

April 4, 1961

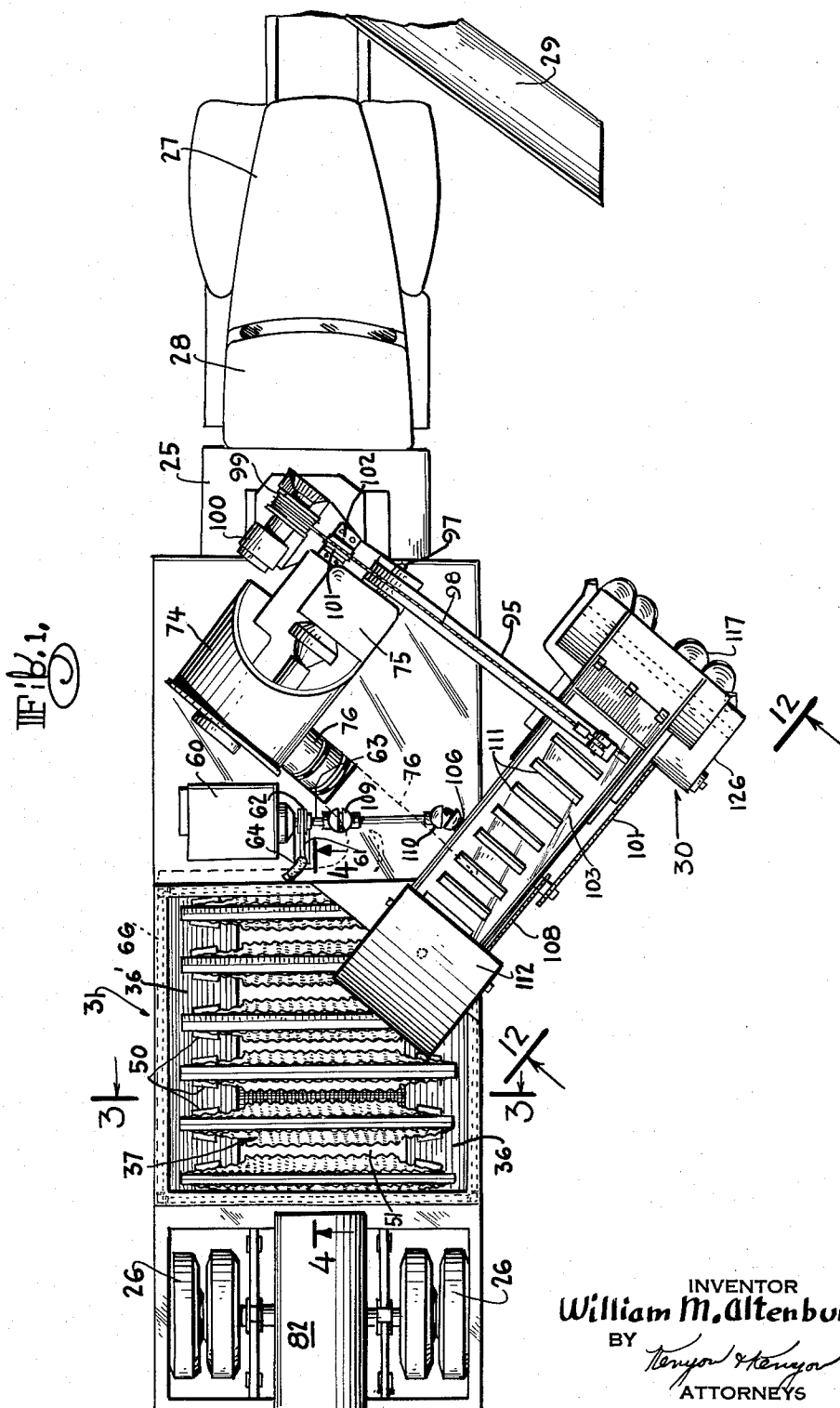
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2,977,955

SNOW-MELTING MACHINE AND METHOD

Filed Jan. 4, 1957

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2,977,955

SNOW-MELTING MACHINE AND METHOD

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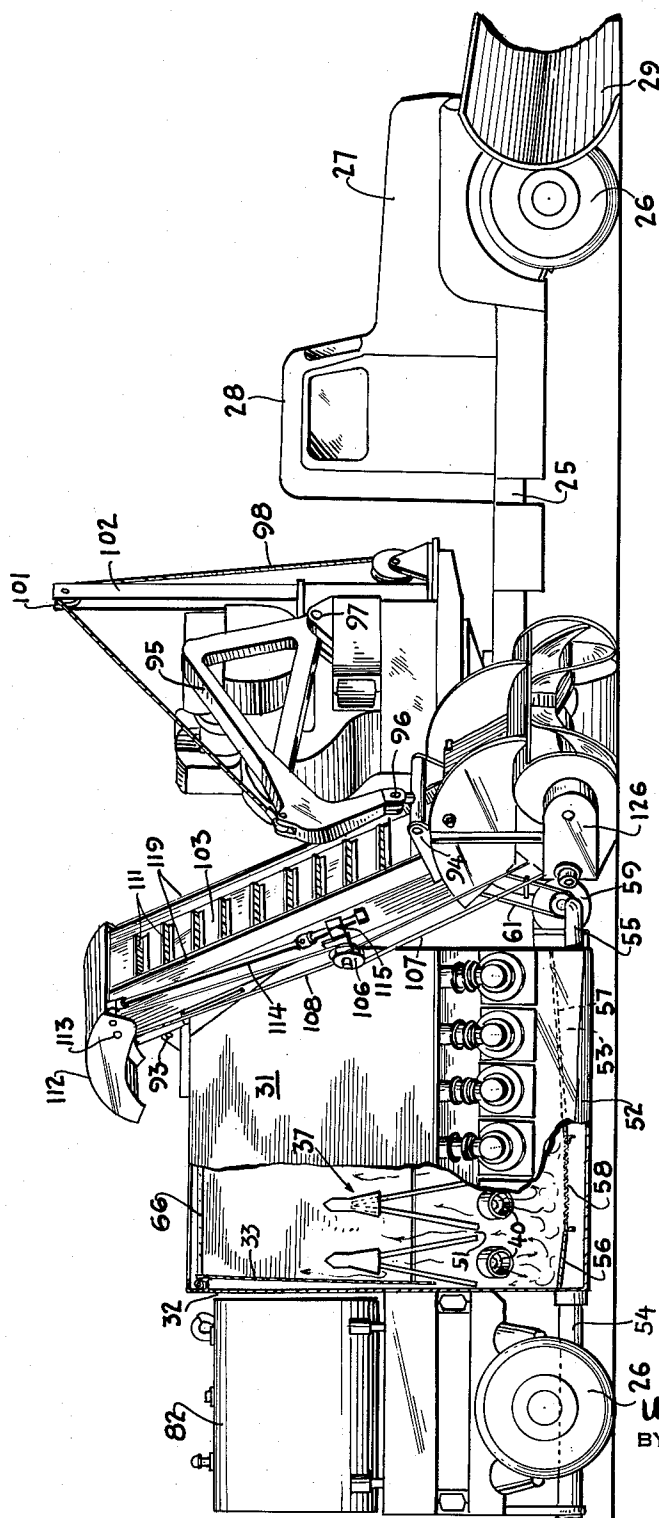


FIG. 2.

