

March 5, 1968

A. F. NIKOLAEV ETAL
APPARATUS FOR PACKING SNOW TO OBTAIN A SNOW
AND ICE COVER SURFACE

3,371,586

Filed July 30, 1965

3 Sheets-Sheet 1

FIG. 1

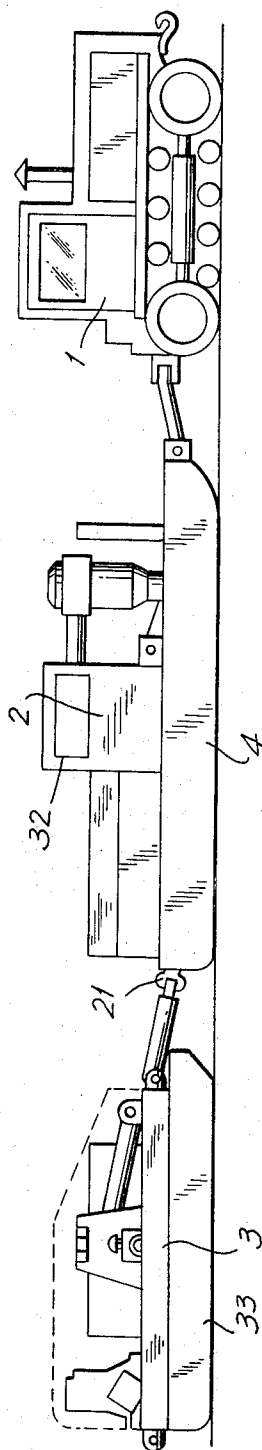
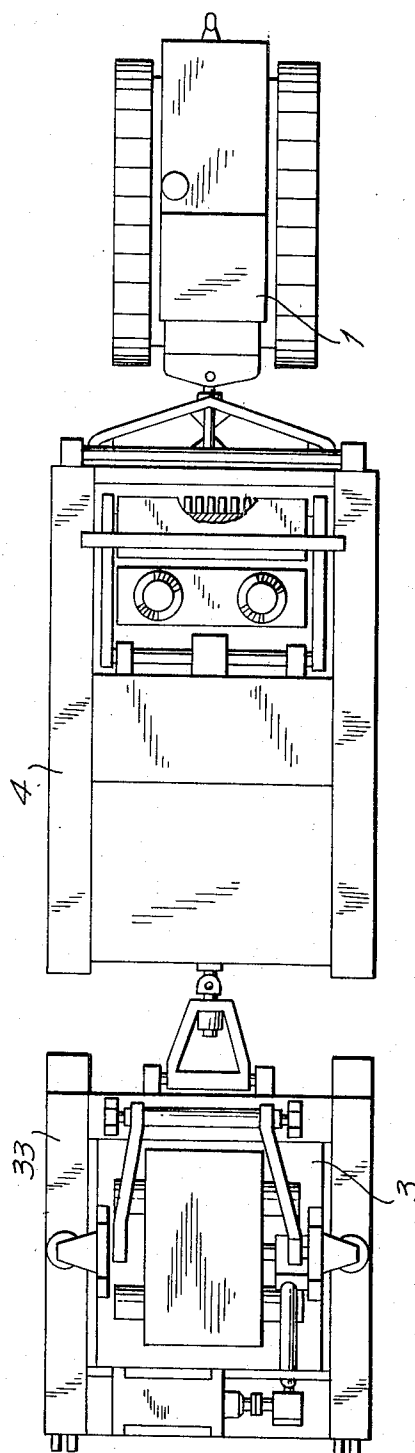


