July 5, 1966 P. SANGIVANNI 3,259,123

SNOW LOADING AND MELTING MACHINE

Filed May 3, 1963 5 Sheets-Sheet 1

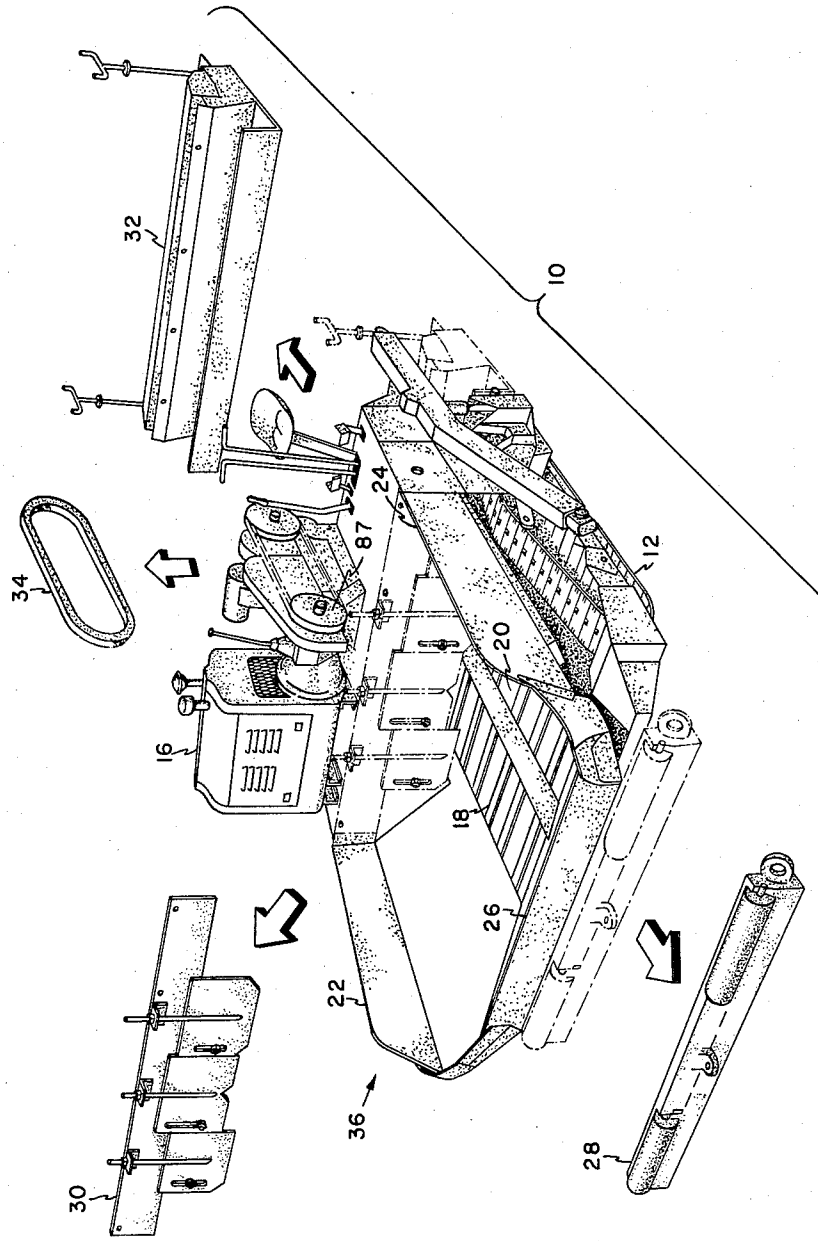


FIG. 1

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July 5, 1966 P. SANGIVANNI 3,259,123

SNOW LOADING AND MELTING MACHINE

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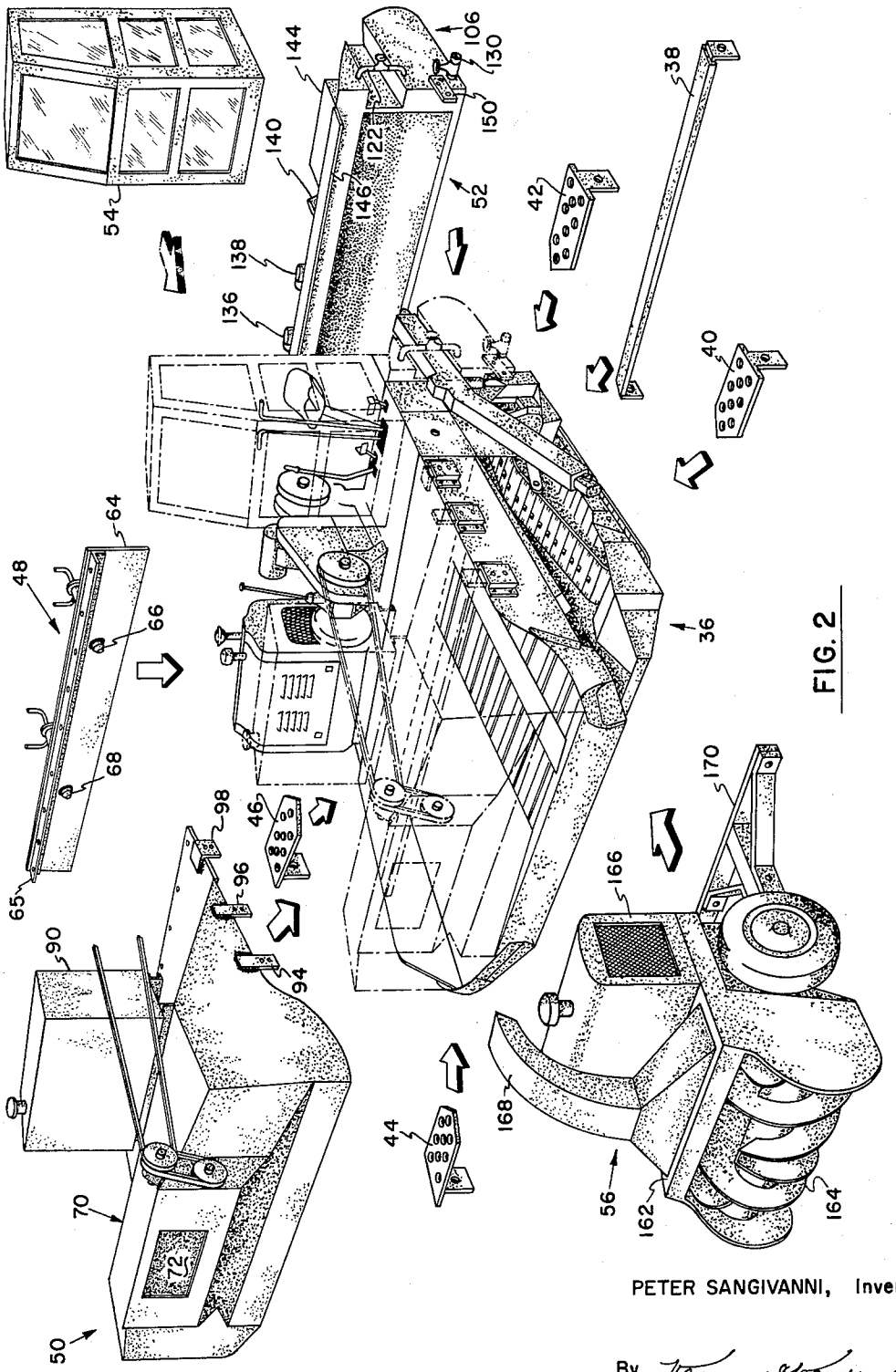


