H. F. CUNTZ.

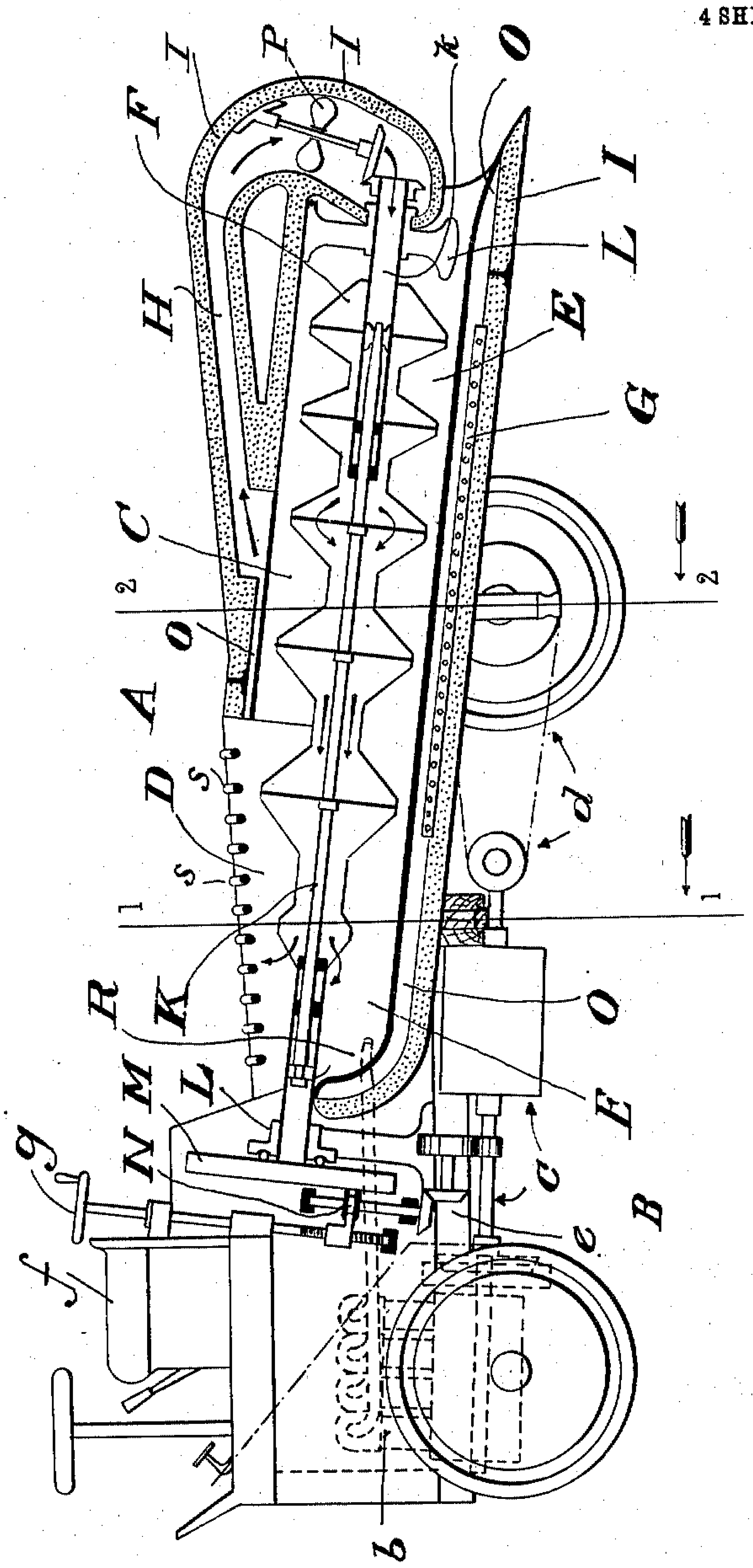
SNOW MELTING MACHINE.

APPLICATION FILED OCT. 1, 1908. RENEWED JULY 14, 1909.

950,895. Patented Mar. 1, 1910.

