason of the particular configuration given to the snow shovelling wheel, as will hereinafter more fully appear, the power required for rotating the wheel is kept at a minimum, and, therefore, the carriage supporting the prime mover and the shovelling wheel and its casing may be of light construction and preferably mounted on two wheels 2. The prime mover, preferably an internal combustion engine (not shown), is enclosed within a casing 1 and has a transmission gear arrangement (not shown), of conventional construction, associated therewith for driving the wheels 2. A second transmission gear arrangement 3 is provided ahead of the engine and driven by the latter for rotating a shaft 9 (Figs. 2 and 3) extending forwardly and nor-

mally parallel to the direction of movement of the carriage on the wheels 2. The two-wheeled carriage is further preferably provided with handles 3 extending rearwardly therefrom to be grasped by the operator for steering or controlling the movement of the snow removal device.

In accordance with the present invention, a fixed housing or casing 4 for a shovelling wheel 5 is mounted at the front of the two-wheeled carriage. The casing 4 may be generally cylindrical, having an end wall closing the back thereof, and opening at the front or in the direction of travel of the carriage. A snow discharge conduit 17 extends tangentially from the side wall 15 of the housing or casing 4 and is directed upwardly and outwardly to broadcast the removed snow to areas remote from the path of travel of the snow removal device.

The shaft 9, driven by the engine, extends centrally through the back wall of the casing 4 to support the shovelling wheel 5 within the latter. In order to provide for efficient snow removal, the shovelling wheel 5 includes a preferably circular base plate 10 fixed on the shaft 9 adjacent the front face of the back wall of the casing 4. A plurality of shovelling blades 11, four of such blades being shown in the device of Fig. 1, extend from the front face of the base plate 10. Referring to Figs. 2 and 3, it will be seen that each of the shovelling blades 11 has an outer edge defined by a directrix 19 which is in the form of a helix having a radius 14. That is, all points on the outer edge of the blade 11 are equidistant from the axis of rotation of the shaft 9, and hence of the wheel 5. Preferably, the radii of the base plate 10 and of the helix defining the directrix 19 are the same, and are only slightly smaller than the internal radius of the side wall 15 of casing 4 so that the shovelling wheel will work closely within the latter.

In the embodiment of the invention illustrated in Figs. 2 and 3, each blade 11 extends forwardly from the base plate 10 a distance 13 which is substantially equal to the length of the casing 4 so that the free ends or tips of the blades are substantially co-planar with the front open end of the casing. The blades 11 each have a configuration defined by the aforementioned directrix and by a radial generatrix which is a straight line passing, at its outer end, through the directrix 19, while the inner end of the straight line, or an elongation thereof, passes through the axis of rotation, the generatrix moving axially and angularly relative to the axis of rotation as hereinafter described in detail, so that, as the casing 4 is moved forwardly, the free end portions of the blades grasp the snow entering the open front of the casing and convey such snow longitudinally into the casing toward the base plate 10, that is, in the direction opposite to the direction of motion of the casing indicated by the arrow 12 on Fig. 2. When the snow has been thus conveyed into the casing 4, it is moved rotationally by the blades and hurled centrifugally outward against the casing wall 15 for escape through the snow discharge conduit 17 extending tangentially from the latter.

In order to provide the above mode of operation, the helix forming the directrix 19 has a pitch which increases from the free end portion 18 of the blade toward the base plate 10. Either the radial generatrix, cooperating with the directrix 19 to define the surface of each blade 11, or an elongation of the inner end of the generatrix, extends radially from the axis of rotation of the shaft 9 to the related point on the directrix so that the surface of each blade is part of a substantially helical area. As seen in Figs. 2 and 3, the portion of the blade adjacent to the base plate 10 and extending forwardly therefrom a longitudinal distance 24, has its inner edge extending along, and secured to, the shaft or axle 9. However, the free end portion 18 of the blade longitudinally remote from the base plate 10 and extending over the longitudinal distance 25, has its inner edge 19*a* curved convexly with respect to the axis of rotation and, starting at the axle 9, is increasingly radially distanced from the axle in the direction away from the base plate 10. For example, when the generatrix 20 is disposed at a location the distance 21 from the base plate, which distance is greater than the distance 24 (Fig. 2), so that the generatrix position is thereby identified as one defining the free end portion 18 of the blade, the inner end of the generatrix is spaced a distance 26 from the axis of rotation and defined by a point on the convex inner edge portion 19*a*, while the outer end of the generatrix 20 is defined by a point 22 on the directrix 19. However, in the embodiment of Figs. 2 and 3, an elongation of the inner end of the generatrix 20 defining the free end portion 18 and represented by the broken line passes through the axis of rotation, as at 23. Thus, the inner edge of the free end portion 18 of the blade is spaced radially outward from the axis of rotation over the longitudinal distance 25. When the shovelling wheel 5 is rotated, the inner edges of the free end portions 18 of blades formed as above define a body of revolution concentric with the axis of rotation of the wheel and coming to a point on said axis at a location 24*a* within the shovelling wheel defined by the meeting or adjacent ends of the longitudinal distances 24 and 25.

