Nov. 16, 1971 A. Z. MORIN 3,619,918

SNOW CLEARING AND MELTING APPARATUS

Filed March 5, 1969 3 Sheets-Sheet 1

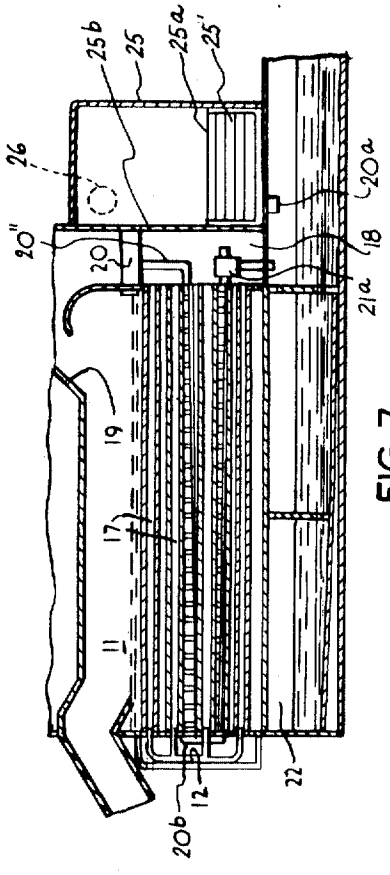


FIG. 7.

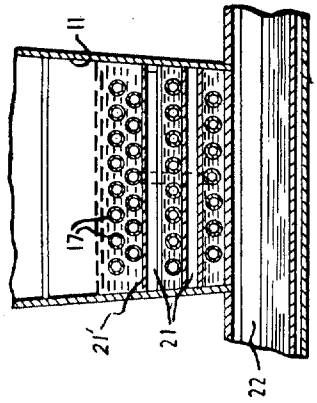


FIG. 6.

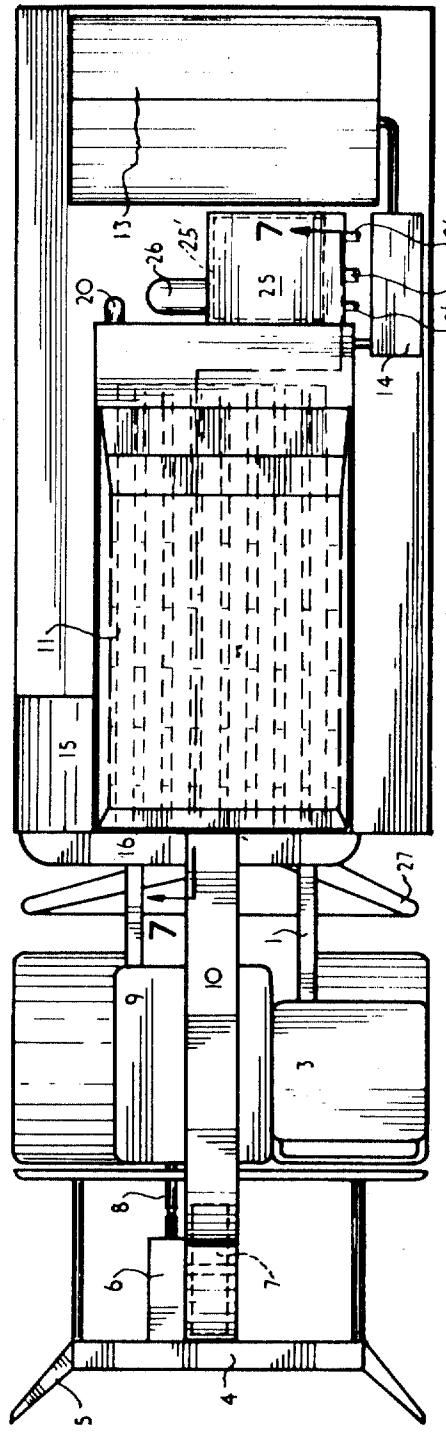


FIG. 1.