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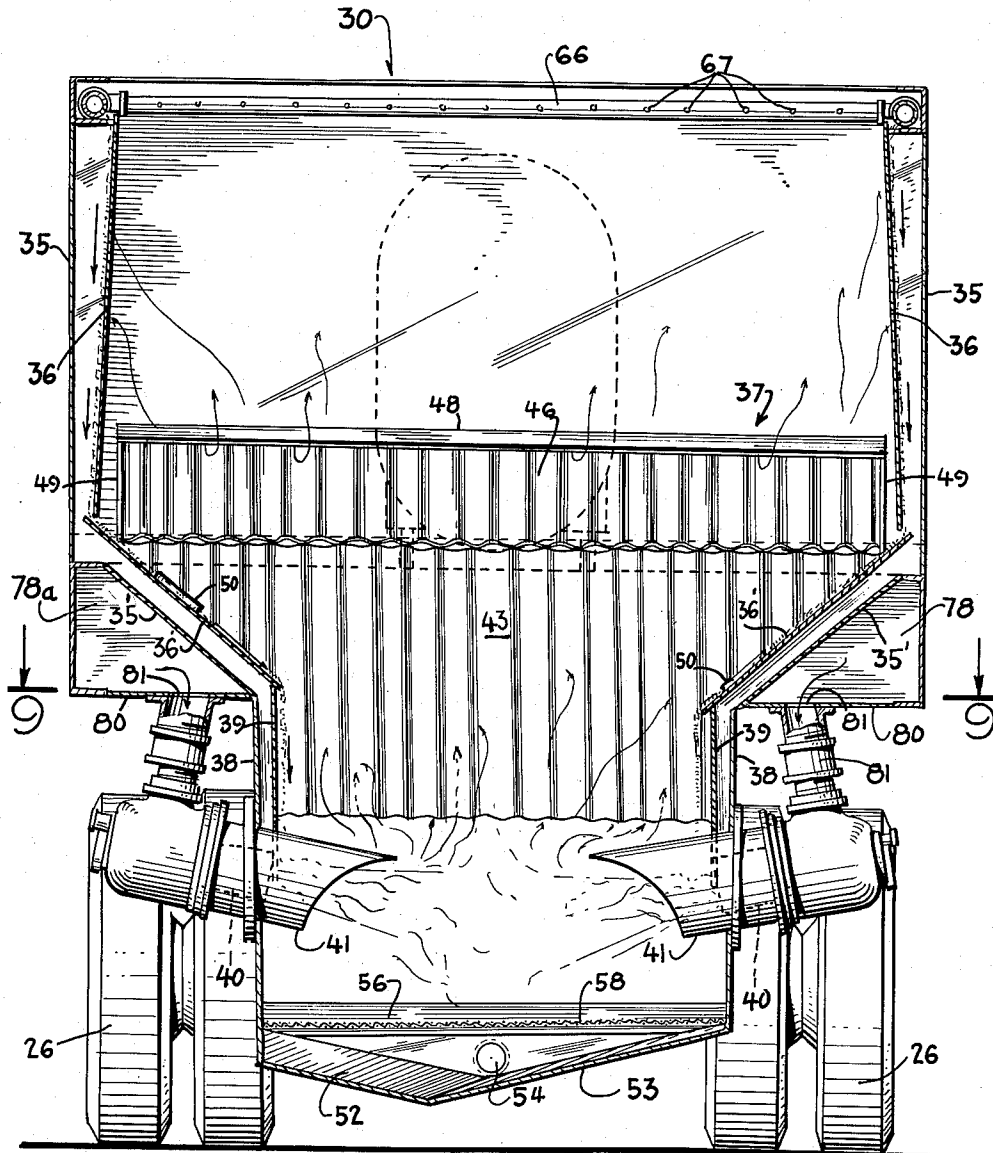


Fig. 3.

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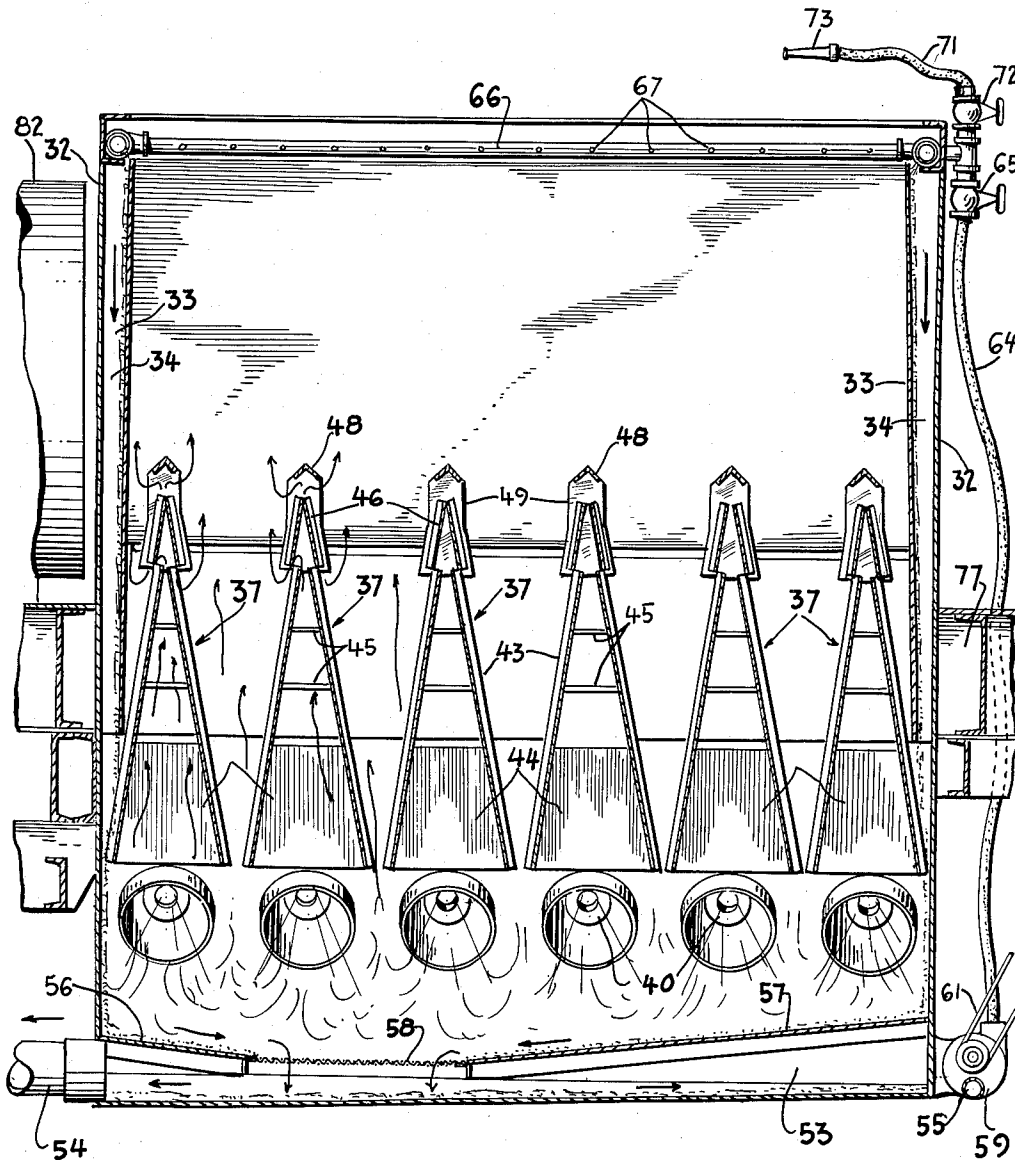


Fig. 4.

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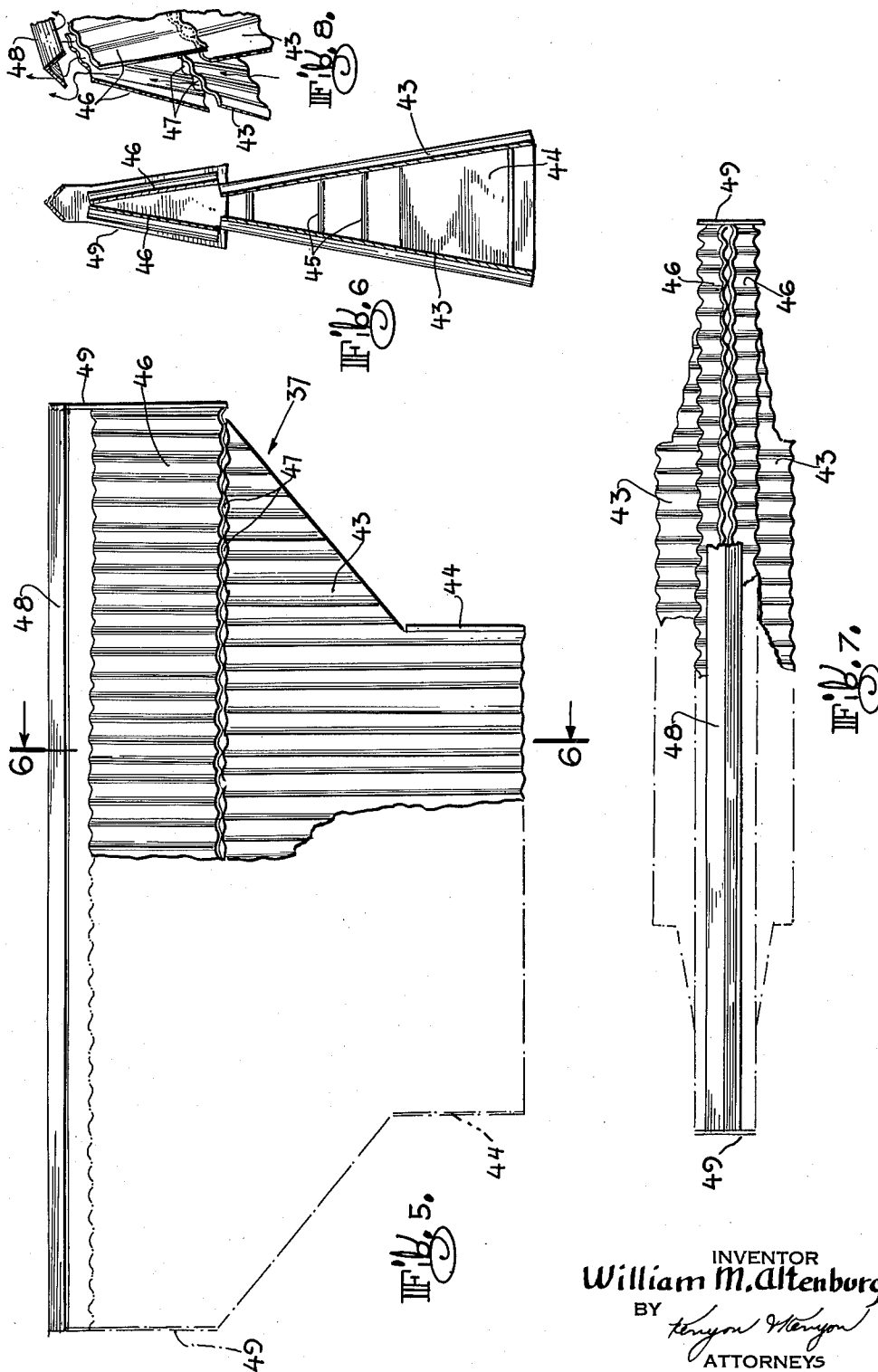
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SNOW-MELTING MACHINE AND METHOD