FIG. 2

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FIG. 3

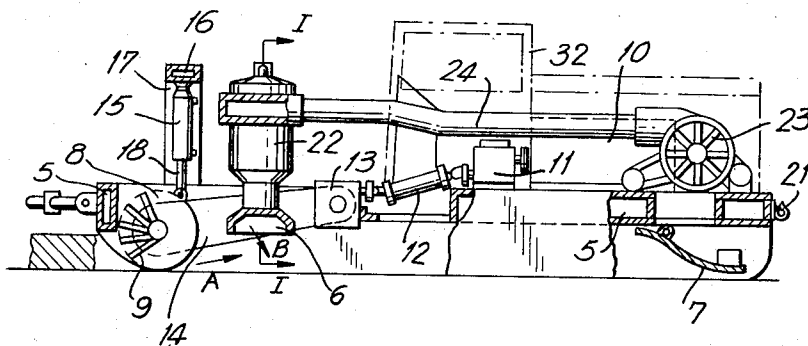


FIG. 4

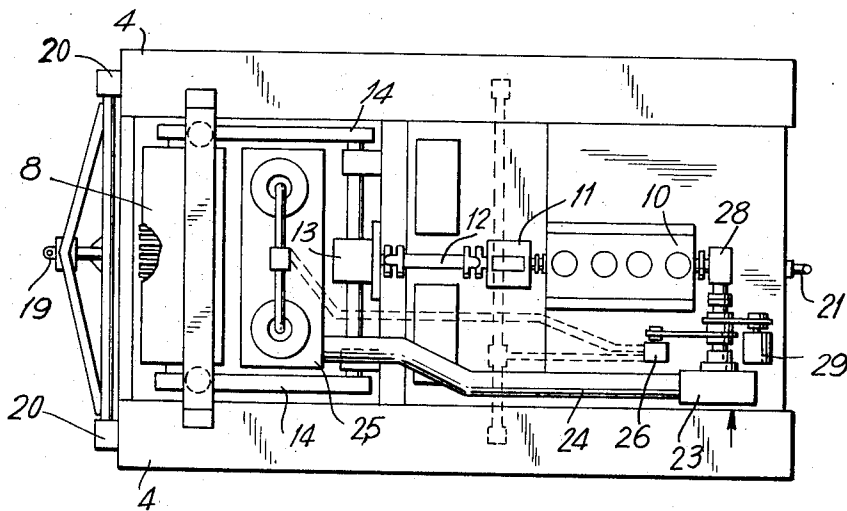


FIG. 5

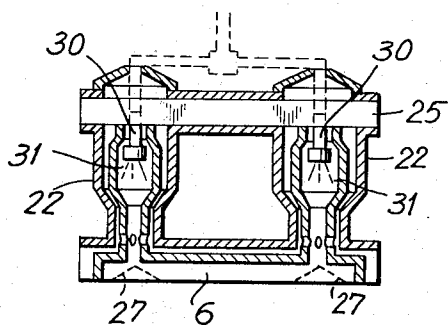
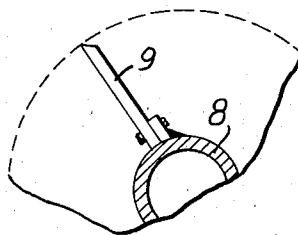


FIG. 6



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FIG. 7

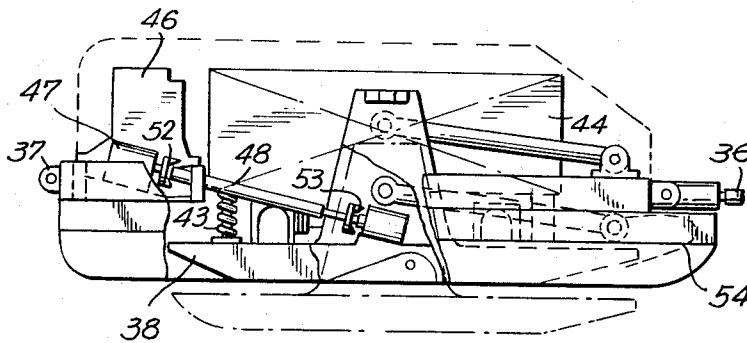


FIG. 8

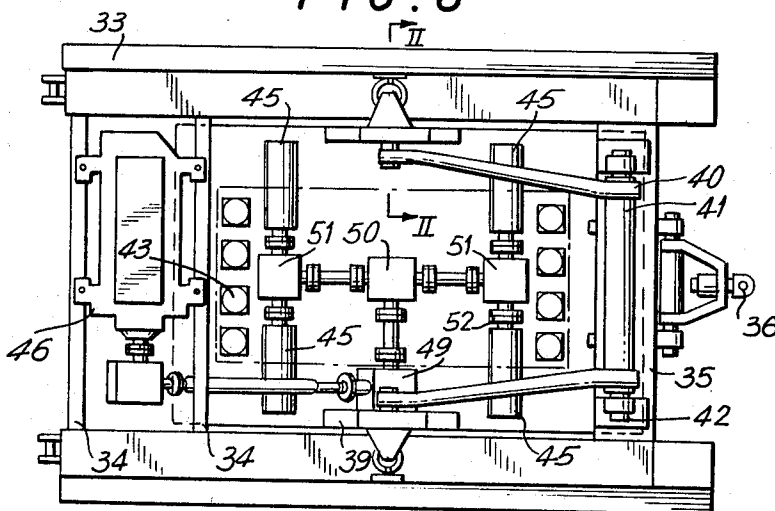
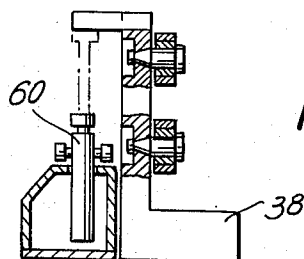


FIG. 9

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APPARATUS FOR PACKING SNOW TO OBTAIN A SNOW AND ICE COVER SURFACE

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6 Claims. (Cl. 94—39)

ABSTRACT OF THE DISCLOSURE

Apparatus comprising an assembly of three detachably coupled units in which the first unit serves to displace the assembly over a snow surface, the second unit comminutes snow and lays down a melted layer on the snow surface and the third unit compacts the layer and snow surface.