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SNOW CLEARING AND MELTING APPARATUS

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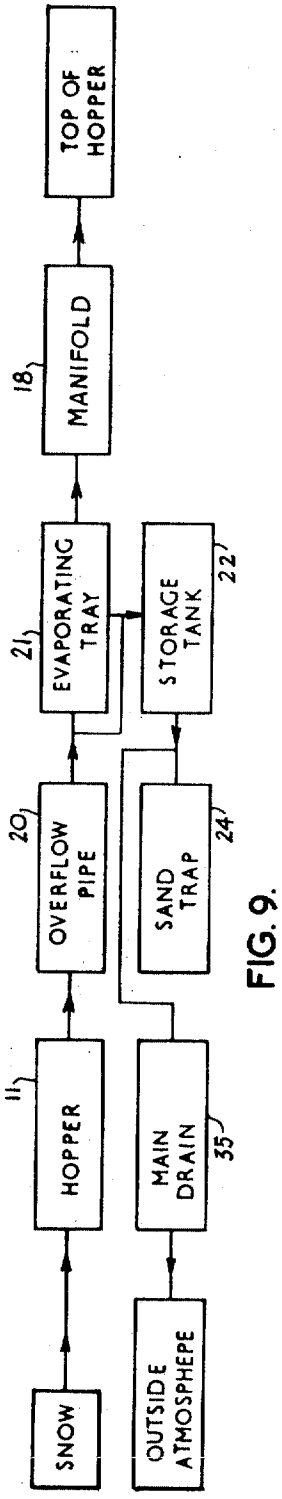


FIG. 9.

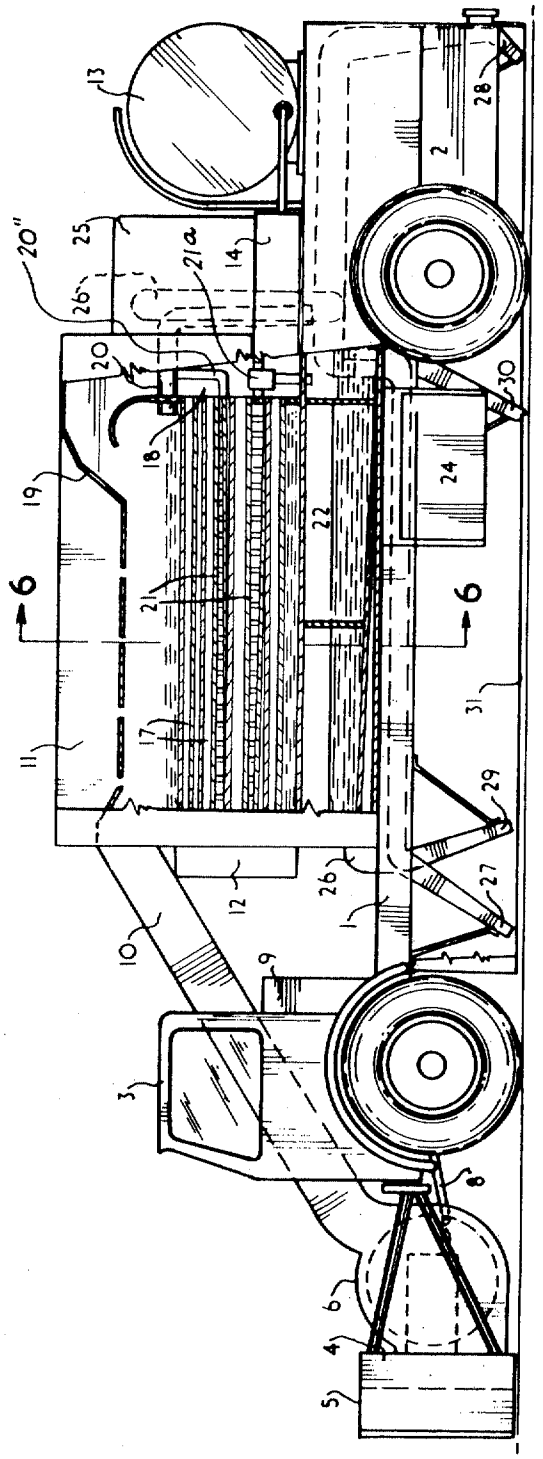


FIG. 2.