FIG. 2

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SNOW LOADING AND MELTING MACHINE

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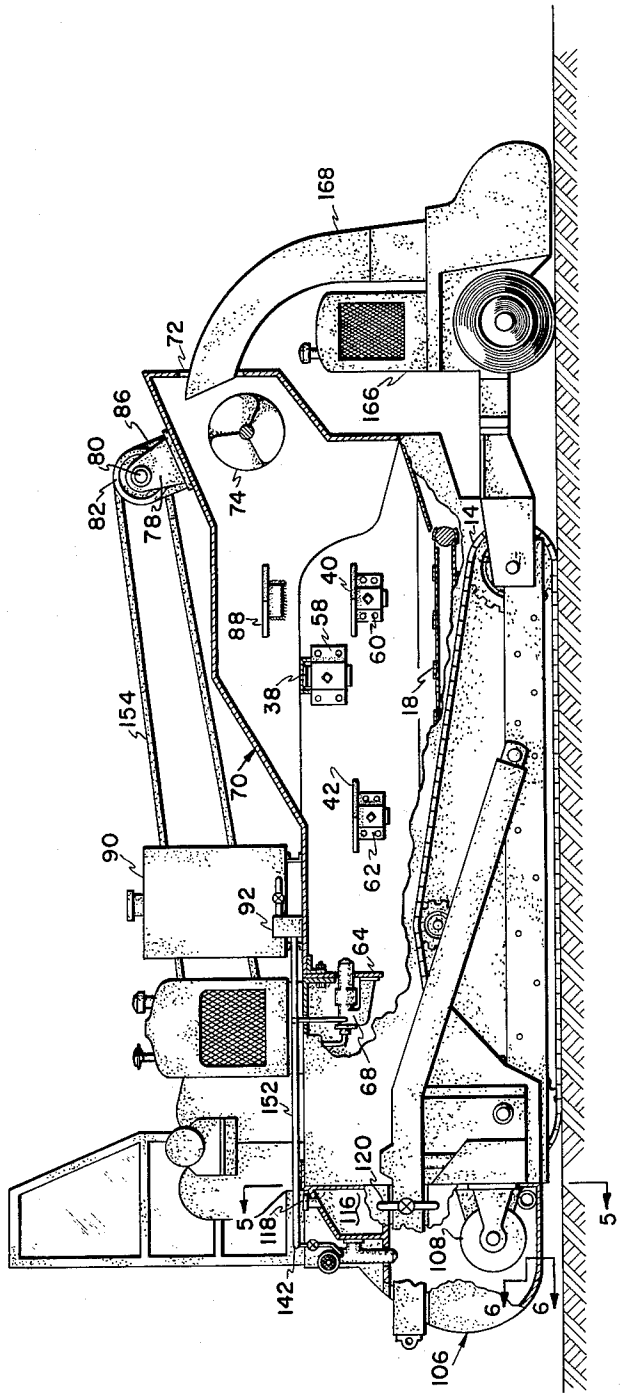


FIG. 3

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SNOW LOADING AND MELTING MACHINE

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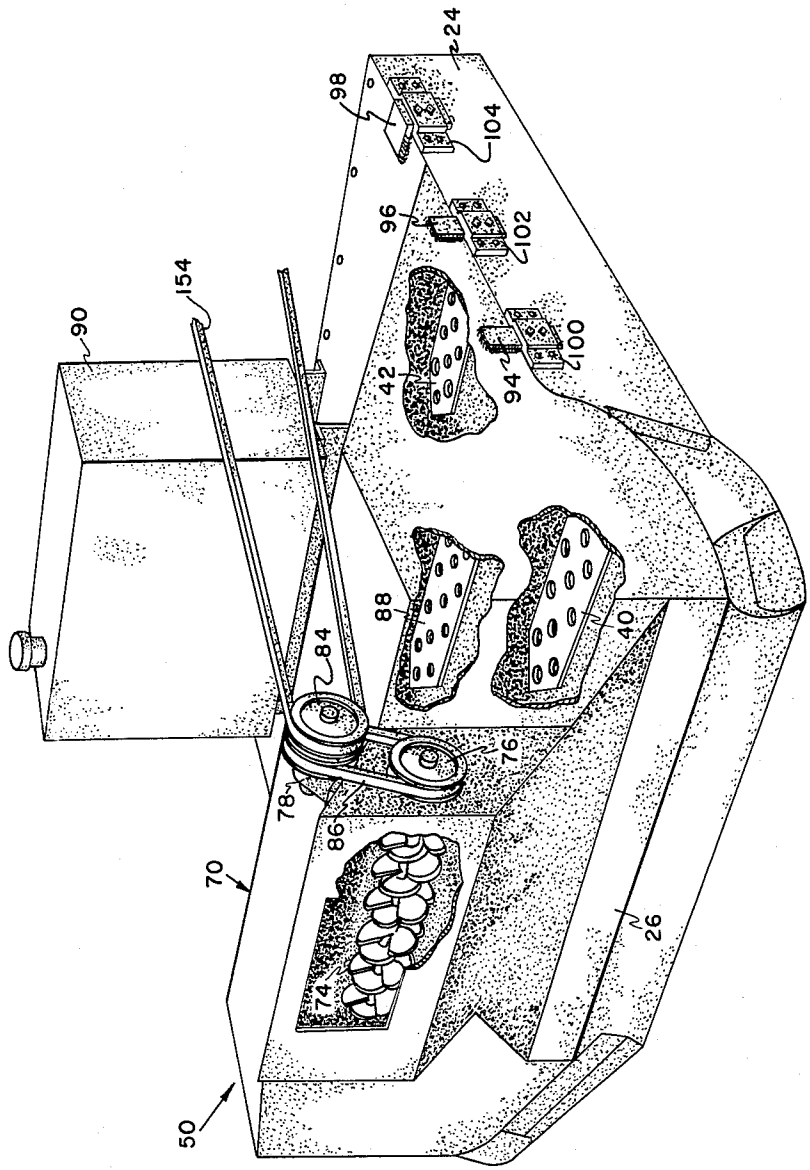