4 SHEETS—SHEET 1.

Fig. I



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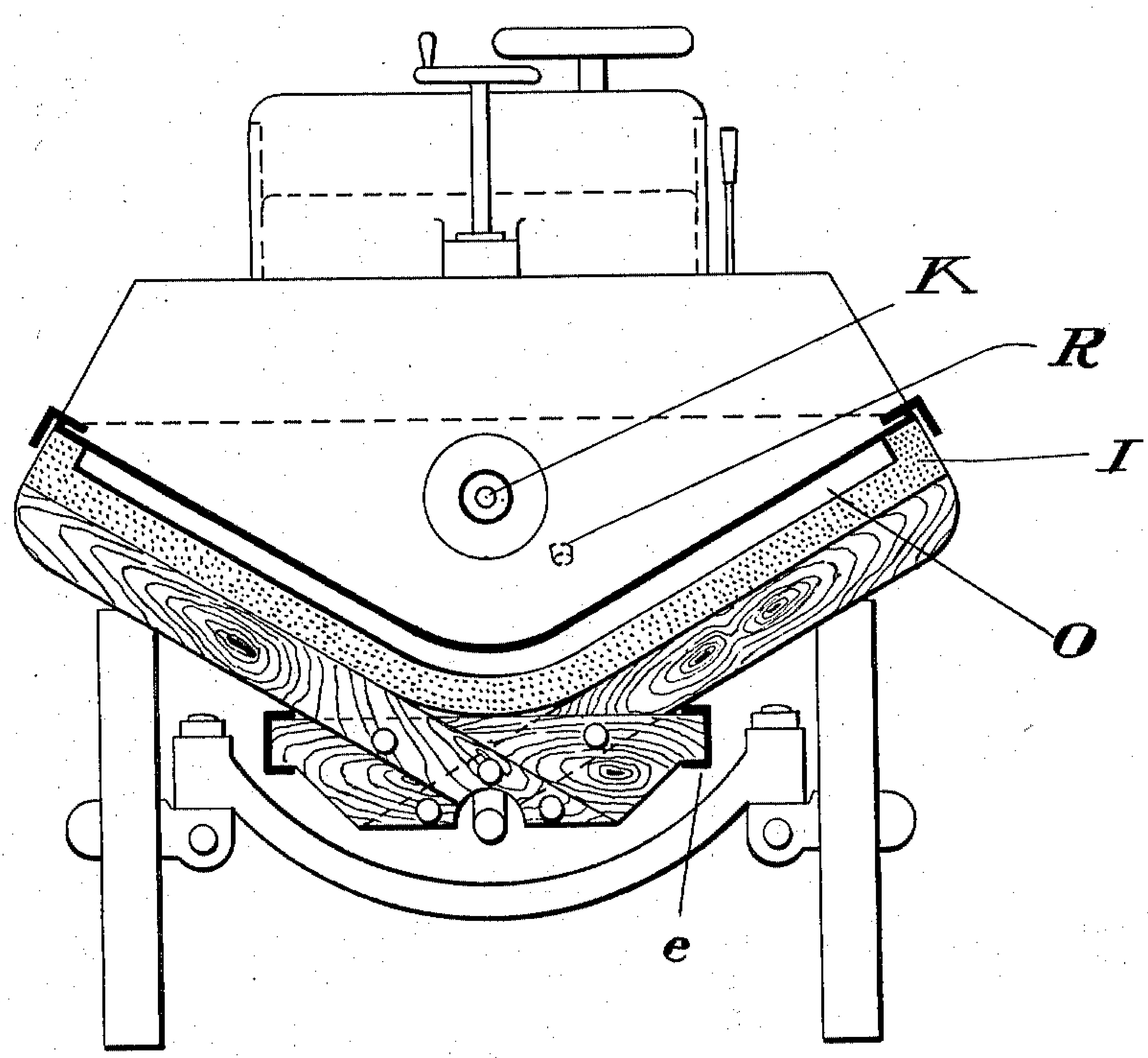
4 SHEETS—SHEET 2.

*Fig. II*

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4 SHEETS—SHEET 3.

