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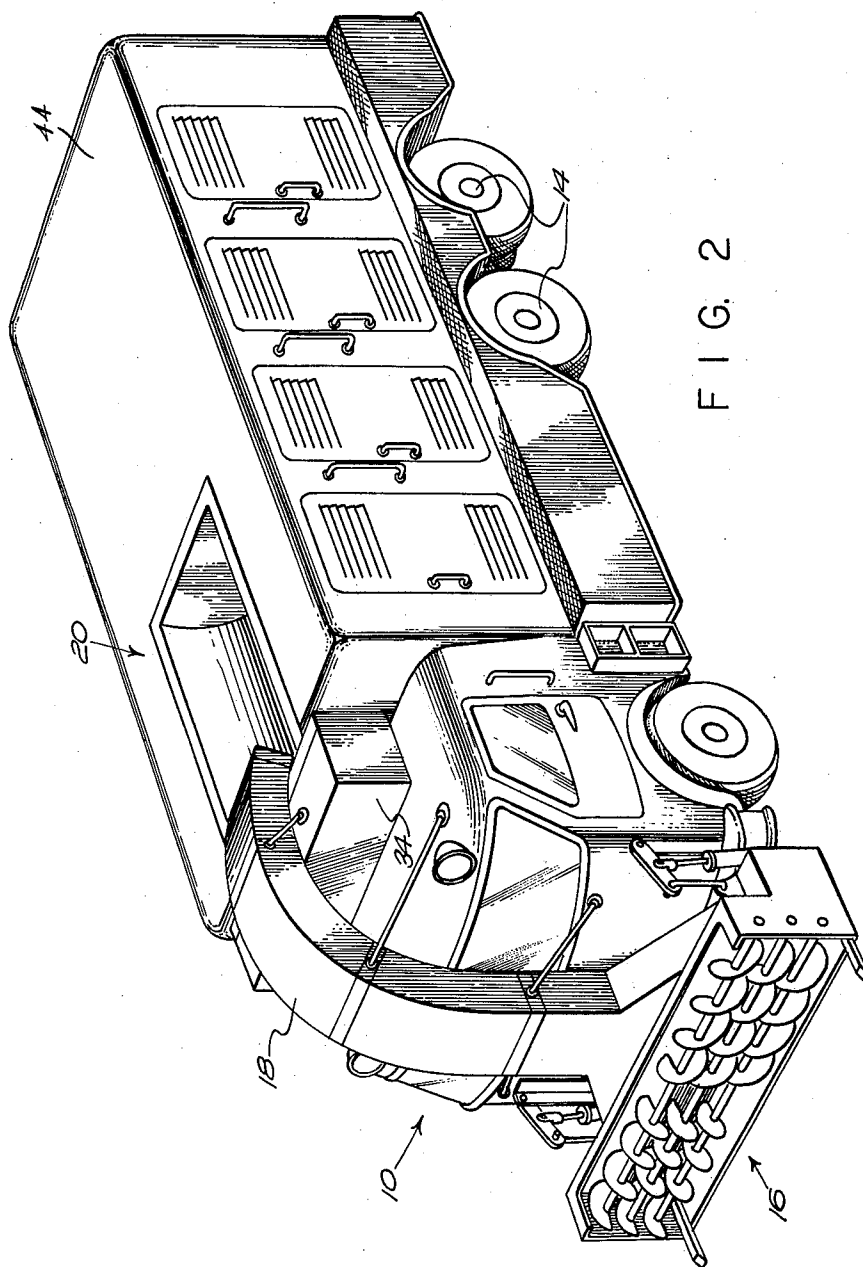
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APPARATUS FOR REMOVING SNOW FROM HIGHWAYS

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2 Sheets-Sheet 2



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APPARATUS FOR REMOVING SNOW FROM HIGHWAYS

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10 Claims. (Cl. 37-12)

This invention relates to snow removal equipment and more particularly to self-propelled apparatus for picking up snow and evaporating it into the atmosphere.