Filed Jan. 4, 1957

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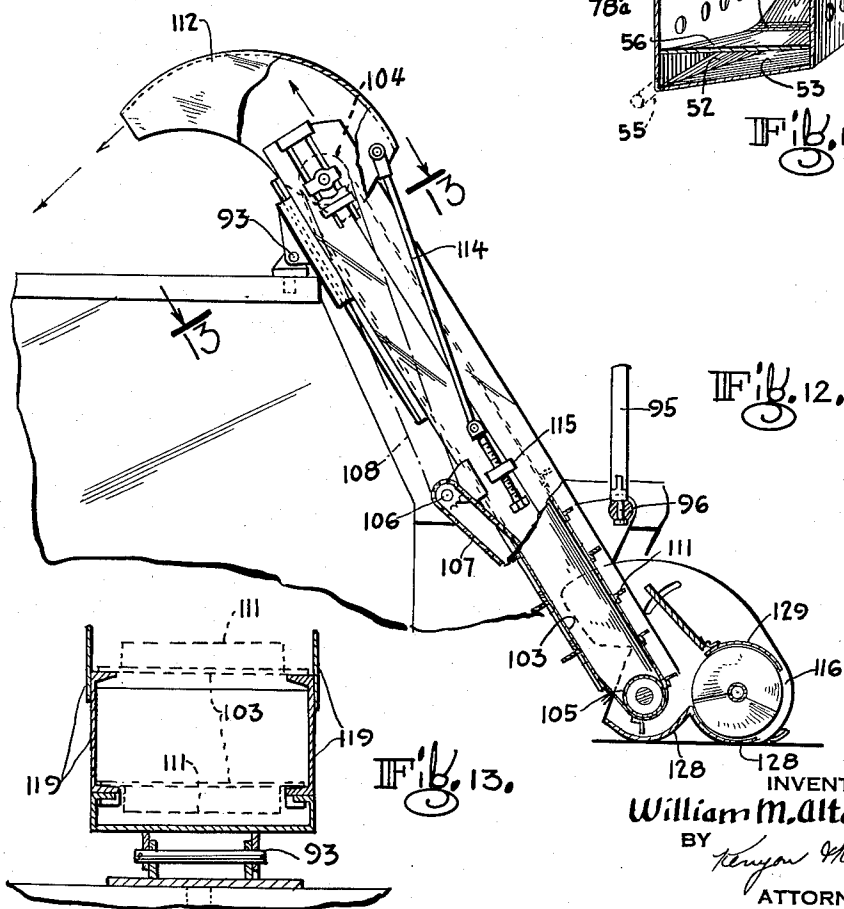
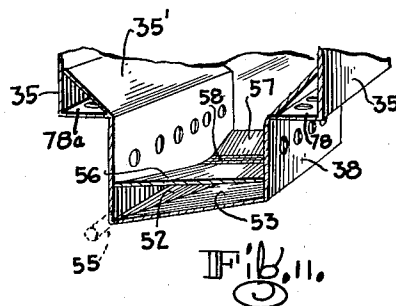
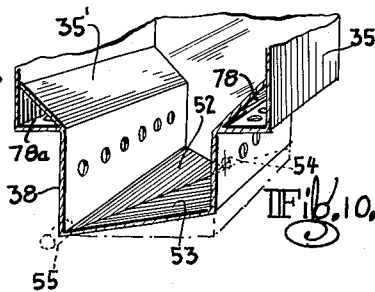
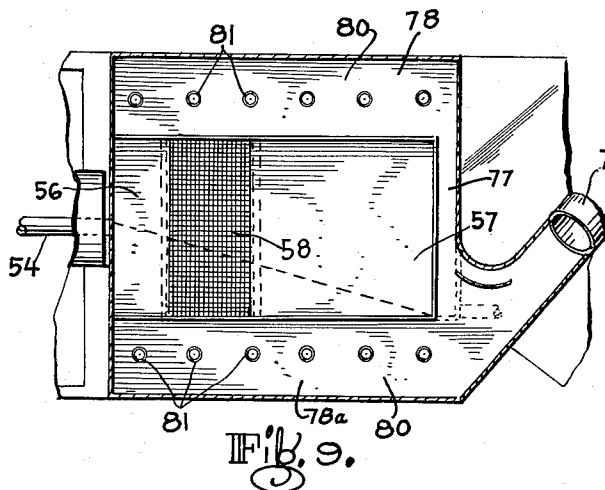
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SNOW-MELTING MACHINE AND METHOD