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SNOW CLEARING AND MELTING APPARATUS

Filed March 5, 1969 3 Sheets-Sheet 3

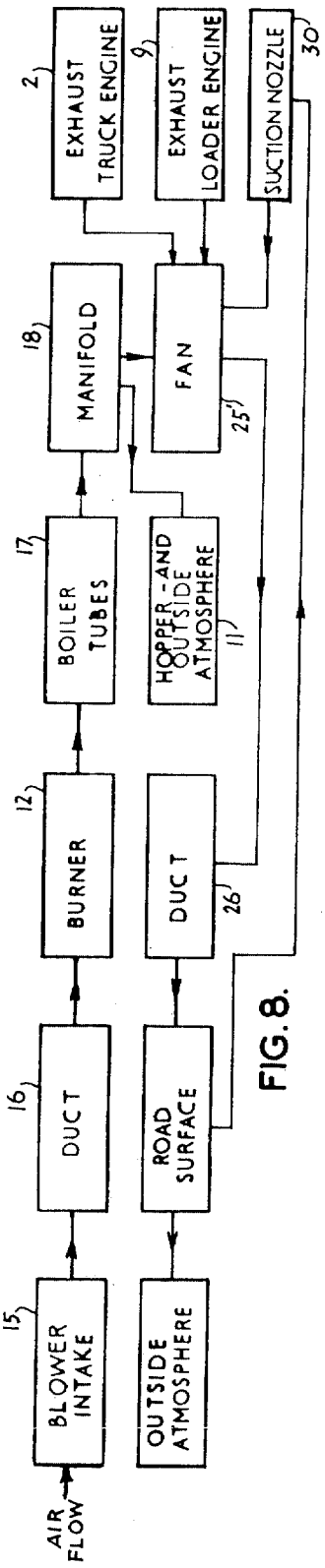


FIG. 8.

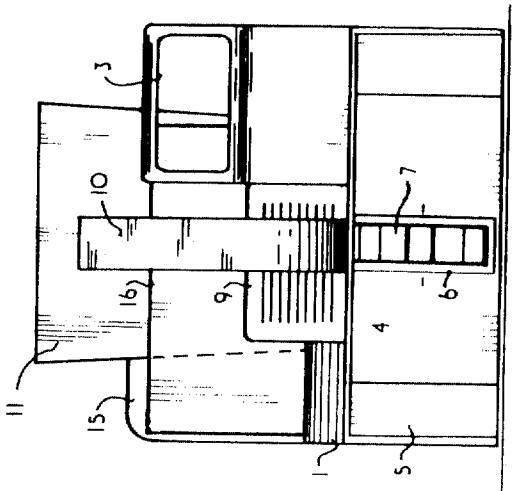


FIG. 3.

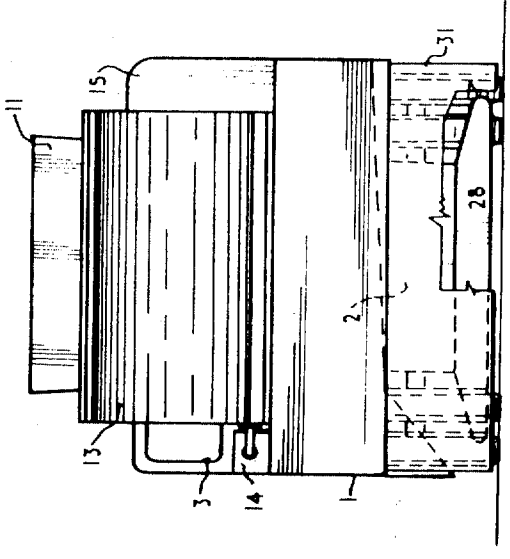


FIG. 4.

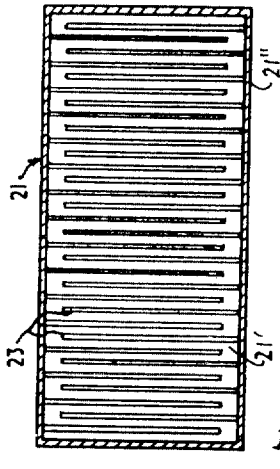


FIG. 5.

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3,619,918

SNOW CLEARING AND MELTING APPARATUS

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Continuation-in-part of application Ser. No. 579,282, Sept. 14, 1966. This application Mar. 5, 1969, Ser. No. 804,645

Int. Cl. E01h 5/10

U.S. Cl. 37—12 8 Claims

ABSTRACT OF THE DISCLOSURE

A self-propelled snow clearing apparatus embodying loading and melting mechanisms, the latter including a hopper into which the loader discharges and wherein melting is caused by a large body of hot water heated by a battery of horizontal boiler tubes immersed therein that extend longitudinally through the hopper and convey the products of combustion from a fuel fired heater in front of the hopper to an upright manifold at the rear of the hopper, from which latter a blast of hot air is conveyed to the top of the hopper and directed onto the snow being discharged into the hopper by the loader. Additional heat generated in the apparatus may be applied as hot gaseous blasts on the roadway traversed by the apparatus to the rear of the loading mechanism.