Our modern way of life dictates that even after a moderate snowfall the streets must be plowed. Next the snow must be removed from metropolitan and business areas to allow parking and normal routines of daily business. Usually the removal is accomplished with loading machines, of various types, filling fleets of dump trucks which remove the snow to a suitable area some distance away. Attempts have been made to melt snow in the street, draining along the gutters into the street sewers. Below freezing temperatures of both the pavement and surrounding air cause the water formed to turn to ice almost immediately. Eliminating the problem of snow in this manner thus only creates the more severe problem of ice. Huge heated tank trailers have also been tried as a means of eliminating the dump truck and the long haul to a dumping area. While such a single vehicle can receive the equivalent of a number of dump truck loads, no advantage is gained in that it must still spend considerable time in idleness while discharging its contents into a street sewer, river, marsh or other suitable drainage area.

A prime object of the present invention is to provide apparatus for disposing of snow at the point at which it is picked up by evaporation into the atmosphere, eliminating trucking the snow to a suitable dumping area. Further objects are to provide an apparatus which is self-loading and self-propelled; which is efficient and largely automatic in operation; which is reliable; which operates swiftly; and which is competitive in cost with conventional types of snow removal based upon the amount of snow completely removed.

In achieving these objects the invention contemplates snow disposal apparatus including snow loading means, a hopper for receiving snow from said loading means, a jacket around said hopper, a boiler for receiving water from said hopper and converting water so received to steam, means for conducting the burner exhaust gases from said boiler through said hopper jacket thereby to melt snow in said hopper, and vehicle means for conveying and propelling the apparatus so that snow to be disposed of may be reached by said snow loading means.

More specifically, the invention comprises a self-propelled apparatus capable of ingesting a minimum of three cubic yard of snow per minute and upon which is mounted steam-generating means comprising, for example, two four-hundred horsepower boilers with the necessary pumps, blowers, and so forth, and with a power-driven snow-elevating device for lifting the snow from the highway, a jacketed receptacle into which the snow is discharged by the elevating device, as the vehicle progressively advances along the highway, the receptacle having a jacket through which exhaust gases are passed so as to heat the receptacle and melt the snow therein, a reservoir which receives the water from the receptacle and from which the water is pumped into the boilers, means for guiding the steam, which is generated by the boilers, so that it flows through a separator on its way to discharge into the atmosphere, means for so discharging the steam that it forms a wall of steam around the stream of snow falling into the receptacle, together with means for auto-

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matically controlling the production of steam by the boilers in accordance with the rate at which water is melted. Desirably, this automatic control system comprises immersion switches installed in the reservoir in which the melted snow collects, so designed that the feed pumps for the boilers operate at low speed when the receptacle is one-fourth full of water, and supplying water to the steam generators and fuel to their burners at such a rate as normally to maintain the water reservoir approximately one-half full, and preferably having a control panel in the operator's cab showing the performance of the automatic apparatus and including manually actuable switches for shutting down the generators and pumps when desired.

For purposes of illustration, a preferred embodiment of the present invention is shown in the accompanying drawings in which:

FIG. 1 is a diagrammatic side elevation of a snow evaporator truck;

FIG. 2 is a diagrammatic perspective view of the apparatus of FIG. 1;

FIG. 3 is a section on the line 3—3 of FIG. 1;

FIG. 4 is a fragmentary section on the line 4—4 of FIG. 3; and

FIG. 5 is a flow-sheet illustrating the steps involved in the removal of snow by apparatus functioning like that here disclosed.

Referring to the drawings, the invention is illustrated as comprising a six-wheel-drive truck 10 of the cab-over-engine type. A pair of water-tube boilers 12 of known type (here diagrammatically indicated) is placed over the two rear, load-bearing axles 14. Conventional burners (not shown) supplied with liquid or gaseous fuel, heat the water in these boilers. Boilers of this type are now available commercially, each of which produces approximately 8,500 pounds of steam per hour (or for the two boilers 34.0 gallons of water per minute) and each weighs approximately 8,200 pounds itself. Steam generators of this type, with customary controls and other accessories, are made and sold by such concerns as the Vapor Heating Corporation of Chicago, Illinois. This capacity is sufficient to render the present invention competitive in first cost as compared with any conventional apparatus for removing snow from the street. Since the average water content of snow is one gallon per each two square feet of a ten inch snow fall, one cubic yard of snow contains 16.2 gallons of water, so that the boiler capacity would be 2.09 cubic yards of snow per minute. An auxiliary internal combustion engine 21, driving an electrical generator of commercial type, is located behind the truck's cab and provides power for operating the usual blowers and pumps (not here shown), which are customary accessories of power boilers and which are associated with each of the boilers 12.