Filed Jan. 4, 1957

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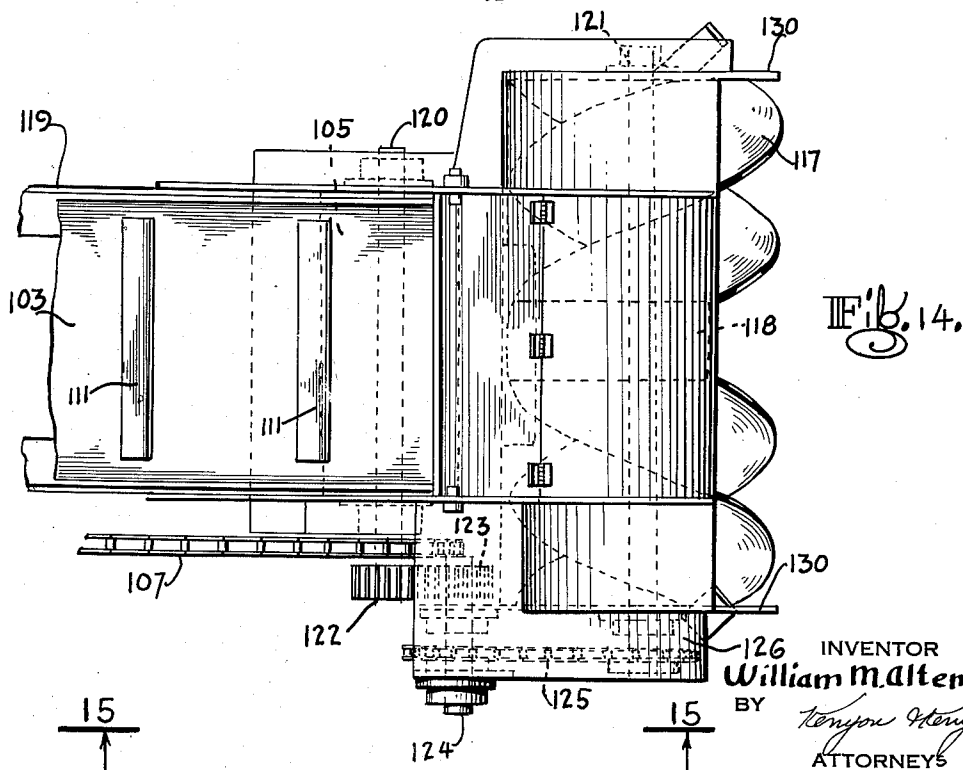
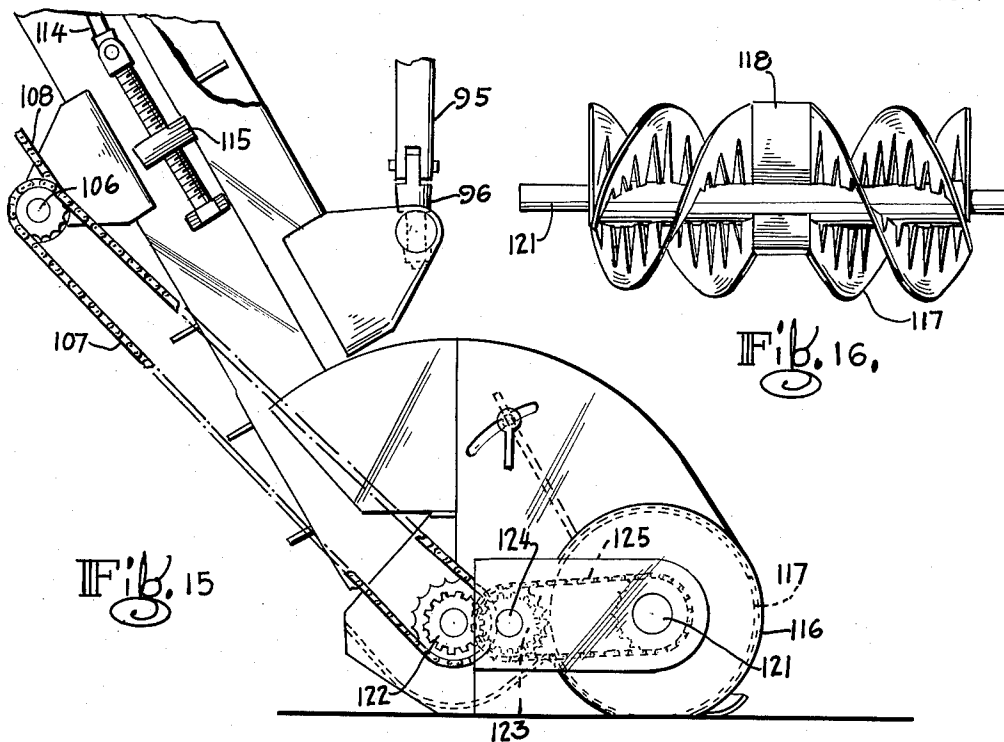
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SNOW-MELTING MACHINE AND METHOD

Filed Jan. 4, 1957

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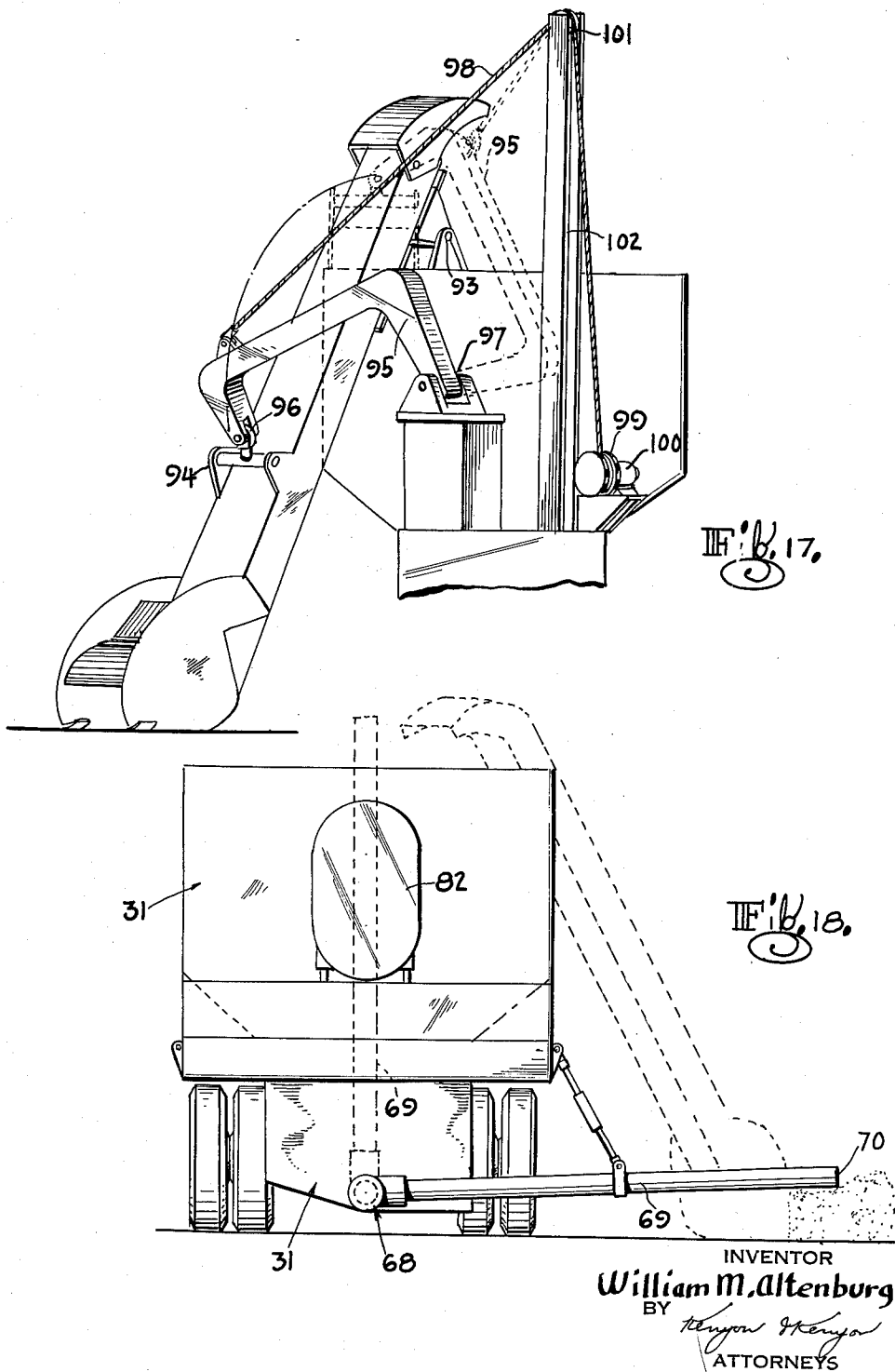
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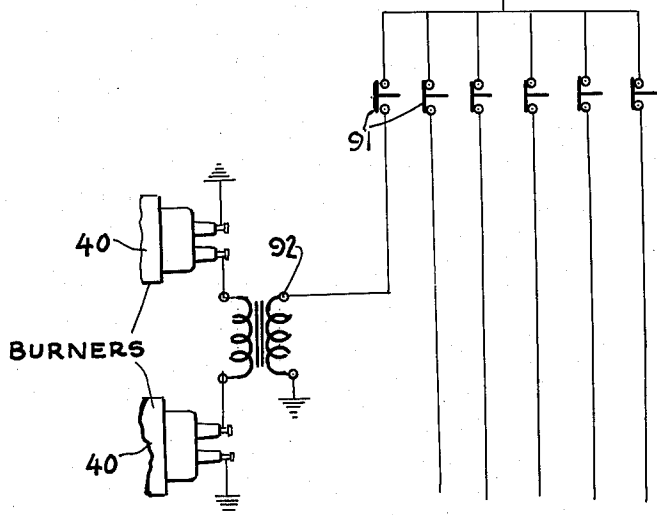
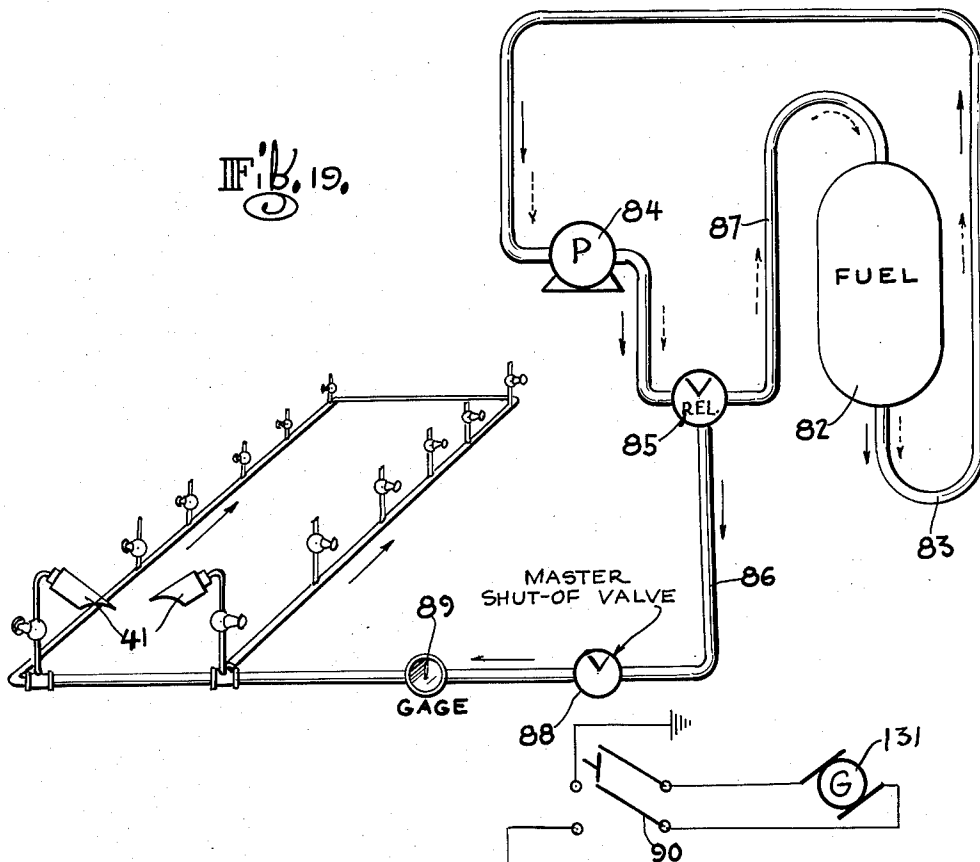
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SNOW-MELTING MACHINE AND METHOD