*Fig. III*

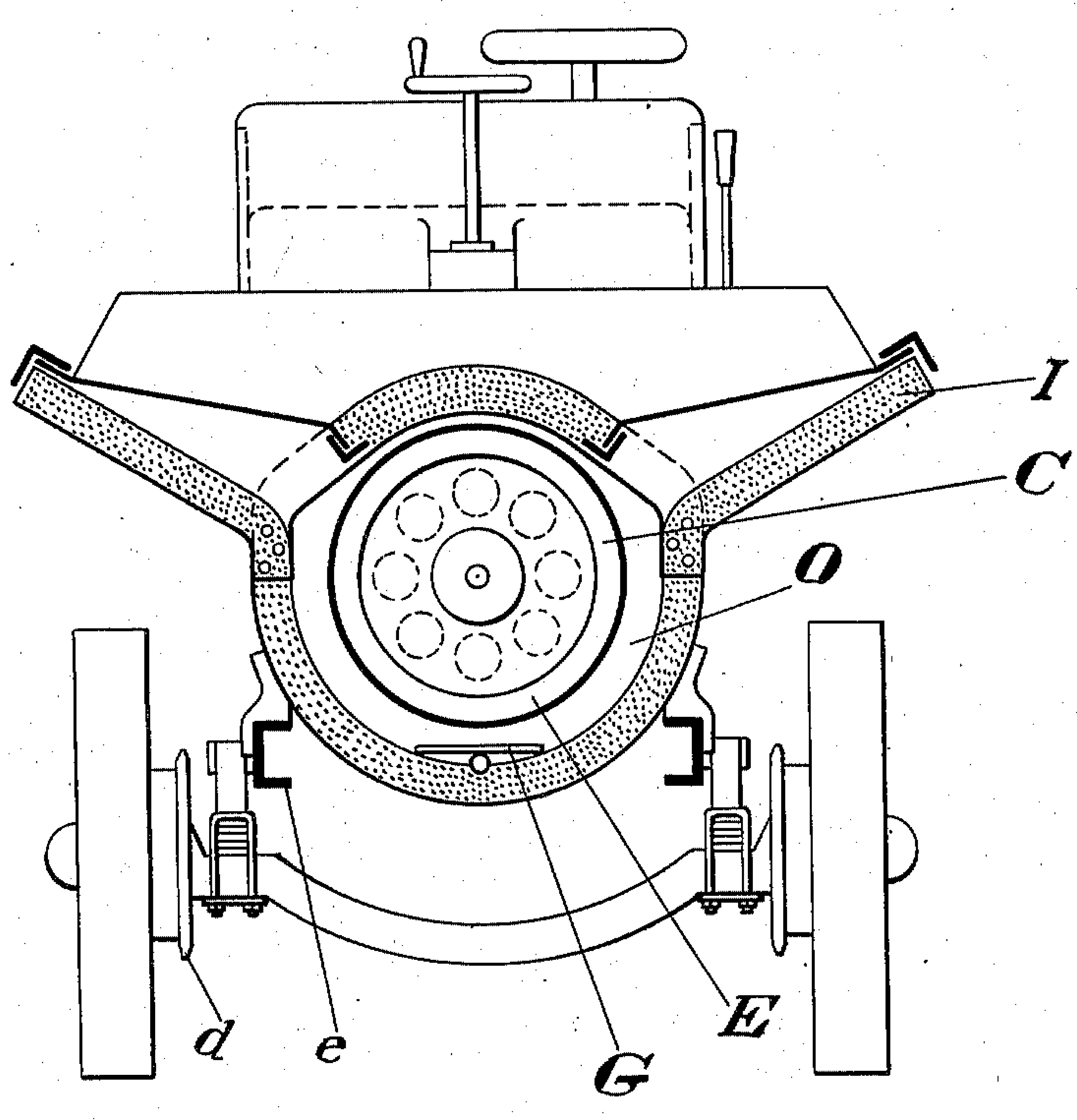


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Fig. IV