This application is a continuation-in-part of my copending application Ser. No. 579,282 filed Sept. 14, 1966, now abandoned.

The invention relates to improvements in snow clearing apparatus, and more particularly appertains to apparatus in which snow picked up by the apparatus is melted in a novel manner.

Heretofore, it has been conventional to melt snow picked up by a snow clearing machine by subjecting it to heat from heated flues. Basically the melting is performed by heat exchange between the heated flues and the fresh loaded snow. Such a method has not proven economical or wholly effective in practice for a number of reasons. As the cold snow is applied to the heated flues it tends to cool the hot contacted surface so that further melting is retarded until the newly melted snow drains away. Furthermore, a considerable amount of heat is wasted in heating the melted snow after it is melted. This is highly undesirable and very uneconomic, since it will be apparent when it is thoroughly melted it can be discharged to a drain and need not be discharged as mere melted snow to a sewer drain in a warm or hot condition. A further disadvantage of conventional snow clearing machines employing heated flues is the waste of heat which occurs when hot flue gases are exhausted to the atmosphere.

The present invention is directed at overcoming the shortcomings, difficulties and disadvantages of prior snow clearing devices by providing apparatus in which heat transfer during normal operation of apparatus takes place between a large body of water, the product of initial melting, heated by burner tubes in a hopper in which incoming snow is deposited. The hot products of combustion pass from the burner tubes through a manifold to the hopper where they are discharged into the incoming snow at the top of the burner. Thus heat transfer takes place between the incoming snow and both the large body of hot water surrounding the burner tubes, and the hot blast of solid and gaseous products of combustion from the burner tubes.

A further important feature of the invention involves application of blasts of heated air and products combustion from engines employed in the apparatus to the roadway to dry the same after the snow is picked up.

Other and further objects and advantages of the invention will become apparent from the following detailed description, taken together with the drawings, wherein:

FIG. 1 is a plan view of a self-contained motor vehicle carried apparatus.

FIG. 2 is a side elevation thereof.

FIGS. 3 and 4 are front and rear elevations thereof.

FIG. 5 is a plan view of the evaporating chamber.

FIG. 6 is a vertical transverse sectional detail of the snow melting hopper as taken on line 6—6 of FIG. 2.

FIG. 7 is a vertical longitudinal section thereof taken on line 7—7 of FIG. 1.

FIG. 8 is an air flow diagram; and

FIG. 9 is a water circulation diagram.

The illustrated embodiment of my snow clearing apparatus will be seen to comprise broadly a motor driven vehicle, a snow loader, a melting and evaporating section and a road cleaning mechanism, said section and mechanism being interrelated in a unique manner to achieve particularly efficient and economical operation.

A rear wheel drive truck **1** is propelled by an engine **2** suspended below the frame behind the rear wheels. The cab **3** is mounted up front at one side.

Across the forward end of the vehicle a snow loader is arranged, comprising a plow **4** with wings **5** feeding into a blower housing **6** in which a blower fan **7** is mounted on a transverse horizontal shaft and driven by suitable gearing and shafting **8** from a blower motor **9** on the vehicle opposite the cab **3**. From the housing **6** a rearwardly extending snow delivery chute **10** inclines upwards and empties into an enclosed snow receiving hopper **11**.

The snow receiving hopper is in effect the receiving chamber of both melting and evaporating sections. At the front of hopper **11** a propane or other suitable fluid fuel burner **12** is arranged and fed from fuel tank **13** on the rear of the vehicle through fuel vaporizer **14**. A motor driven air blower **15** located to the right of the forward end of the hopper has a duct **16** leading to the burner **12**. Burner heat is carried through a battery of horizontally disposed burner tubes **17** extending longitudinally through the hopper and opening into an upright manifold **18** at the rear thereof. Above the manifold at the top of the hopper is a baffle **19**. Hot products of combustion passing out of tubes **17** rise in the manifold and are then deflected and directed forwardly and downwardly in the hopper. The first snow fed into the hopper via duct **10** initially encounters the hot blast from the manifold **18** and the hot air rising from the heated tubes **17**. This continues until a body of hot water collects in the hopper around the tubes **17** (see FIG. 6).