FIG. 4

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SNOW LOADING AND MELTING MACHINE

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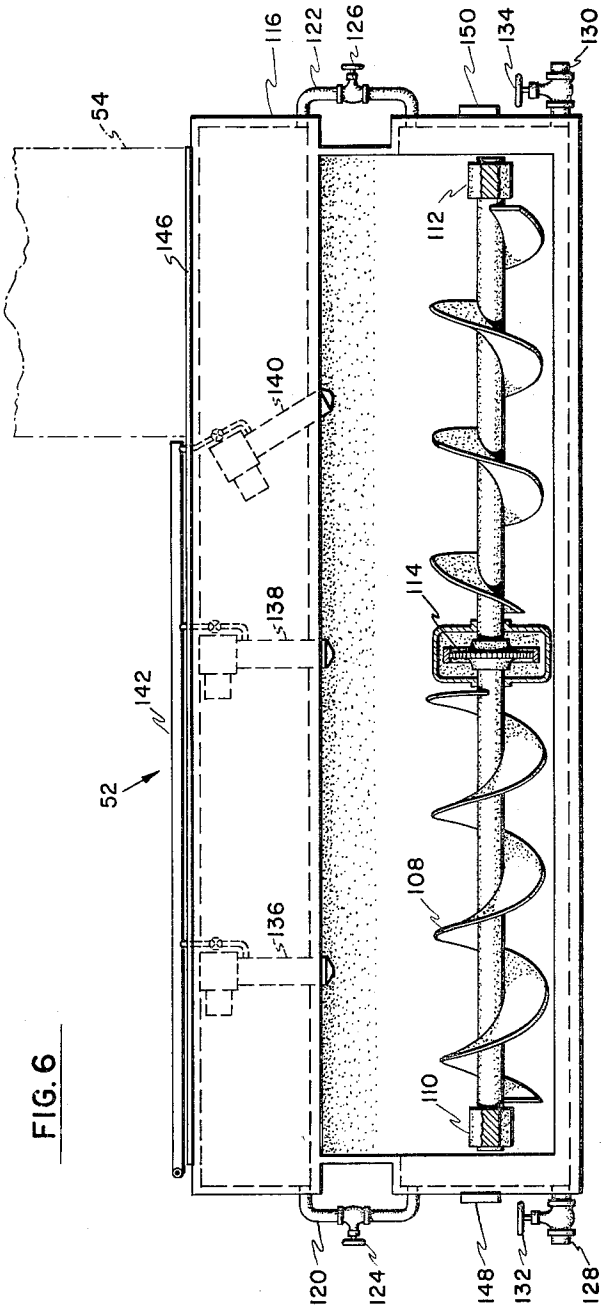


FIG. 5

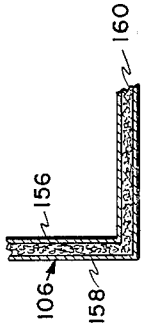


FIG. 6

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United States Patent Office

3,259,123

Patented July 5, 1966

3,259,123

SNOW LOADING AND MELTING MACHINE

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Filed May 3, 1963, Ser. No. 277,860
7 Claims. (Cl. 126—343.5)

This invention relates to a snow loading and melting machine. It relates particularly to a snow loading and melting machine which is adapted to travel under its own power over either highways or off-the-road terrain. It relates more particularly to a compatible group of structures and parts whereby an existing machine used generally for the spreading of black top or other asphaltic-type road surfacing material may be converted to a machine for loading and melting snow.

Machines of both stationary and mobile kinds for the melting of snow are well known to the prior art, at least the prior patent art. They have been designed to operate on a variety of melting principles, for example, that of loading snow against the outer surfaces of tubes which are heated internally by hot gases; that of spraying hot water directly onto snow; that of discharging snow into a body of heated water; and that of allowing flames from a burner or burners of some suitable kind to impinge directly upon the snow to be melted.

One characteristic of known snow melters, however, particularly those of a mobile kind such as those intended to operate on railways or highways, is that the only thing that these machines are really capable of doing is melting snow, including, in some cases, the prior loading or snow gathering operation. The disadvantage of this, from at least the economic point of view, is that in most sections of the United States and indeed in most inhabited sections of the world, the period of any year averaged over a number of years during which there are large quantities of snow on the ground is relatively short. This means that during the greater part of the year a snow melting machine must remain idle so far as performance of any function of melting snow is concerned.

In view of the foregoing, if a snow melter constitutes a fairly large and fairly expensive piece of machinery as it will in practically any reasonable instance, it will represent a substantial investment by an individual, company, municipality, or other owner which gives back useful service during only a very small part of its existence. It is probably this relatively slight opportunity for usage of snow melting machines coupled with their relatively high initial cost that has discouraged municipalities from investing in equipment of this sort. It would, therefore, be economically beneficial if a machine could be provided which would be useful for at least some purpose during the greater part of any year in most municipalities, and further be relatively easily convertible when the snow season comes to have a capability for loading and melting snow. Correspondingly it would be economically beneficial if there were made available a set of parts or assemblies which could be applied to a machine of some existing and substantially year-round useful kind to convert it to a snow loading and melting machine.