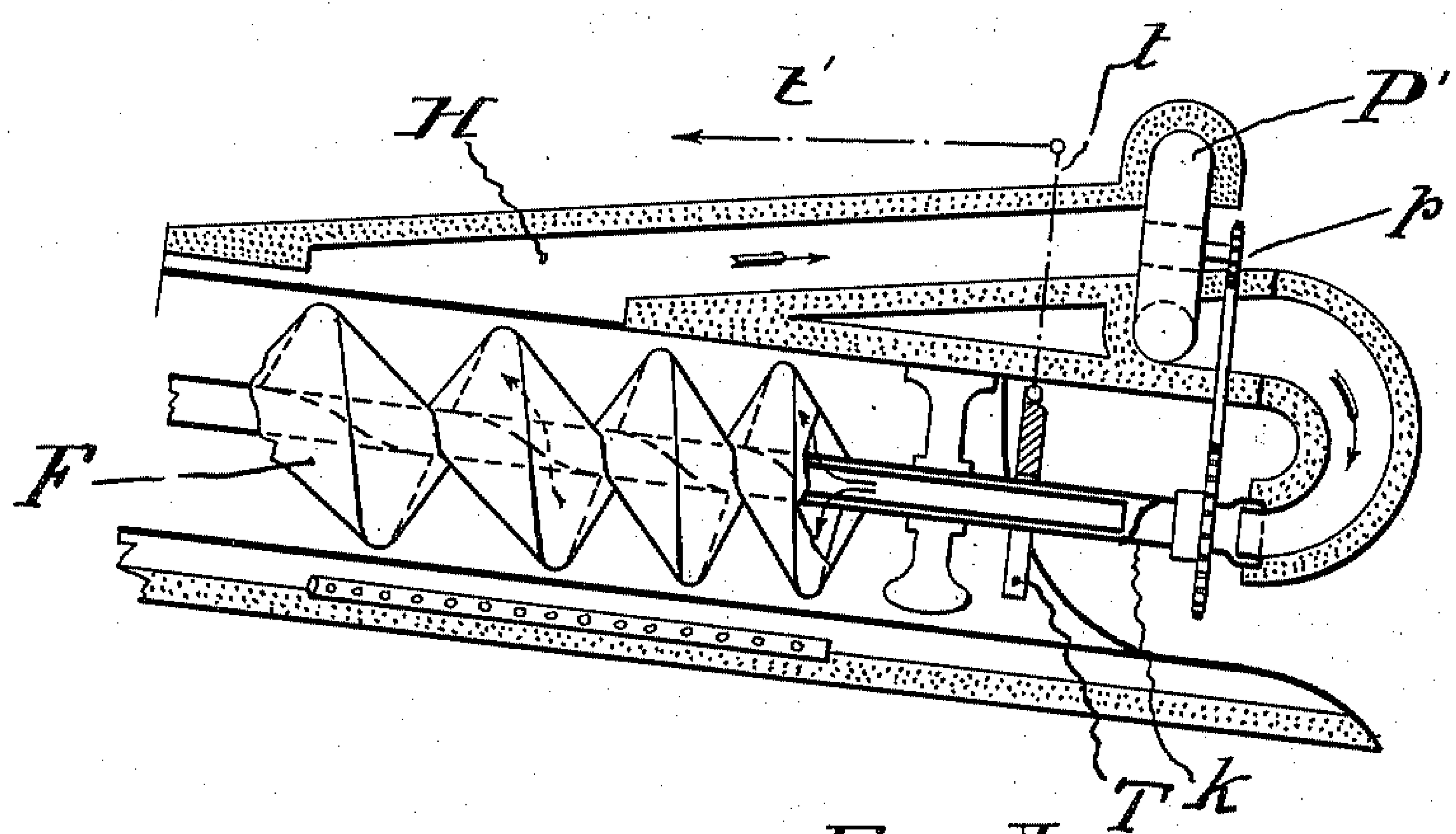



Fig. V

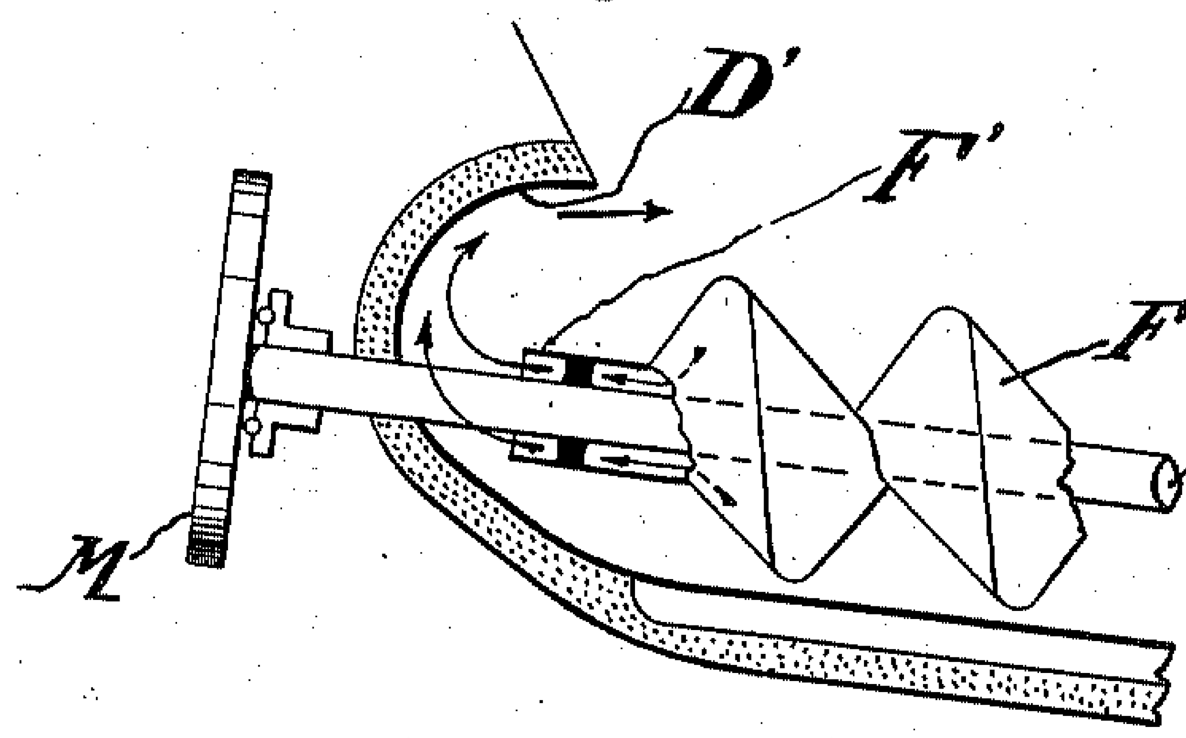
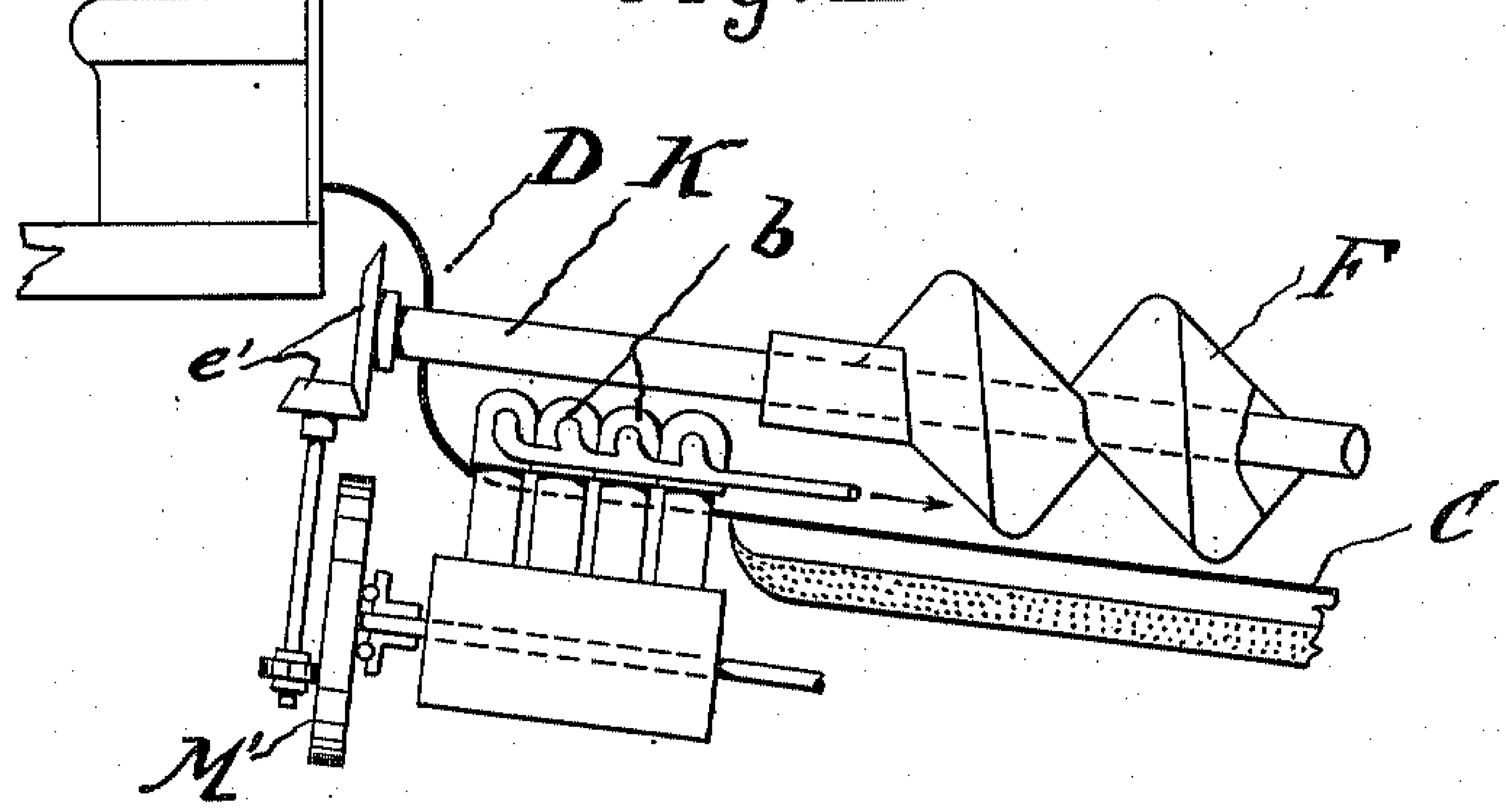