An L-shaped overflow outlet pipe **20** is arranged in the hopper at a suitable level above tubes **17**. This pipe extends downwardly and opens at lower end **20***a* into a storage tank or reservoir **22** located below the hopper and extending to the rear of the vehicle (see FIG. 7). Two evaporating trays or chambers **21** are located in the base of the hopper **11**. These chambers extend the full length of the hopper and are defined by horizontal partitions **21'** and side walls **21''**. In these chambers are horizontal staggered transverse baffles **23** (see FIG. 5). The chambers are arranged in two levels. The upper chamber preferably slopes down forwardly and the lower chamber slopes down rearwardly. The chambers are narrower in width than the hopper so that water completely fills the hopper as shown in FIG. 6 with pipes **17** located above and below both chambers. An L-shaped branch pipe **20''** leads from overflow pipe **20** to the upper evaporating chamber at the rear ends of the chambers, and a short conduit **20***b* leads from the upper chamber to the lower one at the front ends of the chambers.

A T-shaped pipe assembly **21***a* has one upper forward section opening into the rear end of the lower chamber **21** (see FIGS. 2 and 7). The other upper rear section opens into manifold **18**. The lower vertical section opens into reservoir. Water fed into the upper chamber **21** partially evaporates and passes with residue water into the lower chamber where further evaporation takes place as the chambers are heated by the burner tubes **17**. Hot vapor and steam passes into manifold **18** and then to the top of the hopper via pipe assembly **21***a* and excess water drains into the storage tank or reservoir **22** (see FIG. 9).

Solids and other foreign matter such as sand and debris flowing into the reservoir **22** collect in a pit or sump **24** from which they can be discharged at required intervals. Water can be drawn off from tank **22** at intervals via main drain **35**, not shown but indicated in FIG. 9, for discharge into a sewer.

To the rear of the hopper **11** is another motor powered rotary blower of fan **25'** arranged in a housing **25**. The hot exhausts from engine **2** of the truck and blower motor **9** are fed to the input end **25***a* of the fan via pipes **2'** and **9'** shown in FIG. 1. An output duct **26** leads from the fan to a wide forwardly directed nozzle **27** that depends from the vehicle to a level near the road surface just behind the front wheels and somewhat rearwardly of the snow blower plow. Another similar nozzle **28** supplied also by duct **26** is located across the rear of the vehicle with its forwardly directed mouth in close proximity to the road surface. Still another nozzle **29** is arranged just to the rear of nozzle **27** and directs a hot blast rearwardly on the roadway. Nozzle **29** is also fed by duct **26**. A suction or intake nozzle **30** is located just forwardly of the rear wheels. This takes in vapors produced when the hot gaseous blasts impinge on the wet roadway. These vapors are passed via pipe **31** to the inlet end of fan **25'**. Partition **25***b* located between fan **25'** and manifold **18** is thermally conductive and serves as a heat exchanger between the manifold and fan **25'** in casing **25**. Thus hot gases and vapors in casing **25** are further heated or superheated by heat exchange with manifold **18**.

To make maximum use of the heat directed on the roadway by the hot gaseous blasts emitted by nozzles **27**, **28** and **29**, it is desirable to enclose the under part of the vehicle to the rear of the loader mechanism with an encircling skirt **31** depending almost to the ground and boxing in the nozzles **27**, **28**, **29** and **30**. Thus it will be seen that the self-propelled snow clearing apparatus described above may be caused to advance along a roadway, plowing and collecting the snow, conveying it to the hopper where it is melted with some of the resulting water being evaporated and discharged into the atmosphere while the remaining water is collected in the reservoir to be intermittently discharged into sewer manholes or ditches, as required.

Maximum use is made of the hot exhaust gases and heat generated by the motors to melt any remaining snow and ice on the roadway left by the advancing plow and to dry the roadway (see FIG. 8). Some heat generated by burner **12** and emitted through tubes **17** into the manifold is utilized by heat exchange via partition **25***b* to increase the efficiency of the cleanup operation following initial plowing snow pickup.

Maximum use is made of the heat generated by burner **12** to melt the snow in the hopper, to evaporate some of the water resulting from melting the snow, and to superheat both the vapors picked up by suction pipe **30** and the exhaust gases of the motors.