While the distance 26, which indicates the radial spacing of points on the inner edge of the free end portion 18 from the axis of rotation, varies along the longitudinal distance 25, the distance 26 preferably should not exceed ⅞ of the radius 13 of the shovelling wheel periphery.

While the directrix 19 of the blade described above is preferably a three dimensional spiral line or helix lying in the periphery or surface of an imaginary cylinder or cylindrical body of revolution, the longitudinal axis of which coincides with the axis of rotation, it is to be understood that the directrix may, in accordance with another embodiment of the invention (not illustrated), pass through the axis of rotation. Further, while the generatrix, defining the surface of each blade, is a straight radial line, such generatrix may have any desired form, for example, a two or three dimensionally curved line.

For example, referring to Fig. 4, wherein the various parts of the snow removal device are identified by the same reference numerals employed in connection with the description of the corresponding parts in Figs. 2 and 3, it will be seen that the generatrix 20, cooperating with the directrix 19 to define the surface of the blade 11, is a curved line, rather than a straight line, as in Figs. 2 and 3, and that, as before, the inner edge 19*a* of the free end portion 18 of the blade is curved convexly with respect to the axis of rotation, so that the inner end of the generatrix 20, at locations within the free end portion 18, is spaced by the distance 26 from the axis of rotation, but the elongation (shown as a broken line) of the curved generatrix still passes through the axis of rotation at 23.

Although the inner ends, or inner end elongations, of the generatrix 20 in the embodiments of the invention illustrated in Figs. 2 and 3 and Fig. 4, respectively, pass through the axis of rotation, the invention is not limited in that respect, and, as shown in Figs. 5 and 6, a snow removal device may have a shovelling wheel wherein the generatrix of each blade has its inner end, or an elongation of the latter, spaced from the axis of rotation. In both Figs. 5 and 6, the several parts are identified by the same reference numerals employed in connection with the corresponding parts of the embodiment illustrated in Figs. 2 and 3, and it will be seen that, in each of the embodiments shown in Figs. 5 and 6, respectively, the inner end of the generatrix 20, or the elongation of the latter shown in broken lines, is tangential to an imaginary cylinder, as at 28, said cylinder having a radius 27 representing the distance that the inner end, or elongation of the latter, of the generatrix is spaced from the axis of rotation. In Fig. 5, the generatrix is a straight line, as in Figs. 2 and 3, while, in Fig. 6, the generatrix is a curved line, as in Fig. 4.

Since the rotated shovelling wheel alone would remove

a cylindrical volume of snow during forward movement of the snow removal device, plow elements 7 (Fig. 1) preferably extend forwardly from at least the two lower corners of the casing 4. Each plow element 7 is formed with right angularly related outside and bottom surfaces and with a curved inside surface so that the volume of snow removed, at least at the bottom portion, is of rectangular cross-section. Thus, the plow elements 7 deflect the snow engaged thereby into the path of the blades 11. The plow elements 7 are preferably removably attached to the casing so that variously shaped elements may be interchanged to adapt the device for different snow conditions.

Referring now to Figs. 7 and 8, a shovelling wheel and casing therefor constructed according to another embodiment of the present invention is there illustrated. In the embodiment of Figs. 7 and 8, two shovelling wheels (only one of which is illustrated) are arranged in a casing 15' with their axes of rotation 29 extending parallel to each other and to the direction of forward motion of the device, as indicated by the arrow 33. Each of the shovelling wheels includes four shovelling blades 30 of equal length and defined as parts of substantially helical areas by directrixes and generatrixes in the manner described in detail in connection with the embodiment of Figs. 2 and 3. The blades 30 are distinguished from the previously described blades 11 in that their free end portions 31, spaced radially from the axis 28 by the distance 32, also protrude longitudinally ahead of the front open end of the casing 15', as by the distance 34.

In snow removal devices of the rotary type heretofore proposed, the shovelling wheels are rotated about axes extending parallel to direction of movement, and remove volumes of snow of circular cross-section. In order to remove volumes of snow of rectangular cross-section, the clearing action of the shovelling wheels is augmented by plow elements, usually designed as part of the casing, which deflect the snow, that would otherwise remain, into the path of the shovelling wheels. Such plow elements in the conventional arrangements present relatively great resistance to the forward movement of the snow removal device since in the conventional arrangements the front edges of the blades on the shovelling wheels and the front of the casing are substantially in the same plane.