Filed Jan. 4, 1957

9 Sheets-Sheet 9



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2,977,955

SNOW-MELTING MACHINE AND METHOD

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5 Claims. (Cl. 126—343.5)

This invention relates to snow-melting machine and method. It relates more particularly to machines and methods for effecting snow removal from streets and roads by charging the snow into a snow-melting receptacle, the water resulting from the melting of the snow thereafter being discharged from the machine.

It is an object of this invention to provide a snow-melting machine which has a very large snow-melting capacity for its size and weight and which makes highly efficient utilization of fuel used for melting the snow. It is a further object of this invention to provide a snow-melting machine which is comprised in a vehicle and which is adapted to receive and take up snow from ground level while the machine is being moved forwardly and to continuously melt the snow and discharge the resulting water either continuously or discontinuously during the progression of the machine.

It is a further object of this invention to provide snow-melting equipment which can be controlled by one operator and which can be towed and maneuvered by conventional truck-tractor equipment.

Heretofore snow-melting machines comprised in a vehicle have been proposed but have not been extensively used principally because of problems due to low capacity, lack of efficiency and unreliability.

Features and advantages of this invention relate to the snow-melting receptacle into which the snow is charged for melting and to the means for heating the snow in the receptacle to melt it. Certain features of this invention relate to the burners which are disposed adjacent the bottom of the snow-melting receptacle and to the grates disposed above the burners for supporting the snow in efficient manner for effecting rapid melting. In preferred embodiments the grates are disposed in the form of an inverted V having greater vertical extent than horizontal extent, thus providing a large area of heat-conducting surface for contact with the snow in relation to the horizontal dimensions of the melting receptacle and the cubic feet of snow charged into the receptacle. Moreover, the grates are separated from each other adjacent the bottom thereof so that blasts of hot products of combustion are projected upwardly into the snow overlying the grates at spaced intervals, thereby providing a slicing action in the overlying snow which aids in preventing bridging of the snow across the melting receptacle.

In combination with the grates having the aforesaid features, further features are preferably employed in that adjacent the upper portion of the grate members, whose cross section resembles an inverted V, there are outlets for the hot products of combustion which discharge the products of combustion laterally and preferably in a generally horizontal direction. Thus, there are blasts of hot products of combustion that are projected upwardly from adjacent the bottom of the grate members at spaced intervals and there are blasts which are projected laterally from adjacent the tops of the grate members, this combination of blasts being especially

effective in melting the snow while minimizing bridging.

Further features of this invention relate to the provision of double walls for the melting receptacle which have flue spaces therebetween to which the hot products of combustion have access so as to thereby minimize sticking of the snow to the walls with resultant bridge formation. Alternatively, or preferably also, the inner walls of the snow-melting receptacle are inwardly inclined, extending upwardly in the region above the grates.

Further features of this invention relate to the handling of the melted snow which is caused to be collected in a sump at the bottom of the snow-melting chamber. One feature resides in the provision of a sump which is adapted to hold a substantial amount of water resulting from the melting of snow in the snow-melting receptacle. Preferably, the water collected in the sump is exposed to heat from the burners so as to become heated and remain heated above the melting point of snow. Other features relate to the provision of means whereby foreign bodies contained in snow taken into the machine become exposed to the hot products of combustion with resultant combustion in the machine of combustible material comprised in the foreign bodies.

Further features of this invention relate to the provision of water-discharging means adjacent the top and preferably disposed along and about the top of the snow-melting receptacle in combination with pump and conduit means for pumping water from the sump at the bottom of the snow-melting receptacle to the water-discharging means adjacent the top. Preferably also, the water-discharging means comprises a manually operated hose or the like so that, when desired, an operator may select the optimum spot at which a spray or stream of hot water pumped from the sump may be played over the top of the snow in the snow-melting receptacle. By causing a valve or other flow control device to be disposed in the conduit and pump means for pumping water from the sump into snow in the melting receptacle the amount of heat utilized in melting snow can be regulated and in turn the temperature of the water collected in the sump may be regulated.

During a snow-melting operation water is discharged from the apparatus in an amount corresponding to the amount of snow taken in, and by virtue of the water recirculating system above described the temperature of the water discharged from the machine may be controlled as desired. This is an advantage in that water may be discharged onto a street, for example, at a temperature sufficiently high so that the pavement surface becomes warm and any residual moisture evaporates completely before it can freeze into a glaze of ice, thus leaving the surface of the street dry. Alternatively, the water may be discharged at just above freezing temperature when freezing on the street is not a problem.

Further features of this invention relate to the means utilized in discharging water from the melted snow in the sump for making effective use thereof and whereby it may be discontinued at intervals so as to cut off the discharge of water in a zone where such discharge is not desired.

Further features of this invention relate to the means for charging the snow into the snow-melting receptacle during progress of the machine along a road or street. Thus, one feature resides in the provision of a high speed conveyor for conveying and elevating the snow in combination with a baffle which causes the snow to be distributed throughout most of the upper portion of the snow-melting receptacle so as to minimize by-passing of the incoming snow by the hot products of combustion from the burner means. Other features relate to the provision of a snow-receiving and elevating means which

is adapted to be moved from working position with the mouth of the snow-receiving means at ground level to position overlying and in general alignment with the vehicle during transportation of the vehicle under its own power from one location to another.

Another feature relates to providing sufficient capacity in the stack area above the grates to hold enough melted snow to cool the stack gases to a relatively low temperature, thus utilizing the bulk of the heat in the stack gases before the gases are released into the atmosphere.

Further features and advantages of this invention relate to the application of heat at a very high temperature in excess of 2000° F. adjacent the bottom of the snow-melting receptacle and in the blanketing of the upper portion of the snow-melting receptacle without substantial bridging, with the result that the products of combustion which ultimately escape into the atmosphere are at a temperature less than 200° F. Further features and advantages of this invention relate to making available an average of over 40,000 B.t.u. per hour for each cubic foot of snow capacity of the snow-melting equipment.