A machine which is widely used on what approaches a year-round basis by or under contract to municipalities or public authorities or, occasionally, individuals or private corporations is one which is known generally as a black top spreader or black top spreading machine, that is, a machine which lays down road surfacing material of a generally hot, asphaltic nature. Such a machine is represented by, for example, Model 879–B "Finisher" or road finishing machine manufactured by the Barber-Greene Company of Aurora, Illinois, and shown in that company's sales manual page 7001 entry dated June, 1958. This machine is designed to proceed under its own power; to receive hot, semi-fluid asphaltic material from a dump truck or other carrier which it is capable of pushing ahead of itself, and to discharge this material in tamped and leveled form to generate the surface of a road, parking lot, airport runway, etc.

It is an object of the present invention to provide a set of compatible conversion structures and parts which upon the removal of certain other parts and assemblies from a black top spreading machine may be applied to the remaining machine structure for the creation of a machine for loading and melting snow, the remaining machine structure in this case representing a substantially greater part of the investment value of the original black top spreader.

It is another object of the present invention to provide a set of compatible conversion structures and parts as aforesaid which are quickly and easily applicable to the remaining black top spreading machine structure after removal of certain other parts and assemblies therefrom, and which are themselves relatively inexpensive to manufacture, and accordingly represent no great idle tying-up of capital even though they be used actively during only a relatively small portion of each year.

It is another object of the present invention to provide a set of compatible conversion structures and parts as aforesaid through the use of which a machine is created capable of effecting the melting of snow by the direct impingement of flames and hot combustion products thereupon in a thermo-dynamically highly efficient counterflow arrangement, these flames and hot combustion products coming from burners which are supplied with electrical power for ignition and air under pressure for the support of combustion from systems installed in the remaining structure of the black top spreading machine to which the conversion items have been applied.

These and other objects and advantages of the present invention as well as its nature and substance will be more clearly perceived and fully understood by referring to the following description and claims taken in connection with the accompanying drawings in which:

FIG. 1 represents an exploded view of a typical black top spreader showing parts and assemblies coming off to leave a basic machine structure in the nature of a basic tractor apparatus to which snow loader and melter conversion structures and parts may be applied;

FIG. 2 represents an imploded view showing snow loader and melter conversion structures and parts going onto the basic tractor apparatus left from FIG. 1;

FIG. 3 represents a side elevation view of the complete snow loading and melting machine of this invention, partly broken away to show certain interior fittings and features of the pre-melting and final melting chambers;

FIG. 4 represents a perspective view of the pre-melting chamber assembly of the complete snow loading and melting machine of this invention, partly broken away to show particularly the snow shredder and some of the baffles within this assembly;

FIG. 5 represents a front or inlet end view of the final melting chamber assembly of the completed snow loading and melting machine of this invention taken along line 5—5 in FIG. 3 looking in the direction of the arrows, and

FIG. 6 represents an enlarged fragmentary corner portion of the final melting chamber attachment of this invention taken in section along line 6—6 in FIG. 3 looking in the direction of the arrows, and showing particularly the insulated double-wall construction of this attachment which is also typical of the construction of the pre-melting chamber attachment.

Referring now to the drawings in detail, especially FIG. 1 thereof, a typical black top spreader such as the aforementioned Barber-Greene road finishing machine is generally designated **10**. This machine is operated from its own power plant which supplies tractive effort to move

the machine over the road or other surface through a pair of crawler treads **12** and **14** (see FIG. 3). The source of power for the crawler treads and other power-operated equipment on the machine is an internal combustion engine **16** which may be of either the spark-ignition or compression-ignition (diesel) variety depending upon a customer's specifications. Other power-driven apparatus of road finishing machine **10** which is important for purposes of the present invention includes a pair of link belt or slat conveyors **18** and **20** which operate at the bottom of and in particular form the lower surface of a hopper region of road finishing machine **10** as this machine is used for its customary purpose of spreading road surfacing material. This hopper region is further defined by side plates **22** and **24** and front apron **26**.

Parts which are shown in place on the road finishing machine in dashed outline and which are also shown in solid outline as removed from the machine for purposes of conversion of machine **10** to a snow melter include the following: bumper assembly **28**, hopper gate assembly **30**, screed and tamper assembly **32**, and drive belt **34** whereby power is normally transmitted from engine **16** to the tamper mechanism. Removal of all these parts and assemblies leaves a basic tractor apparatus generally designated **36**.

Referring next to FIG. 2, the basic tractor apparatus of road finishing machine **10** remaining after the removal of items of equipment according to FIG. 1 is shown with certain other parts and assemblies mounted upon it in dashed outline. The parts and assemblies so mounted represent the conversion equipment of this invention which is otherwise shown in FIG. 2 in solid outline removed from the basic machine structure with directional arrows pointing from individual equipment components toward the tractor structure to show the direction of application of these components to the basic machine. The illustrated equipment components or new parts and assemblies include the following: side plate across brace **38**; side plate baffles, **40**, **42**, **44**, and **46**; pre-melting burner plate attachment **48**; pre-melting chamber attachment **50**; final melting chamber attachment **52**; operator's cab **54**, and snow gatherer and blower **56**.

Considering the installation of side plate cross brace **38**, and referring to FIGS. 2 and 3, a centrally jogged-out bracket such as bracket **58** is attached to each of side plates **22** and **24** on their interior surfaces near their upper edges, the brackets themselves being substantially directly opposite each other. The attachment of these brackets to the side plates may be of a substantially permanent nature as by riveting since these brackets alone will not interfere with the operation of machine **10** as a road finishing machine. With the brackets installed, the turned-down ends of cross brace **38** are slipped down between the brackets and the side plates and fastened detachably to the brackets by heavy machine screws. The cross brace is thus positioned and affixed to prevent side plates **22** and **24** from bending either in or out under the weight of pre-melting chamber attachment **50**.

Considering the installation of side plate baffles **40**, **42**, **44**, and **46**, and referring to FIGS. 2 and 3, a pair of centrally jogged-out brackets such as brackets **60** and **62** are attached to each of side plates **22** and **24** on their interior surfaces at about their mid-heights, the brackets of each pair of brackets being spaced one behind the other, and corresponding brackets from pair to pair being substantially directly opposite each other. The attachment of these brackets to the side plates may be of substantially permanent nature as by riveting since these brackets alone will not interfere with the operation of machine **10** as a road finishing machine. With the brackets installed, the turned-down ends of baffles **40**, **42**, **44** and **46** are slipped down between the brackets and the side plates and fastened detachably to the brackets by heavy machine screws.