The blade arrangement in Figs. 7 and 8, in which the free end portions of the blades extend forwardly out of the casing, substantially reduces the resistance to forward motion developed by the plow elements 7 (Fig. 8). This reduction of the resistance to forward motion results from the fact that the forwardly protruding free end portions of the blades cut cavities from the snow and the plow elements, which direct the snow engaged thereby radially inward, merely displace such engaged snow into the cavities previously formed by the blade ends so that there is little or no resistance to the movement of the snow by the plow elements.

It is advantageous in the embodiment of Figs. 7 and 8 to form the blades 30 there shown so that the directrix 36 defining the portion 31 of the blade protruding from the front of the casing, is disposed a greater radial distance 37 from the axis of rotation than the portion 38 of the directrix defining the outer edge of the part of the blade within the casing so that the outer edge part of such protruding portion is radially enlarged or extended, as at 35, and has a small clearance with respect to said inner surfaces of the plow elements. Thus, an area of snow is cut off bounded by the circle 39 having a radius 37 (Fig. 8). Finally, it will be advantageous to incline the enlarged outer edge part with respect to the generatrixes of the remainder of the protruding portion in the direction toward the plow elements, it being preferable to increase such inclination with increasing distance from the free end edge of the blade and such inclination may be as large as an angle of 90°.

It has been found that the arrangement of the blades in each of the described embodiments, having the inner edges of the free end portions thereof spaced from the axis of rotation, provides for the cutting of cavities in the snow by such free end portions without excessively compressing either the snow removed from the cavities or the snow remaining around the cavities. Thus, the snow being removed maintains a loose structure and reduces the resistance to both the rotational and forward movements of the shovelling wheel. This advantage cannot be realized with the snow augers now in use in which the front ends of the blades meet each other in the axis of rotation.



Having described and illustrated preferred embodiments of our invention, it is to be understood that the invention is not limited to these precise embodiments, and that changes and modifications, obvious to one skilled in the art, may be embodied therein without departing from the scope or spirit of the invention as defined in the appended claims.

Having now particularly described the nature of our invention what we claim is:

1. In a snow removal device; the combination of at least one cylindrical casing open at the front to receive snow and having at least one tangential snow discharge conduit extending from the side thereof and substantially coextensive with the casing in the axial direction of the latter; and at least one shovelling wheel for rotatable mounting in the casing comprising a circular base plate having a central aperture and being otherwise solid, a straight supporting axle extending through said central aperture of the base plate normal to the latter and having said base plate secured thereto, and a plurality of shovelling blades extending from the front face of said base plate and projecting in the axial direction at least to the open front of said casing, each of said blades having an inner edge formed with a straight portion extending from said base plate along said axle and secured to the latter and with a portion curved convexly in respect to the axis of rotation and starting at said axle and increasingly distanced from the axis of rotation in the radial direction towards the free end of the blade remote from said base plate, said axle and base plate forming the sole support for each blade, each of said blades further being defined by a directrix forming the outer edge of the related blade and which is equidistant from said axis of rotation throughout said casing and by a substantially radially extending generatrix which moves axially along the blade and angularly relative to the axis of rotation, one end of the generatrix being defined by a single point of said directrix and the other end thereof being defined by a single point of the inner edge of the related one of said blades, said directrix being further formed as a helix having a pitch which increases from the free end portion of the blade toward the base.

2. In a snow removal device, the combination according to claim 1; wherein said blades are dimensioned in the direction axially of the wheel to be entirely disposed within the confines of said casing.

3. In a snow removal device, the combination according to claim 1; wherein said blades are dimensioned in the direction axially of the wheel to protrude forwardly through the open front of the casing.

4. In a snow removal device, the combination according to claim 1; wherein said generatrix is a straight line the elongation thereof passing through the axis of rotation.

5. In a snow removal device, the combination according to claim 1; wherein said generatrix is a straight line the elongation thereof being spaced from said axis of rotation.

6. In a snow removal device, the combination according to claim 1; wherein said generatrix is a curved line the elongation thereof passing through said axis of rotation.

7. In a snow removal device, the combination accord-

ing to claim 1; wherein said generatrix is a curved line the elongation thereof being spaced from said axis of rotation.

8. In a snow removal device, the combination according to claim 1; wherein said blades are dimensioned in the direction axially of the wheel to protrude forwardly through the open front of the casing, and said generatrix is a straight line the elongation thereof passing through the axis of rotation.

9. In a snow removal device, the combination according to claim 1; wherein said blades are dimensioned in the direction axially of the wheel to protrude forwardly through the open front of the casing, and the part of the directrix defining the outer edge of the portion of the blade protruding from the casing is disposed a greater distance from the axis of rotation than the part of the directrix within the casing to provide an outer enlargement along said protruding portion of the blade.

10. In a snow removal device, the combination according to claim 9; wherein said outer enlargement is inclined relative to the adjacent part of said protruding portion of the blade.

11. In a snow removal device, the combination according to claim 1; further comprising guide means for the snow extending forwardly from said casing.



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