Further objects, features and advantages of this invention will be apparent from the following description of a typical illustration of the practice of this invention and of a preferred embodiment thereof in connection with the accompanying drawings, wherein:

Fig. 1 is a plan view of a snow-melting machine embodying this invention;

Fig. 2 is a side elevation of the machine;

Fig. 3 is a sectional elevation taken on the line 3—3 of Fig. 1;

Fig. 4 is a sectional elevation taken on the line 4—4 of Fig. 1;

Fig. 5 is an enlarged side elevation of one of the removable grates employed in the snow-melting receptacle over the burners;

Fig. 6 is a sectional elevation of the grate taken on the line 6—6 of Fig. 5;

Fig. 7 is a plan view of the grate shown in Fig. 5;

Fig. 8 is a detail perspective view, partially in section, showing the upper portion of the grate shown in Figs. 5 to 7;

Fig. 9 is a plan view on a small scale taken in section at the line 9—9 of Fig. 3 showing the air feed conduit means for the burners, the burners and grates being removed;

Fig. 10 is a schematic perspective view on a small scale showing the sump at the bottom of the snow-melting receptacle, the burners and grates being removed, and the drain and screen members above the bottom of the sump also being removed;

Fig. 11 is similar to Fig. 10, but showing the drain and screen members in place above the bottom of the sump;

Fig. 12 is a side elevation drawing of moving parts of the snow-receiving and elevating means for loading snow from the ground level into the snow-melting receptacle;

Fig. 13 is a section taken on the line 13—13 of Fig. 12;

Fig. 14 is a plan view on an enlarged scale of the snow-receiving means and the lower end of the snow-elevating means;

Fig. 15 is a side elevation viewed from the line 15—15 of Fig. 14;

Fig. 16 is a front view of the rotary snow blade at the mouth of the snow-receiving means;

Fig. 17 is a diagrammatic view of the means for raising the front end of the snow-receiving and elevating means and swinging it into alignment with the vehicle chassis of the machine;

Fig. 18 is a rear end elevation of the machine showing the effluent line for melted snow;

Fig. 19 is a schematic showing of the fuel supply means for the burners; and

Fig. 20 is a schematic showing of the electrical circuit for the burner igniters.

In the embodiment of this invention shown in the

accompanying drawings the apparatus for loading and melting the snow is mounted on the truck chassis 25 which is mounted on wheels 26. Within the hood 27 there is a suitable engine (not shown) which is connected to at least the rear wheels of the truck for propelling the entire machine along a road or street and by suitable mechanisms (not shown) the truck may be steered by an operator located within the cab 28.

At the front of the truck chassis there is mounted a diagonally disposed snow plow blade 29 which pushes the snow on a road or street to the righthand side of the machine as the machine is moved forwardly and concentrates it in an elongated pile in line with the mouth of the snow-receiving and elevating means for loading the snow into the snow-melting receptacle of the machine, the snow-receiving and elevating means being indicated generally by the reference character 30.

The snow-melting receptacle, which is indicated generally by the reference character 31, comprises vertically disposed walls. The walls at each side and at each end are double walls with a flue space therebetween. The outer walls 32 at each end of the receptacle are substantially vertical from top to bottom and extend down to the sump at the bottom of the receptacle. Spaced from the walls 32 are the walls 33 (see especially Fig. 4) which are somewhat inwardly inclined in extending upwardly from the region of the grates above the burners. The bottoms of the walls 33 are spaced from the walls 32 so that products of combustion from the burners, which will be described hereinafter, may have access to the flue spaces 34 between the walls 32 and 33.

Similarly, the walls on each side of the snow-melting receptacle 31 (see Fig. 3) comprise the outer walls 35 and spaced therefrom the inner walls 36, the inner walls 36 being inwardly inclined extending upwardly from the region of the grates above the burner means. The side walls also comprise the inwardly inclined portions 35' and 36', the walls 36' providing a support for the grates, which are indicated generally by the reference character 37. The space between the walls 35 and 36 and between the walls 35' and 36' constitute a flue space to which hot products of combustion from the burners have access. The bottoms of the walls 36 are spaced slightly from the upper portions of the inclined walls 36' so as to provide an exit aperture for hot products of combustion into the interior of the snow-melting chamber in direct contact with the snow in the melting chamber.

In the region of the burners side walls 38 are provided that extend down to the sump and spaced therefrom are the walls 39 which serve to control the passage of hot products of combustion into the flue spaces between the walls 35' and 36' and between walls 35 and 36.

Disposed in the lower portion of the snow-melting receptacle immediately above the bottom thereof there are a plurality of burners 40 whose ends are protected by the shields 41. The burners are supplied with both air and fuel under pressure so as to produce a blast flame at a temperature of at least about 2000° F. Suitable burners for the purpose are well known. Above each of the burners 40 there is a grate 37. Each grate has the general configuration of an inverted V, the vertical extent of each grate being substantially greater than the horizontal extent and preferably the vertical extent is at least twice the horizontal extent of the grate, the optimum relative dimensions being as shown, wherein the vertical extent is somewhat over three times the horizontal extent of each grate.

As most clearly shown in Figs. 6 to 8, each grate comprises inclined walls with a flue space therebetween. The major portion of each grate is composed of inclined spaced walls 43 which are held in assembled relation to each other by the end plates 44 and the cross braces 45. The walls 43 are made of corrugated metal which provides an increase in surface area and also facilitates the pro-

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vision of exits for products of combustion in the region of the upper portion of each grate.

Above the walls 43, which are spaced somewhat apart adjacent the tops thereof, there is a second pair of inclined spaced walls 46 which also are made of corrugated metal. The lower margins of the walls 46 are welded to the upper margins of the walls 43, as best shown in Fig. 8, so that the walls 46 provide a slight overhang and apertures 47 formed by the corrugations whereby products of combustion may escape laterally into snow supported between the grates. The upper margins of the walls 46 are welded together, crest to crest, so that products of combustion may escape from the top of the grates. In order to deflect the escaping products of combustion at the top of the grate so as to direct them laterally or horizontally, a cap member 48 is provided which is secured at each end to a plate 49 which may rest, respectively, on the inclined walls 36' together with the lower margins of the walls 43 in the region where the inclined walls 36' occur. In order to keep each grate in proper position guide blocks 50 are employed (Figs. 1 and 3). Otherwise, the grates merely rest freely in the lower portion of the snow-melting receptacle and may be readily removed merely by lifting them out whenever it is desired to clean out the machine.

Particularly in connection with Figs. 1, 2 and 4, it is to be noted that each grate 37 is spaced from an adjoining grate by a substantial distance or space indicated at 51. It is thus seen that products of combustion from the burners 40 have different routes of travel. One portion rises up into the flue spaces within the grates 37 and is projected laterally into snow above the grates. At the same time there is a blast of the products of combustion through the spaces 51 so that in the body of snow within the receptacle there are regions where the upwardly projected blasts of hot products of combustion tend to slice the snow and thereby aid in preventing bridging within the snow-melting receptacle, such bridging if it occurs being very detrimental as regards the efficiency of the utilization of the heat generated by the burners. At the same time hot products of combustion are discharged laterally into the snow as it collapses into the spaces between the grates. In this manner, by the combined blasts, efficient direct contact of the products of combustion with the snow in the snow-melting receptacle or chamber is provided. Moreover, because of the sharp inclination of the side walls of the grates 42 so that their vertical extent is greater than their horizontal extent a very extensive area of heat-conductive surface is provided which is supplemented by the heated walls of the snow-melting receptacle. To heat this extensive area of heat-conductive surface, there is available an average of at least 34,000 B.t.u. per hour for every square foot of heat-conductive surface contacting the snow. By the means referred to an extremely high rate of heat transfer to the melting snow is effected in a compact melting receptacle wherein a blanket of snow may be maintained over the heating means so as to provide the maximum efficiency in utilization of the heat. While the grates intentionally provide a large area of heat exchange surface in relation to the lateral extent of the lower portion of the snow-melting receptacle, nevertheless the disposition of the burners under the grates and the utilization of both direct and indirect transfer of heat to the melting snow enables the machine to transfer at least 34,000 B.t.u. or more per hour to the melting snow per square foot of heat-conductive surface employed. Moreover, as aforesaid, it is possible to make available about 40,000 B.t.u. or more per hour to each cubic foot of capacity for snow of the snow-melting receptacle.

Another factor contributing to the efficiency and capacity of the snow-melting machine of this invention results from the fact that the heated inwardly inclined walls, which have been described hereinabove, contribute to minimization of any bridging of the snow or development

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of chimneys or funnels therethrough, which, when occurring, permit escape of products of combustion without efficient utilization of the heat content thereof. Even a slight inward inclination such as 1° from the vertical is beneficial, although the inward inclination preferably is at least about 3°.

Another feature of this invention which likewise contributes to its efficiency both in the over-all utilization of heat and in the minimization of bridging resides in the pumping of water produced by the melting of the snow from the sump at the bottom of the snow-melting chamber so as to be discharged onto the snow in the snow-melting receptacle.