Fig. VI




WITNESSES:

INVENTOR

# UNITED STATES PATENT OFFICE.

HERMANN F. CUNTZ, OF HARTFORD, CONNECTICUT.

## SNOW-MELTING MACHINE.

950,895. Specification of Letters Patent. Patented Mar. 1, 1910.

Application filed October 1, 1908, Serial No. 455,635. Renewed July 14, 1909. Serial No. 507,585.

*To all whom it may concern:*

Be it known that I, Hermann F. Cuntz, a citizen of the United States, residing in the city and county of Hartford, State of Connecticut, have invented certain new and useful Improvements in Snow-Melting Machines, of which the following is a specification, reference being had to the accompanying drawings, illustrative of one particular embodiment of my invention.

This invention relates to an apparatus, primarily for municipal use, and has for its object the disposal of snow or ice or the like, which it is desired to remove from streets or like places; while other applications of my invention are within the scope of my intent.

More particularly the purpose of my invention is to melt the snow which accumulates in cities, instead of being put to the necessity of carting the snow from the streets to a distant place of disposal, usually known as a dump, and by melting it on the spot permitting resultant water or slush to pass into the nearest sewer or drain pipe. By my invention I reduce expense of disposal and avoid congestion of traffic incident to the present method of carting, requiring a large number of carts, frequently in practically impassable streets, in order to effect the quick removal in cleaning the streets in large cities with heavy traffic.

While generally the melting of snow has heretofore been suggested, by the practice of my invention it is possible to effect such disposal of snow with great economy, efficiency and rapidity, while other and various advantages will appear from the following and in the practice of my invention.

In the simplest form of my invention the snow is introduced into my machine by shoveling, although I may adopt means for mechanically removing the snow from the streets to be treated according to inventions involved in my machine, or other means of eliminating the hand labor incident to shoveling, are within the intent of application of my invention. The methods heretofore suggested for melting snow have not included the use of any means which would reduce the cost or make the work effective or rapid enough to show a net advantage over hand shoveling and carting, or else they involved apparatus unsuitable to the rough work of street cleaning.