The present invention relates to apparatus for packing snow and forming an ice-bound coating capable of bearing a preset specific pressure, when laying roads and the like.

The apparatus comprises a prime mover, to which is hooked a snow-loosening-and-heating device mounted on hollow skis, and a vibration packer also mounted on skis.

In areas where the earth is covered with snow for quite a long time the traffic is seriously hampered, for instance during lumbering operations, and in this case, it is most expedient and economical to provide roads with a hard cover that is obtained by means of appropriate treatment of snow.

There are devices which are known for this purpose, including devices provided with a heating device for the warming and melting of snow and also with a device for snow loosening and packing.

However, these devices of conventional design have a number of disadvantages making their employment difficult and increasing the cost of roads laid.

These disadvantages consist in the presence of separate frame-mounted fuel tanks. Such an arrangement of said tanks makes it necessary to employ a more reinforced and rigid base for the arrangement of equipment and also to increase the power of a transport machine (prime mover); to employ rigid bolt-joint cutting members (blades) in a ripper (cutter) that results very often in their being broken while encountering obstacles or striking rigid objects; to employ a heater with open type injectors positioned directly in the flow of the snow particles which causes increase of the fuel consumption, frequent extinction of flame, impossibility to regulate the combustion process as well as to effect remote control of the ignition; in said devices a snow packing plate of the vibrator cannot be transferred from a transit to an operating position and the plate is not protected against snow accumulating thereon. The drive mechanisms are not vibration-proof and their operation is disrupted frequently. The vibro-packing device is mounted on the same frame together with the loosening-and-heating device which does not permit their separate employment, for instance in case where it is not required to loosen and melt snow due to the snow condition and air temperature.

The object of the present invention is to provide an apparatus of a simple and reliable design for laying snow

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and ice bound roads and the like requiring a less powerful prime mover. Another object of the invention is to provide a snow heating device with low fuel consumption, with a possibility to employ heavy types of liquid fuel as well as with a possibility of remote ignition and of control over the combustion process. Still another object of the invention is to provide a working element, such as a cutter-ripper, characterized by an increased hardness of its cutting members (blades) which can be replaced quickly.

A further object of the invention is to provide a snow packing device, whose vibrator plate can be shifted vertically to transfer it from a transit position to a service position and vice versa, said plate remaining parallel to the surface being packed. A further object of the invention is to protect the drive and gearing elements from the effect of vibration, and the plate from snow and to ensure the possibility of using said snow packing device independently of the device for the loosening and heating of snow.

According to the invention, the above objects are achieved if the melting of snow particles produced by a snow ripper is performed by hot gases produced inside closed chambers which make it possible to exercise remote control over the rate of escape of hot gases and over their temperature. This allows cutting of the fuel consumption and provides for the possibility of exercise of remote ignition of fuel. To achieve these objects blades having the shape of spring bands and made of spring steel are used as cutting elements of said snow ripper; said bands are fixed in cantilevered fashion to the rotating drum (cutter).

The possibility of quick replacement of these blades is achieved by fixing them by means of one bolt to special lugs on the body of a drum (cutter).

Furthermore, a special protective device is used to protect the blades and at the same time the whole working unit can be shifted vertically by means of remote controlled hydraulic cylinders that provide for the possibility of regulating the thickness of the layer of treated snow.

Also in the accomplishment of the above objects, the vibrator of the packing unit is mounted on a separate frame, said frame resting on skis, while the engine and transmission are installed separately on the same frame so as to reduce their susceptibility to vibration. Additionally, the plate itself is suspended on a double-arm suspension, said suspension being connected to hydraulic cylinders by means of which it is lifted to reach a transit position, and lowered to reach a service position remaining parallel with relation to the surface being packed. A special sheet guard is employed to protect the plate vibrator from snow.