At the front of the truck, which is an all-wheel conventional drive type, is mounted a conventional snow blower 16 of a kind which is capable, at will, of discharging snow in normal fashion, alternatively to either side of the vehicle, or, at will, to deliver snow upwardly through a chute 18 into an open-topped hopper 20 (FIGS. 1, 2 and 3), whose bottom slopes rearwardly. While a snow blower is deemed preferable, it should be understood that an endless belt or other conventional type of elevating conveyor might also be used. A separate engine indicated at 23, desirably a conventional internal combustion engine, is provided for powering the snow blower 16 so that its operation may be controlled independently of the truck's engine. The hopper 20 is heated by means to be explained hereinafter and the water resultant from the melting of snow in the hopper is drained into a reservoir indicated at 22, located at a lower level than the

hopper. From the reservoir 22 water is pumped, by an auxiliary internal combustion engine 21 of conventional type constituting the power source of a conventional demand-control system (not here specifically shown), to the boilers 12 so that the boilers receive water only according to their capacities and fuel flow settings. Fuel for the boiler's burners and the internal combustion engines is stored in suitable reservoirs, such as the tanks 24, here shown as by way of example as suspended beneath the truck's frame.

As may be seen from FIG. 3 a jacket 30 surrounds the hopper 20. The burner exhaust gases from the boilers 12 and the exhaust gases from the auxiliary engines 21 and 23 and the truck engine flow through this jacket and thereby melt snow contained therein. By means of this method of heat utilization, highly efficient use of the vehicle, auxiliary and boiler fuel is obtained. Further, these same exhaust gases are discharged through vents 32 (FIG. 3), into the area immediately above the hopper 20 so as to create walls of warmer air at opposite sides of the stream of snow falling into the hopper, to minimize the escape of heat.

The steam output from the boilers, which is typically approximately 90% steam at 212° F. and 10% water at boiling temperature, is first conducted to conventional steam separator means 34 (FIG. 1). The pure or dry steam, at a temperature above 212° F. resultant from the separation of the liquid water, is then so vented into the atmosphere through manifolds 36 located adjacent to and at opposite sides of the outlet of the chute 18 as to mingle with the exhaust gases from the vents 32 and thus provide a zone of heat through which the snow passes in falling into the hopper. In this way, the snow being fed into the hopper 20 is slightly preheated and a further increase in thermal efficiency is obtained, while the water vapor, not condensed by contact with the snow, is carried away by the ambient air as mist or fog. The hot water and steam (at substantially 212° F.) and under substantial pressure discharged from the separator means 34, is directed by multiple nozzles 38 located at the front of the hopper 20 in such a way as to sweep along the bottom of the hopper 20, thus effecting a melting and sluicing action which tends to disintegrate and melt the snow and keep it in thermal contact with the walls of the hopper and to maintain a flow of water through a suitable drain into the reservoir 22. Immediately above the level of the nozzles 38 is a coarse mesh screen 42 which prevents large foreign objects from entering the reservoir. Smaller objects are permitted to settle to the bottom of the reservoir from which they may be periodically removed.

Preferably the apparatus also includes a conventional, automatic fuel flow control system (not shown) so that the rate at which the boilers 12 are operated is dependent upon the level of water held within the reservoir 22. A simple and yet satisfactory mode of operation is one in which the boilers operate at slow rate whenever the reservoir is less than one-quarter full and in which the boilers are switched to full capacity when the reservoir reaches one-half full and remains operating at full capacity until the water level again drops.