Pre-melting burner plate attachment **48** comprises a plate member **64**, an angle member **65** welded longitudinally along the plate member just below the upper edge thereof, and two pre-melting burners **66** and **68** mounted on the side of the plate member away from the angle member and extending out beyond the angle member side of plate member **64** through spaced apertures in the latter member. Burners **66** and **68** are each of a heavy industrial type capable of throwing a flame a comparatively long distance upon being supplied with fuel and air at suitably elevated pressures. These burners may be either oil burners or gas burners for purposes of the present invention, although in their illustrated embodiment they are shown as oil burners.

Considering the installation of pre-melting burner plate attachment **48**, and referring to FIGS. 2 and 3, this attachment is set in place and mounted as a direct replacement for hopper gate assembly **30** with plate member **64** being so turned that burners **66** and **68** are aimed forwardly. Air supply connections are made to the burners from an air compressor (not shown) remaining as part of basic tractor apparatus **36**. Electrical connections for ignition purposes are made to the burner from an electrical system also remaining as part of the basic tractor apparatus. Fuel supply connections are made to the burners as pointed out in greater detail hereinafter from a fuel tank and fuel pump forming parts of the structure of pre-melting chamber attachment **50**. It is to be noted that at its lower edge plate element **64** terminates well above slat conveyors **18** and **20**.

Pre-melting chamber attachment **50**, as shown in FIGS. 2, 3, and 4, comprises a hood-like structure **70** and a number of fittings or apparatus items mounted on or in it as will be described. The hood-like structure itself is sized and shape to have an accurate and essentially gap-free fit on and along the upper edges or surfaces of side plates **22** and **24**, front apron **26**, and angle member **65**, and against the front of plate member **64** of pre-melting burner plate attachment **48** as the latter attachment is installed on basic tractor apparatus **36**. Hood-like structure **70**, the wall or panel portions of which are internally insulated as illustrated and described hereinafter, is adapted, in effect, to provide a complete roof or top closure over the afore-mentioned hopper region of basic machine **36**, and in so doing create a well-defined and substantially fully enclosed pre-melting chamber in the machine as converted to a snow melter.

At its front end, hood-like structure **70** is characterized by a centrally-located aperture **72**. Closely in back of this aperture within structure **70** there is a transversely oriented snow shredder **74** which comprises a plurality of blades or leaves affixed to a shaft which is rotatably mounted in bearings, and which at one end is provided with a pulley or sheave **76** outside of structure **70**. On its top surface near its front end, the hood-like structure is surmounted by a bearing bracket or pedestal **78**. Mounted rotatably within and extending outwardly from pedestal **78** is a shaft **80** on which are fixed sheaves **82** and **84**, with sheave **82** being in substantial alignment with sheave **76** and connected to it by a belt **86**, and sheave **84** being in substantial alignment with sheave **87** (see FIG. 1) driven by engine **16** and from which tamper drive belt **34** has been removed.

Further back within hood-like structure **70**, that is, rearwardly from snow shredder **74**, there are two baffles mounted substantially directly across from each other on opposite side panels of the hood-like structure. Of these two baffles only one, baffle **88**, is shown. Both baffles are, however, configured and oriented generally like baffles **40**, **42**, **44**, and **46** from side to side of the pre-melting chamber. Baffle **88** and its counterpart may be permanently mounted on or attached to hood-like structure **70** by welding.

On the top surface of the hood-like structure near its back end, there is mounted a fuel tank **90** and a fuel pump **92** which is in piped connection with the tank to withdraw

and discharge liquid fuel such as heating oil from it. The fuel pump may include any suitable driving means such as an electric motor adapted to be energized from and by the electrical system remaining in basic tractor apparatus **36**.

Permanently attached to and extending downwardly from the visible side and lower edge of hood-like structure **70** as seen in FIGS. 2 and 4 are three spaced-apart clips **94**, **96**, and **98**. Corresponding clips are provided on the side of the bond-like structure not shown. These clips constitute part of the means whereby pre-melting chamber assembly **50** is secured in place on basic tractor apparatus **36**.

Considering the installation of pre-melting chamber attachment **50**, three centrally jogged-out brackets **100**, **102**, and **104** are attached to each of side plates **22** and **24** on their exterior surfaces at or near their upper edges, these brackets being spaced and located in keeping with the clips on the pre-melting chamber assembly with this assembly imagined to be set in place on the side plates and front apron of the basic tractor structure to enclose its hopper region. The attachment of brackets **100**, **102**, and **104** on side plate **24** and their counterparts on side plate **22** may be of a substantially permanent nature as by riveting since these brackets alone will not interfere with the operation of machine **10** as a road finishing machine.

With brackets **100**, **102**, **104**, etc., installed, a suitably composed and configured strip of gasket material may be laid along the top edges or surfaces of side plates **22** and **24**, front apron **26**, and angle member **65**, and then pre-melting chamber attachment lowered into place on basic tractor structure **36** with clip **94** passing downwardly inside bracket **100**, clip **96** passing downwardly inside bracket **102**, etc. The pre-melting chamber attachment is finally fastened detachably to the basic machine structure by means of heavy machine screws passed through brackets **100**, **102**, **104**, etc., and threaded into clips **94**, **96**, **98**, etcs., and also by means of screws passed through hood-like structure **70** very close to its back edge and threaded into angle member **65**.

Although use of the afore-mentioned strip of gasket material is generally desirable, failure to employ such a strip with possible resultant leakage of some gaseous and/or liquid material out below the bottom edges and surfaces of pre-melting chamber attachment **50** when the snow melting machine of the present invention is in active service will not significantly impair the operational utility of this machine.

Final melting chamber attachment **52**, as shown in FIGS. 2, 3, and 5, comprises a somewhat semi-cylindrical shell-like structure **106** and a number of fittings or apparatus items mounted on or in it as will be described. The shell-like structure itself is sized and shaped to have an accurate and essentially gap-free fit on and around the back end of basic tractor apparatus **36**, and to have its interior in essentially full-width direct communication with the pre-melting chamber as the latter chamber continues to the back of the basic tractor apparatus beyond plate member **64** on which the pre-melting burners are mounted. As set in place on and against the basic tractor apparatus, the final melting chamber attachment encloses spreading screw or auger **108** which is regularly installed as a power-driven part of black top spreading or road finishing machine **10**. This auger is supported in bearings **110** and **112**, and is driven by a chain passing around an enclosed sprocket wheel **114**.