In the accompanying drawings in which I illustrate one embodiment of my invention, I show a structure in which I generate heat from any suitable means such as liquid hydrocarbon, and by the construction and arrangement and method of handling the snow and the machine, I am enabled to transmit to the snow under uniform conditions, practically all the heat units generated by the combustion of the fuel used. While embodying such a means to transmit all of the heat units, I furthermore include a maximum surface for contact with the snow for the conduction and radiation of heat to the snow, securing a maximum in rapidity and effectiveness of the apparatus. Likewise, with features to accomplish the above, I have embodied means for insuring the contacting of the snow with the secondary source of heat, the conducting surface, in a manner effective for rapidity and efficiency of operation. In other respects advantageous features of my invention are shown and described in connection with the particular embodiment or modified details here given, as will hereinafter more particularly appear.

In the drawings, Figure I is a longitudinal section of a self-propelled vehicle containing an embodiment of my invention; Fig. II. is a transverse section of the vehicle at the line 1—1 of Fig. I.; Fig. III. is a transverse section of the vehicle at the sections 2—2 in Fig. I., Fig. IV. shows in section a partially modified arrangement of the parts at the rear of the muffle; Fig. V. shows in section a modified form of the forward end of the bin wall; Fig. VI. shows in section a modified arrangement of bin and engine.

While the embodiment of my invention as shown is in combination with a self-propelled vehicle, such lends itself particularly to the practice of this invention, whereas certain features, and particularly the main element, may in part or whole be used as a portable apparatus or even in stationary mechanism; and even while embodied on a vehicle its operation would usually be during the time that the vehicle was stationary. The same power, however, which lends itself to the operation of my melting mechanism, when desired, may be readily used to constantly propel the vehicle or simply move it from place to place, and for other purposes.

In the illustration, as in Fig. I, the muffle as a whole is indicated at A, while the vehicle proper, indicated at B, carries and is variously connected with the muffle. The vehicle includes an engine $b$, transmission mechanism $c$, driving mechanism $d$ with suitable driving wheels, frame $e$ and suitable steering wheels, seat $f$ with operating pedal lever and steering wheel, while in proximity to the seat are the other means of control of engine and drive mechanism, as well as $g$ the controlling wheel for a variable speed drive mechanism for transmitting some of the power of the engine to the moving part of the muffle A.

The muffle A consists of a tunnel or shell C, which about the middle of the vehicle is open at the top constituting a receptacle D, while a larger rear portion constitutes what I call the tunnel E. D, which I call the bin, may also be of greater extent or otherwise disposed. Within this tunnel is a hollow irregular heater F, which in the form shown is a hollow worm of decreasing pitch from the receptacle toward the rear or lower end of the tunnel.

Below the lower portion of the shell C is a burner G adapted to burn liquid fuel, the operation of which may be regulated from the seat or elsewhere as desired by the operator of the vehicle, and suitable connections extending outward and accessible from the outside of the muffle for regulation of the burner, supply fuel and lighting or other necessary attention, are adopted as may be desired. Extending from the upper portion of the shell near the top of the tunnel is a flue H, adapted to carry the products of combustion from the space O to the end of the hollow movable heater. Below the burner G is heat insulation I, which extends laterally and longitudinally the full length of the muffle C, completely inclosing on the outside all of the shell, and likewise covering the top of the tunnel and the flue H to where the gases are conducted into the hollow internal heater.

The hollow heater F is supported on a shaft K, or may as a structure constitute a supporting means, having the hollow extension $k$ at the rear, supported in suitable brackets and bearings L at the front and rear so that the heater, or, in this case, the hollow worm, may be rotated. At the forward end of this structure in front of the bearing L, is a disk M engaged by the friction wheel N, which is driven by suitable gearing constituting a friction disk driving mechanism, which can be controlled by the controller $g$ to regulate the speed of rotation of the hollow worm F. The shell C is separated from the insulation by a space O, so that the hot gases from the burner G may come in contact with the shell all around the tunnel E, as well as the receptacle D, in order that they may transmit their heat through the shell to be radiated by the shell to the snow or ice in contact with the shell, while the insulation completely surrounding the outside prevents the conduction and radiation of heat outwardly. In the flue from the top of the shell to the rear of the hollow worm I place any suitable blowing means, such as fan P or rotary blower P', which may be operated by the movement of the hollow worm or directly by the mechanism, to force the hot gases through the hollow worm and thus cause a draft exhausting the gases from the space O around the shell, while fresh air is suitably supplied for combustion at the burner G as shown, or otherwise suitably arranged.