As shown largely diagrammatically in Figs. 10 and 11, the bottom of the snow-melting receptacle is provided with sloping panels 52 and 53. These panels slope downwardly so that at the rear of the sump there is an outlet line 54 at about the middle of the sump. Adjacent the forward end of the sump and near the righthand wall of the sump (as one faces the forward end of the vehicle) there is another outlet line 55. The inclined panels 52 and 53 thus provide a basin which becomes filled with melting snow during operation of the apparatus when free outlet through either line 54 or line 55 is closed off or partially closed off so that the outflow from the sump is not greater than the inflow from the melting snow, the mouths of the lines 54 and 55 in such case remaining flooded with water from the melting snow.

As best shown in Fig. 11, there are disposed above the sloping bottom panels 52 and 53 drain panels 56 and 57 which slope downwardly toward a screen 58. The screen 58 serves to screen out solid objects in the form of trash of various kinds which may be picked up with the snow during snow removal. The drain panels 56 and 57 are directly underneath the burners 40 and the heat from the burners serves to heat the water draining down the drain panels 56 and 57 and likewise serves to burn any combustible material such as small sticks, leaves, paper and the like. The result is that the principal material which is caught on the screen 58 and which has to be removed from time to time is in the form of stones, small pieces of metal and the like. Because of the easy removability of the grates 42 such objects can be readily removed whenever it becomes desirable to do so.

The outlet line 55 at the forward end of the sump is connected to the inlet side of a pump 59 which may be operated from the motor 60 by means of the belt 61, which is driven by the pulley 62 mounted fixedly on the motor shaft 63. Water impelled by the pump 59 is directed upwardly through a suitable line such as flexible hose 64 which is controlled at its upper end by a valve 65 and which is connected to the piping 66 that is disposed along the upper margins of the snow-melting receptacle. The piping 66 is provided with a plurality of spray jets 67 which are adapted to spray water therefrom over snow within the snow-melting receptacle when water is pumped into the piping 66 by the pump 59. The amount of water that is thus sprayed onto the snow may be controlled by the valve 65. By regulating the rate of flow of water from the sump to the piping 66 and from the spray jets 67 one may control the temperature of the water that collects in the sump, increased quantities of water pumped into contact with the melting snow resulting in lower temperatures of the water in the sump.

The pumping of the water from the sump into contact with the melting snow is an important feature of this invention in assisting and accelerating of the melting of the snow and in preventing bridging which detracts from the efficiency of the apparatus. However, the control of the temperature of the water in the sump also is a feature of this invention in that one is enabled to discharge the water from the machine at a temperature which may be varied according to the weather conditions encountered. For example, in sub-zero weather when the discharged water might well freeze as a slippery film one

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is enabled to discharge the water at a sufficiently high temperature so that it will evaporate away, leaving the road surface dry. Moreover, when it is desired to melt ice or snow in inaccessible regions such as those occurring under parked automobiles, hot water may be discharged from the machine so as to accomplish snow and ice removal by melting it while it is on the street or road.

While the automatic discharge of water from the spray jets 67 serves to prevent any bridging and to keep the contents of the snow-melting receptacle as a slushy blanket over the grates 42, nevertheless it is preferable to provide a manually actuatable spray means such as the flexible hose 71 which extends from the water line 64 and is controlled by the valve 72 and has a suitable nozzle 73 at the end thereof which may be held by an operator and directed so as to break up any inequalities in snow accumulation within the snow-melting receptacle.

The removal of the water from the sump for discharge from the machine is effected through the outlet line 54 that has been referred to hereinabove. This outlet line extends rearwardly from the sump to a swivel joint 68 which has the line 69 extending therefrom that can be caused to extend from either side of the apparatus. As shown in Fig. 18, the line 69 may be disposed for discharging water from the same side of the machine as that from which snow is received by the machine. In this way the discharged water may be caused to flow into the gutter and underneath parked automobiles. However, the line 69 can be swung to the opposite side if desired. Moreover, the level of the outer extremity 70 of the line 69 may be adjusted by the operator. When the end 70 is elevated to the position shown in dotted lines in Fig. 18 it is apparent that water cannot escape from the sump at the bottom of the melting chamber. Moreover, the elevation of the end 70 may be used to control the depth of the water in the sump. When the end 70 is temporarily elevated, one can prevent any discharge of water for a short interval such as two or three minutes, such discontinuance of effluent frequently being desirable under certain circumstances, as, for example, at street intersections.

The burners 40 may be supplied with air and fuel under pressure by any suitable means. In the embodiment shown the air under pressure is supplied by the blower 74, which is driven by the engine 75. Air under pressure produced by the blower is directed through the manifold 76 which communicates with the air ducts 77, 78 and 78a. The ducts 78 and 78a are formed by the lower portions of the wall members 35, the under side of the inclined wall members 35' and the horizontal plates 80. As most clearly shown in Fig. 9, the plates 80 have air pipes 81 opening therethrough, there being one air pipe connected to each burner 40 for supplying air under pressure.

The fuel lines have not been indicated except diagrammatically in Fig. 19. The fuel is supplied from the fuel tank 82 and may be pumped through the line 83 by the pump 84. The pump 84 may, if desired, be powered by engine 75 by suitable means (not shown). The amount of fuel directed to the burners may be regulated by the regulating valve 85 which controls the relative amount of fuel directed to the burners through the line 86 or returned to the fuel tank 82 by the line 87. The line 86 may comprise the master shut-off valve 88 and the pressure gauge 89. By suitable manifolding means the fuel is supplied to the burners 40.

For igniting the burners any suitable means may be employed. Thus, a motor generator (not shown) may be mounted on the vehicle, the generator merely being indicated schematically at 131 in Fig. 20. The electric power produced by the generator is controlled by the master switch 90 and by the individual switches 91, each of which is applicable to a pair of burners 40 as shown. The voltage may be regulated in any manner appropriate for the burners used, e.g. by a transformer 92.

Further features of this invention relate to the means for receiving and elevating the snow from the street level

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for controlled discharge into the snow-melting receptacle 31. In the specific embodiment shown the snow-receiving and elevating means constitutes a unit which is pivotally mounted adjacent one corner of the snow-melting receptacle by the pivot means 93 that is adapted to permit the lower end of the unit to be raised and lowered and, when in raised position, to be swung inwardly so that the snow-receiving and elevating unit will become in general alignment with the vehicle. One means for effecting these movements has been shown in Fig. 2 and more diagrammatically in Fig. 17 so that the motions involved may be more clearly shown. The end of the snow-receiving and elevating means that is remote from the pivot 93 is supported by the bracket 95 which is joined to the part 94 that is rigidly secured to the snow-receiving and elevating means at its far end by the universal joint 96. The other end of the bracket 95 is pivotally carried by the vehicle chassis by the pivot means 97 which is adapted to permit the far end of the bracket to be raised and lowered and to be swung inwardly into alignment with the vehicle chassis when the far end of the bracket 95 is raised. The raising and lowering of the far end of the bracket 95 is effected by the flexible cable 98 which can be wound onto or unwound from the drum 99 by the controlled actuation of the motor 100. When the far end of the bracket 95 is lowered so as to be in the position shown in Fig. 2 and in solid lines in Fig. 17, the snow-receiving mouth of the snow-receiving and elevating unit is at ground level. However, when the far end of the bracket 95 is raised to the position shown in dotted lines in Fig. 17 the spacing and dimensions of the parts are such that the elevation of the far end of the bracket 95 serves to swing both the bracket 95 and the snow-receiving and elevating means as a whole into general alignment with the vehicle chassis so that these parts are brought inboard above the vehicle chassis whenever it may be desired to move the machine from one job location to another. The desired elevation is provided by causing the cable 98 to pass over a pulley 101 at the upper end of the mast 102.

The snow-elevating means comprises a continuous belt 103 which passes over upper and lower drums 104 and 105, respectively, both of which are power-driven from the driven shaft 106 by means of the sprocket chains 107 and 108. The driven shaft 106 is operatively connected to the motor 60 through the universal joints 109 and 110 which permit the pivotal motion of the snow-receiving and elevating unit that has been described hereinabove.

The belt 103 is provided with snow-retaining plates 111 upstanding therefrom. The means for supplying power to the belt 103 is such as to cause motion of the belt 103 at a sufficient velocity for flinging snow from the upper end of the snow-elevating means against the deflector 112 with such force that the deflected snow will fly at least in part substantially completely across the snow-receiving receptacle to the opposite corner thereof while at the same time effecting lateral disposition so that the snow becomes uniformly distributed throughout the upper portion of the snow-melting receptacle as it falls therein. The disposition of the deflector 112 may be varied by mounting the deflector 112 on a hinge 113 and causing its position to be fixed by the bar member 114, which can be manually moved and held in any desired position by the manually operated adjusting device 115.