Located on top of shell-like structure **106** and running along it for substantially its full width is a tank **116** having a filling pipe or filling connection. This tank is intended to contain a liquid anti-freeze of freezing point depressant such as a salt solution. Connections are made from either end of tank **116** into shell-like structure **106**, that is, into the interior of the final melting chamber by means of pipes or conduits **120** and **122** including shut off and flow regulating valves **124** and **126** respectively. Outlet or drain pipes or fittings **128** and **130** including stop valves **132** and **134** respectively are installed in eithed end of shell-like structure **106** very close to its bottom.

Mounted on top of shell-like structure **106** and extending downwardly through this structure into the interior of the final melting chamber are three final melting burners **136**, **138**, and **140**, each of which may be of at least somewhat smaller capacity than either one of the pre-melting burners **66** and **68**. Burners **136**, **138**, and **140** may be either oil burners or gas burners for purposes of the present invention, although in their illustrated embodiments they are shown as oil burners receiving their fuel through branches coming off of a header conduit **142**. Each one of the final melting burners is contemplated to include a motor-driven blower for air supply purposes, electrical power for the blower motors and for ignition purposes being furnished to burners **136**, **138**, and **140** through connections made from the electrical system of basic tractor apparatus **36**.

Fitted over tank **116** near one end of it and supported at least principally from shell-like structure **106** is a platform **144** which constitutes part of the foundation for operator's cab **54** after final melting chamber attachment **52** has itself been installed on basic tractor apparatus **36**. Actual support of the final melting chamber attachment from the basic machine is provided principally by a lip or flange **146** on the attachment which is adapted to be hooked over and bolted down onto the rear or operating deck of the machine. Permanently attached to and extending forwardly from the end or side surfaces of shell-like structure **106** are clips **148** and **150**. These clips serve to hold the lower portion of final melting chamber attachment **52** well snugged in against the back end of basic tractor apparatus **36**.

Considering the installation of final melting chamber attachment **52**, holes are drilled and tapped in the structure of basic tractor apparatus **36** as necessary to accommodate machine screws to be passed through from flange **146** and clips **148** and **150**. With these holes drilled and tapped, none of which will interfere with the operation of machine **10** as a road finishing machine, a suitably composed and configured strip of gasket material may be fitted around and suitably adhered onto the front or inlet face of shell-like structure **106**. The gasket strip being in place, if one be used at all, the final melting chamber attachment is brought up against the back end of basic machine **36** with flange **146** hooking over the back end of the rear deck of the machine, and clips **148** and **150** slipping around and along the sides of the machine. Screws or bolts are applied through the appropriate clear holes in the flange and clips and the mating tapped holes in the structure of basic tractor apparatus **36**.

After installation of final melting chamber **52** on the basic tractor apparatus in respect of structural location and support, suitable connection may be made from final melting burners **136**, **138**, and **140** to the electrical system of the apparatus. Likewise, fuel oil header **142** may be extended back to fuel pump **92** through and by connection to header **152** off of which branch lines are taken to convey fuel to pre-melting burners **66** and **68**. These burners too, of course, are connected as necessary to the electrical as well as to the high pressure air system of basic machine **36**. For completion of installation of the two melting chamber attachments, belt **154** is passed over and around sheaves **84** and **87** to provide a drive for snow shredder **74** from engine **16**.

Considering the actual wall or panel fabrication of both hood-like structure **70** of the pre-melting chamber attachment and shell-like structure **106** of final melting chamber attachment **52**, reference should be had to FIG. 6. Shell-like structure **106** is of an internally insulated double-wall construction comprising an inner wall **156**, an outer wall **158** in spaced relation to the inner wall, and a layer or body of thermal insulating material **160** occupying the space between the two walls. The material of

inner wall **156** should be stainless steel or some other steel which is characterized by good properties at elevated temperatures, for example, a low creep characteristic. The material of outer wall **158** need not be of the same grade or quality as that of the inner wall so far as high temperature service is concerned, but it should be a material which is tough and resistant to impact breakage on account of the relatively rough service in which the snow melting machine of this invention will be employed. The material of insulating layer **160** may be of any suitable material such as, for example, magnesia brick. The wall or panel fabrication shown in FIG. 6 is typical for not only shell-like structure **106** but also hood-like structure **70**.

Operator's cab **54** is intended to provide protection for an operator of the machine of the present invention against both inclement winter and combustion fumes and steam coming back from aperture **72** in pre-melting chamber attachment **50**. As installed, cab **54** is supported partly on the rear deck of basic tractor structure **36** and partly on platform **144** constituting a portion of the structure of final melting chamber attachment **52**. It is removably secured on its supports by any suitable means such as bolts, machine screws, or clips and brackets. The operator's cab is normally entered from the rear over final melting chamber attachment **52**, and steps or rungs may be provided on or formed in shell-like structure **106** of this attachment to facilitate access to the cab. There may be a door at the rear of cab **54**, and on its front and right and left hand sides the cab is provided with glass panels for visibility.

Snow gatherer and blower **56** is a machine in the general form of a one-axle two-wheeled vehicle adapted to be connected to and pushed by a prime mover such as basic tractor apparatus **36**. As particularly illustrated, the snow gatherer and blower comprises a wheeled chassis and inlet snow guide means **162**, a snow pick-up screw or auger **164**, an internal combustion engine **166** having a drive connected to screw **164** but not to either one of the wheels of the vehicle, and a snow outlet or discharge pipe **168**. Bolted or otherwise secured to chassis **162** of the snow blower is a framework **170** which serves as a coupling means between snow gatherer and blower **56** and basic tractor apparatus **36**. At its back end, framework **170** makes connection to the basic tractor apparatus where bumper assembly **28** has been removed. With the snow gatherer and blower and the basic tractor apparatus properly coupled through framework **170**, the discharge end of snow outlet pipe **168** of the blower extends just a little ways into the pre-melting chamber through aperture **72** in hood-like structure **70**, but does not occupy the complete area of this aperture. Specifically, area is left so that gases within the pre-melting chamber may escape from it through aperture **72** around pipe **168**.