At R will be seen the inlet of the exhaust from the engine $b$ into the receptacle D, at a low point so that it will impinge upon the snow put into the receptacle. In my improved form I can utilize the combustion of fuel in the engine to advantage by having a large exhaust and opening the exhaust valve of the engine very early so that the products of combustion and unusually large proportion of heat from the internal combustion engine may be exhausted into the snow. While this would mean an uneconomical engine, it would under certain conditions be an advantageous way of increasing, at least for a time, the supply of heat units to the receptacle D, particularly at a time when only a small amount of power is necessary, when the vehicle is not moving and power is required only to rotate the hollow heater F. Under such conditions of operation, even when the vehicle is standing still, the change speed mechanism at C can be set in a neutral position so that the driving mechanism of the vehicle is not operated, while the main clutch at the engine, connecting it with the transmission shaft, may be engaged.

It will be seen that suitable bearings are arranged to support the forward end of the rotating hollow heater shaft K by members or brackets from the frame of the vehicle, while the rear of that shaft may be supported as shown in Figs. I and IV. by a three-arm bracket connected with the inside of the tunnel E at its rear end. This connection or support at the rear of the tunnel will still leave a space in the middle and bottom of the tunnel for the unrestricted flow of water down the incline of the bottom of the shell C, rearwardly and outwardly, although I prefer to drain off most of the water as fast as the snow melts, as described hereafter. The heat insulated flue transferring the hot gases to the hollow heater partially obstructs the upper portion of the rear end of the tunnel preventing the wind or cold air from penetrating and extracting heat of the muffle and diverting it from its proper service in the melting of snow, while more effective means for this and other purposes are indicated in Fig. IV. and hereafter described.

At the exit for water I may attach a hose which may be lead to the regular sewer openings, in order that in freezing weather, or on level streets, the water will be passed away before it has a chance to freeze on the street. Under proper climatic conditions, such hose can also be used to deliver the water, as desired, about the surface of the streets to wash away the partially melted snow or slush and effect a thorough cleaning of the streets.

As contracting work, for which my apparatus may be largely used, may sometimes involve the payment of work on the basis of the amount of snow melted, I may incorporate in such cases a water-meter at the outlet or in connection with the discharge hose, so that the amount of water from melted snow may be measured and thereby the cubical contents of snow estimated for payment on a predetermined basis.

In cases where it is desired to actually measure the amount of snow supplied to the conveyer, I may supply suitable measuring bins into which the snow is first shoveled and as each unit measure is full the snow is dumped into the receptacle. I have also devised an air-tight shutter arrangement whereby rotating shutters or lids accommodate a measured quantity, and as each is full the rotation of such appliance above the bin or receptacle D, delivers the measured quantity into the bin without loss of heat from the bin into the open.

In Fig. V. I have shown a rotary blower P′, which is driven by means of a chain and sprocket system $p$ from the rear of the shaft $k$, so that a large quantity of gases can be exhausted from the top of the heating space between the shells, accordingly causing a large supply of air for combustion of the fuel. At the same time using a blower capable of effecting a desired exhaust suction, makes it possible to force the gases through the hollow worm and out of the forward end of the hollow worm with the desired pressure, by properly proportioning the exhaust area and the blower.

The exhaust from the forward end F′ of the hollow worm is better illustrated in one form in Fig. V., in which it will be seen that the exhaust gases are guided by a curved wall D′ of the forward end of the bin D. This curvature is such that the speed of the gases will not be reduced any more than necessary, but they will be deflected to exhaust substantially in a horizontal direction to the rear, and therefore into the snow which has been deposited in the bin. In this manner the entire exhaust gases, with their heat content impinge directly upon the snow and the heat will be transmitted to the snow, thereby rapidly starting the melting of the snow in the bin. This greatly assists in breaking down the accumulation of snow at the start and preventing what has been termed "bridging" of the snow in the receiving bin. Furthermore, in this manner a ready exhaust from the hollow worm is effected and the final heat content of the gases from the combustion of the fuel are most advantageously utilized for the same purpose as all the other conducted and radiated heat, which makes it possible to secure a very great efficiency,—that is, a very high percentage of the heat generated is actually transferred to the material to be melted. I may also modify the formation of the wall D′ by having a stationary tubular connection with the end of the hollow worm, which broadens out after turning to the rearwardly facing horizontal position, which insures the proper directing and best distribution of those exhaust gases.

In Fig. IV. it will also be seen that instead of a permanent obstruction covering a large portion of the rear of the tunnel E, as shown in Fig. I, I have placed a gate T hinged at its top, and by means of a rod $t$ and any desired link connection $t'$ leading to a convenient place, such as the operator's seat, this door may be opened or closed as desired. By closing this door the passage through the tunnel is choked, thereby restraining the exit of snow in case the same is conveyed too rapidly through the tunnel E. By choking down the exit an increase in pressure on the snow is obtained, which may crowd back over the edges of the worm convolutions, so that the worm keeps up a substantial compression. This compression of the snow I design to be substantially in proportion. passing from the forward to the rearward end of the worm, to the permissible shrinkage of the snow in its progress. The shrinkage will be generally in proportion to the heat units absorbed by it, and by compressing it in the manner shown and described insures a more or less complete filling of the tunnel, keeping the melting snow in close contact with all the various heating surfaces. In this manner a constant and maximum radiation of heat and absorption by the snow from the heating surfaces, are maintained. By a proper manipulation of the speed of the worm and adjustment or handling of the choke door T, the discharge of water alone instead of only partially melted snow, is entirely within the control of the operator of the machine.