Further features and objects of the invention will become apparent from the following description of the invention with reference to the accompanying drawings wherein:

FIG. 1 is a schematic side view of the overall device;

FIG. 2 is a plan view of the device;

FIG. 3 is a side view on an enlarged scale of a snow loosening-and-heating device;

FIG. 4 is the plan view of a loosening-and-heating device;

FIG. 5 is a cross sectional view of line I—I in FIG. 3;

FIG. 6 is a detail showing the attachment of a blade to the working member of a snow cutter;

FIG. 7 is a side view on an enlarged scale of a vibrating-and-packing device;

FIG. 8 is a plan view of the same device;

FIG. 9 is a sectional view on line II—II of FIG. 8.

The overall apparatus consists of prime mover 1, snow loosening-and-heating device 2 and snow packing device 3.

Device 2 serves to loosen fresh snow. This is achieved by a working member which comminutes the snow and delivers it in particle form. Device 2 also operates to heat and partially melt the snow particles and arrange the product in the form of a layer of a certain thickness; device 3 creates considerable specific pressures and vibration loads upon the snow layer in order to pack the latter. Device 3 can work without a snow loosening-and-heating device 2 and it can pack snow provided it does not require loosening and heating.

Device 2 rests upon two skis 4 connected by lateral beams 5. Skis 4 are hollow and used as containers for liquid fuel. The skis bound a thermal chamber formed by the bottom of the apparatus, the walls of skis 4, a distributing manifold 6 and sheet guard 7. Cutter 8 serves as a working member for grinding fresh snow and delivering it inside the thermal chamber. Said cutter is constituted as a rotating drum fitted with blades 9. The blades are detachably and replaceably mounted on the drum as shown in FIG. 6, and preferably the blades are made of resilient material. An internal combustion engine 10 serving to rotate cutter 8 transmits its power through gear box 11, cardan shaft 12 and distribution box 13 to drive sprockets of the drum (cutter). Journals of the drum are mounted in bearings (not shown in the drawing) fixed in rigid casing 14. In order to grind snow layers of different height, cutter 8 is vertically adjustable by means of hydraulic cylinders 15. The hydraulic cylinders 15 are hinged to cross bar 16 whose ends are rigidly fixed to props 17, said props being attached to top surfaces of skis 4 while rods 18 of said cylinders are hinged to casings 10 of chain transmissions of the drive of cutter 8.

Therefore, to shift cutter 8 to an adjusted position, hydraulic cylinders 15 are operated by means of remote control in the operator's compartment. In order to couple device 2 with the prime mover 1, said device 2 is provided with shackle 19 fastened in supports 20. Towing hook 21 serves to engage device 3 with device 2.

A required amount of hot gases having a preset temperature and outflow speed is obtained in combustion chambers 22. Air is fed to the above mentioned chambers by means of blower 23 along airduct 24 through air distributing manifold 25, while liquid fuel is fed by pump 26. Bottom manifold 6 serves to feed hot gases to the thermal chamber. A gradual distribution of hot gases is ensured by means of dispenser 27.

The snow loosening-and-heating device operates in the following manner.

Fuel pump 26, electric generator 29 and blower 23 are activated by means of internal combustion engine 10 through reduction gear 28 and belt drives. Fuel fed by the pump to injectors 30 of chambers 22 is burnt in burning zone 31, while air is fed to said zone at the same time by means of blower 23 through airduct 24 and top distributing manifold 25. Ignition of fuel is remotely controlled from the operator's compartment. Air distributing manifold 25 serves to divide air being fed from the blower into two flows: one flow is fed to a burning zone 31 in order to intensify said burning, while the second one is fed to a space between the external casing of chambers 22 and zone 31 and serves to cool the chamber. The heated air is mixed with the combustion products and is fed to manifold 6 wherefrom it flows together with snow particles to the foregoing thermal chamber.

In order to obtain an even layer of a certain height of partially melted snow, sheet 7 made of stainless steel is placed behind the thermal chamber, the length of said sheet equalling the distance between the inner walls of skis 4.

The top edge of sheet 7 is hinged to the bottom of device 2 while the end edge is weighted or loaded by a spring in order to maintain the sheet in proper position.

Control of all mechanisms of device 2 is exercised from the control board of the operator's compartment 32.

Gearbox 11 serves to change the speed of rotation of cutter 8.

Device 3 is mounted on a frame resting on skis 33 which are rigidly fixed to each other by means of beams of the rear axle 34 and front axle 35. A shackle 36 is secured at the back part of the frame to provide an attachment with the prime mover.

Coupling device 37 is fastened to front axle 35 in the nose part.