Preferably the apparatus includes a suitable protective housing 44 (FIG. 2) enclosing the various elements of the apparatus and adequate insulation (not shown) around the boilers 12 and other heat emitting elements so as to enhance the thermal efficiency of operation.

It should be understood that this disclosure is for the purpose of illustration only and that the present invention includes all modifications and equivalents falling within the scope of the appended claims.

I claim:

1. Apparatus for removing snow from a highway comprising a motor-driven vehicle which is moved along the highway to be cleared of snow, an open-topped receptacle mounted on the vehicle, means for lifting snow from the

highway and discharging it into the receptacle as the vehicle advances along the highway, means for converting water resultant from the melting of snow in the receptacle into steam, means for separating dry steam from water entrained therein and for discharging the dry steam into the ambient atmosphere, and means whereby the hot water from the steam-separating means is discharged into the receptacle into which the snow is delivered thereby to melt the snow, characterized in that the means for converting water into steam has a capacity of at least 1800 gallons per hour.

2. Apparatus according to claim 1, and further comprising means for sluicing hot water from said separator across the bottom of said hopper.

3. Apparatus according to claim 1, having provision whereby the hot water from the separator is discharged into the snow melting receptacle so as to come into direct contact with the snow which is delivered into the latter.

4. Apparatus for removing snow from a highway at a minimum rate of one and one-half cubic yards per minute by converting the snow into dry steam and discharging the dry steam into the ambient atmosphere, said apparatus comprising a motor-driven vehicle of a conventional type driven by an internal combustion engine, a snow melting receptacle mounted upon the vehicle, means for lifting snow from the highway and discharging it in a continuous stream into the receptacle as the vehicle advances along the highway, steam generating means mounted on the vehicle capable of converting at least one and one-half cubic yards of snow per minute into steam at 212° F., separating means for removing entrained water from the steam so generated, means whereby the hot water from the separating means and the exhaust gases from the vehicle engine are utilized in melting snow delivered into the receptacle, and means for discharging the steam from which entrained water has been separated into the ambient atmosphere.

5. Apparatus according to claim 4, wherein the means for discharging the dry steam into the atmosphere is so arranged that the dry steam obtained from said separator moves oppositely to the falling snow on its way from the snow loading means into the snow melting receptacle, impinging upon and forming a wall on either side, respectively, of the snow dropping down into the receptacle.

6. Apparatus according to claim 4, further characterized in that the receptacle in which the snow is melted has an outer jacket providing a chamber through which exhaust gases flow and a snow-receiving inner chamber through which the hot water from the separator flows.

7. Apparatus according to claim 4, further characterized in having means providing a jacket for the receptacle in which the snow is melted and having provision whereby the exhaust gases from the vehicle engine pass through this jacket thereby to heat the bottom of the receptacle.

8. Apparatus according to claim 4, wherein at least one internal combustion engine, in addition to the vehicle engine, is carried by the vehicle, and means whereby the exhaust from any such internal combustion engine is directed through the receptacle jacket.

9. Apparatus according to claim 4, further characterized in having means for so directing the exhaust gases after they have been utilized for heating the snow melting receptacle, so as to form upwardly directed streams constituting walls parallel to and outside of those formed by the ascending dry steam.

10. Apparatus for removing snow from highways by converting the snow into dry steam and discharging the dry steam into the ambient atmosphere, said apparatus comprising a self-propelled vehicle, steam generating means mounted thereon capable of converting at least 1800 gallons of water per hour into steam at 212° F. said steam generating means comprising a snow-water reservoir for feed water, a boiler having a burner sup-

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plied with compressed gas or liquid fuel, a reservoir for said fuel, and means mounted on the vehicle for removing snow from the highway and discharging it at a point directly above the vehicle, characterized in having an open-topped jacketed hopper mounted upon the vehicle and arranged to receive the snow dropping down from the point of discharge, a steam separator, means for conveying steam generated by the boiler to the separator, means for delivering the dry steam from the separator and the exhaust gases from boiler burners and internal combustion engines, upwardly in streams at opposite sides of the snow dropping down into the hopper, means for delivering the hot water from the separator into the

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hopper, and means for conveying melted snow from the hopper to the feed water reservoir.

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