This snow clearing apparatus can operate successfully on heavily travelled traffic arteries without congesting the traffic flow as it travels along the thoroughfare leaving the road surface to its rear relatively clean and dry.

From the foregoing description taken in connection with the accompanying drawings, it will be manifest that a snow clearing apparatus is provided that will fulfill all the necessary requirements of such a device.

What is claimed is:

1. Snow clearing apparatus comprising a self-propelled engine driven vehicle; a blower operated snow loader arranged over the front of the vehicle and including a snow delivery chute extending rearwardly and upwardly over the vehicle; a snow melting mechanism supported upon the vehicle rearwardly of the snow loader, including a hopper for receiving the snow from the delivery chute, said chute extending over the forward end of the hopper; a fuel burner connected to the hopper; horizontally extending burner tubes extending in the hopper from front to rear thereof, said fuel burner directing hot products of combustion into forward ends of the tubes to melt snow initially delivered to the hopper from the chute to create a body of hot water above and around the tubes; a manifold in rear of the hopper receiving hot products of combustion from the tubes and directing the same upwardly and over the top of the hopper; a forwardly extending inclined baffle at the rear of the hopper for directing the hot products of combustion from the manifold onto the top of snow delivered from the chute and overlying the body of hot water; a water reservoir located in the vehicle below the hopper; an overflow outlet pipe opening above the level of the tubes for delivering water that builds up around the tubes to the reservoir, whereby snow is delivered to the hopper is simultaneously melted by hot water underneath and by hot products of combustion directed onto the top of the snow, further comprising at least one evaporating chamber in the hopper interposed between the tubes; a branch pipe leading from said overflow outlet pipe to the evaporating chamber to deliver water to the evaporating chamber; and a pipe assembly arranged to draw water and vapor from the evaporating chamber and having outlet means opening into the manifold to allow discharge of water vapor thereto and a second outlet means leading to the reservoir to discharge water into the reservoir.

2. Snow clearing apparatus as defined in claim **1**, further comprising another evaporating chamber in the hopper located below and connected to the first named evaporating chamber to receive water and vapor therefrom, said pipe assembly having an inlet opening into said other evaporating chamber for drawing water and vapor therefrom to discharge the same into the reservoir and manifold respectively.

3. Snow clearing apparatus as defined in claim **2**, wherein the evaporating chambers have transversely extending baffles serving as heat exchange surfaces between the hot body of water in the hopper and water delivered to the evaorating chambers via said branch pipe.

4. Snow clearing apparatus as defined in claim **1**, further comprising a motor driven fan at the rear of the vehicle; nozzle depending from the vehicle rearwardly of the snow loader for directing hot gaseous blasts to the road surface for melting snow left behind by the snow loader and for drying the roadway; both the engine of the vehicle and the motor of the fan emitting hot exhaust; pipes connected from the engine of the vehicle and from the motor of said fan to the fan to pass exhaust gases from said engine and motor to the fan, said fan being contained in a housing and separated from said manifold only by a thermally conductive partition to receive heat by heat exchange from the manifold to superheat the exhaust gases; and a duct connected from the fan to said nozzles to keep the same continuously supplied with hot exhaust gases.

5. Snow clearing apparatus as defined in claim **4**, wherein the manifold is defined in part by a lateral thermal conductive wall exposed to said fan for heat exchange between the manifold and fan through said wall.

6. Snow clearing apparatus as defined in claim **1**, further comprising a motor driven fan at the rear of the vehicle; a suction nozzle depending from the vehicle rear-

wardly of the snow loader and connected to the fan for supplying vapors thereto, said fan being contained in a housing and separated from said manifold only by a thermally conductive partition to receive heat by heat exchange from the manifold to superheat the last named vapors; other nozzles depending from the vehicle rearwardly of the snow loader; and a duct connected between the fan and said other nozzles for supplying superheated vapors thereto, so that superheated vapors discharged by the other nozzles melt snow left on the roadway by the snow loader and dry the roadway.

7. Snow clearing apparatus as defined in claim 6, and wherein the engine of the vehicle emits hot exhaust gas, further comprising a pipe connecting the engine of the vehicle to the fan to supply hot exhaust gas from the engine to the fan for passage to said other nozzles.

8. Snow clearing apparatus as defined in claim 6, further comprising a skirt extending along opposite sides of the vehicle to enclose the nozzles and ensure recirculagine for passage to said other nozzles.

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U.S. Cl. X.R.

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