The structure of the snow loading and melting machine of this invention having been described, its mode of operation will now be considered. Imagine that the whole machine is in forward motion across snow-covered terrain, this motion being provided by engine **16** of basic tractor apparatus **36** driving crawler treads **12** and **14**. Additionally, engine **16** is driving snow shredder **74**, slat conveyors **18** and **20**, and spreading screw **108**. Engine **166** of snow gatherer and blower **56** is also in operation to rotate snow pick-up screw **164**. At least one of the stop valves **132** and **134** in the drain fittings from the final melting chamber is open. Assuming that the ambient temperature is significantly below 32° F., at least one of the regulating valves in the conduits leading out of tank **116** is adjusted to allow a controlled flow of liquid freezing point depressant into the final melting chamber. Both of the premelting burners **66** and **68** and all of the final melting burners **136**, **138**, and **140** are assumed to be firing, although for conditions of light snow loading any one or ones of these burners may be left idle by shutting off its fuel supply by means of a valve in the branch line feeding it from header **152** or **142**.

Snow picked up by screw **164** is discharged in stream or chunk form from outlet pipe **168** of snow gatherer and blower **56** onto snow shredder **74** within the pre-melting chamber. The whirling shredder blades divide and finely comminute the snow, and fling it toward the sides and the rear of the pre-melting chamber or enclosed hopper region. Meanwhile with pre-melting burners **66** and **68** in operation there are steady blasts of flames and hot gases traveling forwardly through the pre-melting chamber generally counter-currently to the flow of snow through this chamber. The hot products of combustion will come into direct contact with at least some of the snow and convert a portion of it to water and possibly a small part of it to steam.

As the snow flows or is flung backwardly through the pre-melting chamber it is partially regulated in dispersion by baffles **40**, **42**, **44**, **46**, **88**, and the counterpart of baffle **88**. These baffles are all of a perforated nature, and snow will be melted not only by the warm baffle structures themselves as it comes into contact with these structures, but also by direct contact with flames or combustion products flowing through the baffle openings. In general, baffles **40**, **42**, **44**, etc., serve the purpose of keeping the snow thrown backwardly from shredder **74** from falling too rapidly onto conveyor belts **18** and **20**, and accordingly that of giving products of combustion flowing forwardly from not only the pre-melting burners but also the final melting burners, as is pointed out in greater detail hereinafter, a better opportunity to come into contact with the shredded snow and pre-melt it to a considerable extent. Some baffling effect of the kind described will be provided also by side plate across brace **38**.

With continuance of the pre-melting operation, combustion products in cooled condition leave the snow melting machine of this invention by way of aperture **72** in the front end of hood-like structure **70**, and any steam which has been generated in the pre-melting operation also flows out of the aperture around outlet pipe **168** of snow blower **56**. Snow converted to water within the pre-melting chamber and snow blown into this chamber which is neither liquefied nor vaporized falls or flows downwardly onto slat conveyors **78** and **20** and is all thereby transported to the rear of the machine beneath the lower edge of plate member **64** of pre-melting burner plate attachment **48**. It is contemplated that in normal operation of the snow melting machine of this invention there will be an appreciable quantity of snow which is not melted in the pre-melting chamber, but which is moved backwardly toward the final melting chamber with a stream of water going along with it. Said in other words, water resulting from pre-melting and snow still unmelted all flow or are dumped into the final melting chamber by means of slat conveyors **18** and **20** except for a possible and unintended portion of the water flowing directly downwardly through any separations existing between the conveyor elements.

As unmelted snow accompanied by water flows into the final melting chamber, it is impinged upon by flames and hot gases from final melting burners **136**, **138**, and **140**, and upon tumbling down off the back ends of the conveyor belts this snow, to the extent that it is still unmelted, falls into the convolutions of spreading screw **108** and is distributed right and left to break up any remaining lumps of snow and generate additional snow surface for flame and combustion products impingement. The hot gases from the final melting burners like those from the pre-melting burners flow forwardly through the machine; that is, after swirling through the final melting chamber to reduce all snow therein to a liquid condition they exit toward the front; pass beneath plate member **64** of pre-melting burner plate attachment **48**, and then after flowing to the front throwing the full length of the pre-

melting chamber finally leave the machine through apertuer **72** along with gases from pre-melting burners **66** and **68**. Thus it is that to the extent that they retain at least some warmth after performing the operation of final melting the combustion products from final melting burners **136**, **138**, and **140** have further utility as they mingle with the hot gases from the pre-melting burners and flow counter-currently to snow entering the pre-melting chamber and serve to increase the extent to which this snow is pre-melted.

Water generated from and by the melting of snow which would otherwise tend to accumulate in the final melting chamber is permitted to drain out of this chamber and away from the snow melting machine through either one or both of fittings **128** and **130**. In certain circumstances it may be desirable that one or the other of these fittings be shut off by means of its included stop valve so that water is discharged from only one side of the machine, for example, the side nearer a drainage ditch. The water as discharged may or may not have had a salt solution or other freezing point depressant added to it from tank **116** through valved conduits **120** and/or **122** depending upon the outside temperature and the corresponding opportunity or lack of opportunity for the water resulting from snow melting to freeze before it can get away into a sewer or drainage ditch or other suitable receiving region.

On account of the use of unshielded flames from burners **66**, **68**, **136**, **138**, and **140** it is possible that temperatures within both the pre-melting and final melting chambers of the snow melting machine of this invention will momentarily and at localized areas of structure reach rather high values. For a number of reasons, however, it is quite unlikely that any damage will be inflicted upon the machine by the burner flames. One reason is that when the machine is in regular operation for snow melting there will be continuous direct cooling and shielding of large portions of the interior surfaces of its two melting chambers, particularly certain surface portions otherwise subject to direct flame impingement, by action of snow and water flowing through the machine.

Another reason is that as any machine such as basic tractor apparatus **36** is originally designed to be part of a machine such as road finishing machine **10** it is constructed of materials which are quite well able to stand extended exposures to high temperatures. This is because the road surfacing substances supplied to, conveyed through, and spread by the machine are themselves extremely hot. In particular, the elements of slat conveyors **18** and **20**, side plates **22** and **24**, and other adjoining portions of original road finishing machine **10** which define the hopper region of this machine and which are not disturbed in the process of converting the machine from a black top spreader to a snow melter are constructed of materials retaining good mechanical properties at elevated temperatures.