A plate 38 of the vibrator is positioned in the space between skis 33, and two parallel arms 40 are fastened to side trusses 39 of said plate 38. The ends of arms 40 are rigidly fixed to tube 41, said tube embracing shaft 42 of front axle 35. The plate vibrator 38 is thereby suspended from the frame so as to be movable vertically in relation to the frame, with the plate being parallel to the treated surface. Hydraulic cylinder 60 (FIG. 9) are used to move the plate 38 from a transport position to a service position and vice versa and also to change the plate service position depending upon the height of snow being treated. Ballast box 44 is fastened to plate 38 by means of shock absorbing spring loaded supports 43 in order to apply regulated pressures on the snow, said box being filled with ballast material (cast iron weights of appropriate weight). Shock absorbing spring-loaded supports 43 must be stiff to such an extent as to obtain a definite amplitude of oscillations of the ballast box 44. Driving forces serving to excite the aforesaid oscillations, are produced due to the presence of unbalancing weights fastened to shafts of vibration units 45, said units serving as vibration generators. In order to control the value of driving force at a preset number of revolutions, vibration units 45 have an arrangement permitting to change the balance. At the same time, the kinetic moment of the imbalance developed by the vibration units is also altered.

The rotation of the shafts of vibration units 45 is produced by engine 46, said engine being connected to these shafts through reduction gearbox 47 of the rear axle, shaft 48, side reduction gearbox 49, central reduction gearbox 50 and side reducers 51 which are connected to each other by means of shafts and clutches 52. To ensure the possibility of shifting plate vibrator 38 and altering the distance between reducer 47 of the rear axle and side reduction gearbox 49, the connection between them is made by means of cardan clutches 53 and splined shaft 48 of alternating length.

In order to protect plate 38 from snow, its surface and the vibrator mechanism are covered with steel sheet 54 one edge of which is fixed to plate 38 and the other to the front axle. The configuration of said sheet 54 and its thickness are chosen so that the position of the sheet does not preclude the plate vibrator 39 from vertical lifting and vibration.

The apparatus operates in the following manner.

Device 2 is fastened by means of shackle 19 to a transport machine i.e. prime mover 1, and device 3 is fixed by means of hook 21 to device 2. Prior to the beginning of movement, the engine 10 is started on device 2 and engine 46 on device 3, respectively. At the moment of beginning of the movement an operator in compartment 32 operates gear box 11 and lowers cutter 8 to its working position, thus setting it in rotation. At the same time the operator activates fuel pump 26 and blower 23. Fuel and air are injected into combustion chamber 22 and the fuel is ignited by means of a conventional system of ignition. For this purpose generator 29 and a storage battery (not shown in the drawing) are used. Snow particles produced by cutter 8 are fed into the thermal chamber formed by the bottom of the device 2, skis 4, manifold 6 and sheet guard 7. In this chamber the snow particles are partially melted and fall back onto the road surface.

In device 3 which follows device 2, the operator transfers plate vibrator 38 from a transport position to a working position and sets vibration units 45 in rotation, said vibration units imparting vibration to plate 38. The

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packing of loosened and partially melted snow is effected at this time.

If the temperature of the air and the condition of the snow permit the snow to be packed without its being pre-loosened and preheated, only device 3 is coupled to the prime mover.

We claim:

1. Apparatus for packing snow to obtain a snow and ice cover surface, said apparatus comprising an assembly of three detachably coupled units arranged in consecutive order, the first unit being a prime mover for displacement of the assembly over a surface of snow; the second unit including a comminuting drum having radiating blades to throw the snow rearwardly, means for rotating said drum, a heating manifold behind said drum to partially melt the snow thrown rearwardly by said drum, a downwardly and rearwardly sloping sheet guard spaced rearwardly of said heater manifold, and hollow skis supporting said second unit and constituting a container for fuel for the heating of said manifold; the third unit including vibration means for compacting the layer and the snow surface.

2. Apparatus as claimed in claim 1, wherein said second unit comprises a chamber for the combustion of fuel remote from said manifold, a manifold for the supply of air to the latter chamber, a distributor for feeding combustion gases from said latter chamber to the heating manifold, and means for the remote control of the supply of fuel and air to the combustion chamber.

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3. Apparatus as claimed in claim 2, wherein said radiating blades are resilient and detachably mounted on said drum.

4. Apparatus as claimed in claim 1, comprising means on said second unit for vertically adjusting the rotatable drum.

5. Apparatus as claimed in claim 4, wherein said means for vertically adjusting the rotatable drum comprises a remote controlled hydraulic piston and cylinder device coupled to said drum.

6. Apparatus as claimed in claim 1, wherein said vibration means comprises a vibrator plate, said third unit including means for raising and lowering the vibrator plate between a raised transit position and a lowered operative position.

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JACOB L. NACKENOFF, *Primary Examiner*.