The snow is taken from ground level through the mouth 116, immediately behind which there is the revolving rotatively mounted blade 117 comprising opposed helices on the opposite sides of a centrally impelling blade 118 that throws the snow onto the belt 103 so as to be carried thereby with the aid of the plates 111. For providing structural members and holding the snow on the belt 103, and also in the interests of safety, side plates 119 are provided on either side of the belt 103.

The rotation of the blade 117 may be effected in any

suitable way. For example, in the embodiment shown the shaft 120 on which the drum 105 is mounted and which is driven from the sprocket chain 107 may be operatively connected to the shaft 121 on which the blade 117 is mounted by means of the gears 122, 123, the power-transmitting shaft 124 and the sprocket chain 125. For protection, these parts may be closed in the housing 126. Appropriate confining and guiding parts 127, 128, 129 and 130 may be provided for guiding and controlling the snow which is acted upon by the blade part 117 while being taken up and transferred to the belt 103.

In typical operation of the machine, the belt 103 may be moved at a rate of about 300 to about 500 linear feet per minute while the blade 117 may be rotated at about 1200 r.p.m. When, as shown, there are twelve burners each burner may provide products of combustion at a temperature of the order of 2000° F. or more and they are supplied with air and fuel for producing in the neighborhood of 18,000,000 B.t.u. per hour or more. This requires the consumption of fuel in the neighborhood of 132 gallons per hour. The conducting surface provided by the grates and the heated side walls are approximately 470 square feet, with the result that more than 34,000 B.t.u. per hour are introduced per square foot of heat-conducting surface employed in the machine.

During typical operation the water collected in the sump is pumped for discharge into the snow in the melting chamber with accompanying control of the temperature of the water which is discharged from the machine. Under weather conditions such that the discharged water does not freeze on the street or road the discharged water may be cooled down to just about freezing point, namely, just above 32° F. In this way virtually no heat is unnecessarily lost in the discharge of the water. However, it is a distinct advantage of this invention that in sub-freezing weather the water may be discharged at an elevated temperature which will prevent freezing until the water has evaporated. If the water were to freeze on the street, this would result in icy conditions. Except for extremely cold weather, if the water is discharged at a temperature of 90° to 100° F. onto a pavement, the pavement surface becomes warm and any residual moisture evaporates completely before it can freeze into a glaze of ice, thus leaving the surface of the street dry.

The water discharged from the machine is also effective in snow clearance. Thus, the embodiment that has been disclosed is such that the water may be discharged at the rate of about 200 gallons per minute. When this amount of water is discharged, and especially when it is heated substantially above freezing, the discharged water is highly effective in melting additional snow and removing it from a street. Moreover, the water thus discharged may be used to clear snow underneath parked cars and other inaccessible places. By mounting the discharge line swingably so that the outlet 70 may be moved to either side of the vehicle, a desirable flexibility is provided as regards the points which may be reached in discharging water for effecting snow removal.

While the temperature of the water in the sump may be controlled so as to be at a temperature well below the boiling point, the machine of this invention is such that the water which initially results from the melting of the snow comes into direct contact with the highly heated products of combustion as the water flows down past the burners 40 and is collected on the drain panels 56 and 57. While thus exposed, a portion of the water becomes converted to steam which commingles with the products of combustion that flow into direct contact with the melting snow and the steam increases the effectiveness with which the melting of the snow is accomplished.

Another advantage which results from a machine of this invention is that any foreign bodies contained in the snow that is loaded into the snow-melting receptacle can

fall down through the spaces between the grates and burners as the snow carrying these foreign bodies becomes melted. For the most part, such foreign bodies comprise combustible material, e.g. pieces of wood, paper and the like. When these foreign bodies fall onto the drain panels 56 and 57 the water drains off of them through the screen 58 and the foreign bodies are thus exposed to direct contact with the blasts from the burners. Upon such exposure the combustible material burns off and, to the extent that the foreign bodies are composed of combustible material, the machine is self-cleaning. As regards incombustible things such as glass, metal, cans and the like, they accumulate on the screen 58 and due to the ready removability of the grates 37 it is a simple matter to clear out from time to time any accumulations of incombustible foreign material.

During the melting operation the snow is flung against the deflector 112 and distributed substantially throughout the upper portion of the snow-melting receptacle. At the same time the upward blasts of hot products of combustion together with the heated side walls of the snow-melting receptacle and the spraying of water onto the snow in the snow-melting receptacle serves to prevent bridging and the formation of flues through which the products of combustion might escape without transference of substantially all of the heat content thereof to the melting snow. The snow overlying the grates 37 thus remains as a blanket which confines the hot products of combustion until their heat content is substantially completely exhausted and in typical operation the gases which ultimately emerge become cooled to a temperature substantially lower than 200° F.

While this invention has been described in connection with a typical preferred embodiment thereof, it is to be understood that this has been for purposes of illustration and that the practice and embodiments of this invention may take other forms without departing from the scope of the invention.

I claim:

1. A snow-melting machine comprising a snow-melting receptacle, a plurality of burners disposed adjacent the bottom of said receptacle, a plurality of elongated grates having spaced grate walls with a flue space therebetween disposed for entry of products of combustion from said burners, said grate walls being inclined with the cross-section of said grates generally in the form of an inverted V having greater vertical extent than lateral extent, said grates being substantially spaced from each other along the bottom portions thereof for passage of products of combustion from said burners between said grates into direct contact with snow in said receptacle above said grates, said grate walls adjacent the upper portion thereof having apertures therein for passage there-through from said flue spaces of minor proportion of said products of combustion, and said grate walls having a succession of vertically disposed corrugations therein for contact with snow resting on said grate means.

2. A snow-melting machine comprising a snow-melting receptacle, a plurality of burners disposed adjacent the bottom of said receptacle, a plurality of elongated grates having spaced walls with a flue space therebetween disposed for entry of products of combustion from said burners, said walls being inclined so as to be wider apart at the bottom than at the top and said grates having vertical extent over twice as great as the lateral extent thereof, being substantially spaced apart at the bottoms thereof for permitting passage of products of combustion therebetween and having apertures therein adjacent the top thereof for passage of products of combustion therethrough.

3. A snow-melting machine comprising a snow-melting receptacle, a plurality of burners disposed adjacent the bottom of said receptacle, grate means disposed above said burners with the underside thereof exposed to products of combustion from said burners and adapted

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to support snow in the upper side thereof, said receptacle having walls extending upwardly above said grate means, and means for supplying heat to said walls in the region above said grate means, said means for supplying heat to said walls comprising flue means extending from the region of said burners for entry of products of combustion therein and directing same substantially above the region of said grates in heat exchange relation with said walls, and said walls having apertures therethrough intermediate between the upper and lower ends of said flue means for discharge of products of combustion from said flue means into direct contact with snow contained in said receptacle.

4. A snow-melting machine according to claim 3 wherein said walls in the region thereof above said apertures therein where heated by said heating means have an inward inclination proceeding upwardly of at least 3° from the vertical.

5. A snow-melting machine comprising a snow-melting receptacle, a plurality of spaced burners disposed adjacent the bottom of said receptacle, a plurality of grates having walls inclined so as to provide a cross-section generally in the form of an inverted V having greater vertical extent than horizontal extent and having spaces therebetween for permitting fall of foreign bodies

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between said grates and between said burners, support means for supporting any such foreign bodies that may fall between said grates and holding same in close proximity to the underside of said burners for combustion of combustible material comprised therein, said support comprising a foraminous portion for draining off water from said bodies supported by said support means, a sump underneath said foraminous portion for receiving and collecting water drained therethrough, and means for directing water from said sump.

References Cited in the file of this patent

UNITED STATES PATENTS

665,157	Zetelle	Jan. 1, 1901
1,125,732	Savonius	Jan. 19, 1915
1,204,400	Brauninger	Nov. 14, 1916
1,388,027	Connolly	Aug. 16, 1921
1,665,503	McClave et al.	Apr. 10, 1928
1,739,331	Sidella	Dec. 10, 1929
1,821,292	Chase	Sept. 1, 1931
2,178,400	Marino	Oct. 31, 1939
2,575,729	Radakovich	Nov. 20, 1951
2,576,829	Fiduccia	Nov. 27, 1951