Still another reason is that the principal structural additions to basic tractor apparatus **36** which are even possibly subject to prolonged high temperature exposure, these additions being hood-like structure **70** and shell-like structure **106**, are fabricated with inner walls such as inner wall **156** made out of materials retaining good properties at high temperatures.

Thus for at least the three reasons given, namely, the direct cooling and shielding effects of snow and water flowing through the machine, the ability of certain original parts of road finishing machine **10** remaining in basic tractor apparatus **36** to stand prolonged exposures to high temperatures, and a like ability of certain flame-exposed portions of the conversion structures added to the basic tractor apparatus, the finished snow melter of the present invention is one which may employ the direct flame impingement technique of snow melting without any significant possibility of deleterious effects upon parts or structures of the machine itself due to the unshielded flames employed. Of course some melting will be effected by snow coming into contact with hot fittings and structural elements such as baffles **40**, **42**, **44**, etc., and the inner wall of pre-melting chamber attachment **50**. Additionally, some melting will be achieved through radiant and reverberatory effects.

Although original black top spreading or road finishing machine **10** would normally be used directly on highway or roadway surfaces, it is contemplated that this machine as converted to a snow loading and melting machine will be used primarily for clearing snow from off-the-road surfaces. Specifically, it is contemplated that after there has been a heavy snowfall with highways becoming substantially obstructed thereby, plowing equipment of designs well known to the art will be used to clear the highways and deposit the cleared snow in banks along either side thereof. The snow loading and melting machine of the present invention will then proceed adjacent the road but not on it, and load and melt the snow deposited along the road sides by the snow plows which have gone ahead only shortly previously.

When the time comes that all or substantially all snow in plowed or heavily drifted form in a particular locality has been disposed of, and highways there are substantially clear and no more heavy snows are expected for the season, the snow loading and melting machine of this invention may, in the discretion of the owner or operator, be converted back into a black top spreading or road finishing machine. This is done by simply reversing the operations indicated in FIGS. 1 and 2; that is, by removing from basic tractor apparatus **36** the pre-melting and final melting chamber attachments **50** and **52** and other conversion parts and assemblies shown in FIG. 2, and reinstalling bumper assembly **28**, hopper gate assembly **30**, screed and tamper assembly **32**, and drive belt **34** shown in FIG. 1. The parts and assemblies removed by action in reverse of that indicated in FIG. 2 may be put away at relatively little cost of either capital investment wasting or storage charges accruing until the next heavy snowfall.

While one embodiment of this invention has been described above, it is to be understood that changes and additions may be made thereto without departing from the scope of the invention.

What is claimed is:

1. A snow melting machine which comprises (1) a tractor apparatus having a front end and a back end and including power drive means, (2) a pre-melting chamber mounted and defined in and on said tractor apparatus and having open area at least near the front end of said tractor apparatus wherethrough a stream of snow may flow into and a stream of combustion products may flow out of the chamber, and having further a bottom surface defined at least in part by at least one belt-type conveyor, said conveyor being actuated by the power drive means of said tractor apparatus, (3) snow shredding means positioned within said pre-melting chamber to be impinged upon by snow flowing into said pre-melting chamber through said open area, said snow shredding means being actuated by the power drive means of said tractor apparatus, (4) baffle means within said pre-melting chamber extending from the interior wall surfaces thereof substantially transversely to the overall direction of flow of snow through said chamber, said baffle means serving to regulate the dispersion of snow flowing from said shredding means, and (5) a final melting chamber mounted and defined at the back end of said tractor apparatus, said final melting chamber being in snow and water flow communication with said pre-melting chamber to receive snow and water leaving said pre-melting chamber, both said pre-melting and final melting chambers being of the direct flame impingement type and including burner units disposed toward the rear of them so that the flow of combustion products through said machine is generally counter-current to the flow of snow and the water of melting therethrough, and said final melting chamber having drain means to discharge water of melting.

2. As a means for constructing a snow melting chamber on a tractor apparatus having a hopper region with a dis-

charge passage defined therein, an attachment including (1) a hood-like structure adapted to be mounted on said tractor apparatus with an essentially gap-free fit along the edges of said hopper region as a top and front closure for said region, said hood-like structure being characterized by at least one front aperture in the nature of an inlet and outlet opening wherethrough with said attachment mounted on said tractor apparatus a stream of snow may flow into and a stream of combustion products may simultaneously flow out of the snow melting chamber so constructed, and (2) snow shredding means mounted within said hood-like structure in line of snow flow from and fairly closely adjacent the aperture by which said hood-like structure is characterized.

3. As a means for constructing a snow melting chamber on a tractor apparatus having a hopper region defined therein, a front end, a back end, and a passage communicating from its hopper region to its back end, an attachment including (1) a shell-like structure adapted to be mounted on said tractor apparatus with an essentially gap-free fit along the back end thereof as an end closure for said passage, said shell-like structure being open on its side adapted to be adjacent the back end of said tractor apparatus with said attachment mounted on said tractor apparatus to permit snow loaded into said hopper region to flow through said passage into the snow melting chamber so constructed, and (2) burner means mounted on and in said shell-like structure and disposed to discharge products of combustion into direct contact with snow introduced into said snow melting chamber through said passage, and (3) at least one drain fitting mounted on and in said shell-like structure near the bottom thereof wherethrough water of melting may be discharged therefrom.

4. An attachment according to claim 2 in which said hood-like structure is of double-wall construction with the walls thereof being in spaced relation one to another and having a layer of thermal insulating material between them.

5. An attachment according to claim 2 which further includes at least one baffle mounted within said hood-like structure at least generally in line with snow flow from the aperture by which said hood-like structure is characterized, and otherwise positioned and oriented to regulate the dispersion of snow within the snow melting chamber constructed with said attachment mounted on said tractor apparatus.

6. An attachment according to claim 3 in which said shell-like structure is of double-wall construction with the walls thereof being in spaced relation one to another and having a layer of thermal insulating material between them.

7. An attachment according to claim 3 which further includes freezing point depressant material storage means mounted on said shell-like structure and means for conducting such material from said storage means into said snow melting chamber.

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