A further modification, which under certain conditions may be desirable, is shown in Fig. VI. in which a portion of the engine cylinder $b'$, when using an internal combustion engine, projects into the bottom of the bin D near its forward end, and directly under the worm shaft $k$, which therefore protects it and may also protect such connections which are run to the top of the cylinders. In this manner even the heat usually lost by radiation from the engine cylinders is radiated into the snow, in addition to exhausting the products of combustion from the engine into the snow. With this arrangement it is possible to use a fly wheel of the engine M′ as the disk for effecting the variable speed driving of the worm, the connection from the disk and pulley being made by any suitable gearing, such as *e′*.

While the drawings illustrate only in a general way the burners G, I prefer to support the burners in a rearwardly removable trough section which is lined with fire brick. In such trough section I place the piping for liquid fuel burners, and also a baffle wall of fire brick against which the flame may impinge and which will remain hot, thereby insuring a complete combustion of the liquid fuel.

I prefer also to make the bracket L, supporting the rear end of hollow shaft K, a readily detachable bracket so that the entire worm may be easily removed. At the forward end of K the fit or connection with the driving disk M or its shaft, may be loose, so that after removing the bracket in the rear, L, the entire worm may be pulled out to the rear of the machine. As illustrated in Fig. IV., the flue connection carrying the hot gases to the rear of the hollow worm can be made with a coupling, so that the elbow can be swung to one side, or otherwise quickly displaced so as not to in any way interfere with passing the parts contained in the tunnel out of the rear end.

The choke plate or door T, Fig. IV., may be of any form and arrangement, while I prefer to have it accessible for ready removal. It may also be outside so that it really covers the end, and by removing a pin hinge, or other suitable device, may be entirely dismounted so as not to interfere with the removal of the worm and connection.

From the above the operation of my invention as shown in the particular embodiment, will be understood as follows: Snow is shoveled or otherwise conveyed into the receptacle D. The walls of this receptacle being made of suitable material to conduct and radiate heat, and still stand hard usage, which sheeting is preferably as thin as the required strength will permit, if heated by the hot gases from the combustion at the burner G, will immediately transmit heat to the snow within the receptacle. At the same time the hot gases having been conveyed through the hollow heater F, will transmit heat through the shell of that heater, which I preferably make of sheet copper, though any suitable, strong and good heat conducting material may be used, and will transmit heat to the snow in contact with it; furthermore, the gases reaching the forward end of the hollow heater pass through suitable openings directly or are deflected into the snow, being forced out of that end of the hollow heater by the pressure due to any blowing apparatus such as P. Furthermore, the exhaust from the engine delivers heat units directly into the snow in the receptacle. While absorbing in this manner a large quantity of heat units, being generated from the combustion in the space O, insulated from outside radiation by the insulation I, and transmitting practically all heat through the shell to the bin and tunnel, the snow will tend to slide down the heated shell toward the tunnel E. This movement of the heat-absorbing snow will be supplemented and supplanted by the rotation of the hollow worm with suitable pitch, which rotated in the proper direction will force the snow into the tunnel. Upon entering the tunnel the snow will be surrounded on all sides by the heated shell most advantageously transmitting heat to it, while in the core of the snow packed in the tunnel, will be the hollow heated worm with its conducting and heat radiation shell. The continued motion of the worm will move the snow along the heated walls and cause its rapid absorption of heat units from all sides, forcing all the snow or slush in direct contact with hot surfaces. By the due regulation of the operation of the different parts of the muffle, the snow will have absorbed sufficient heat units equal to the latent heat of melting, by the time it reaches the rear of the tunnel, so that resultant water will pour out of the exit or into the suitably adapted hose and be disposed of into the street directly into the sewer, or otherwise as desired.

It will be seen that in the course of operation of my machine, the variable speed mechanism turning the hollow worm can be regulated so as to move the snow in contact with the heated shell of receptacle and tunnel, just long enough to transmit to the snow the necessary heat units to convert it into water. With different degrees of temperature of the snow, owing to different climatic conditions at the day and hour of operation, the speed of rotation of the hollow worm will be varied and the variation will also depend upon the operation of the burner, whether properly generating, adjusted to generate excessive heat or turned down. By such variable means of adjustment it will be seen that the apparatus can be operated to suit the exact conditions at the time of operation, as, for instance, when large amounts of snow are being supplied by a minimum number of shovelers at greatest rapidity, when maximum heat supply would be adjusted, and on the other hand can be regulated so that a small amount of heat, and proportionate economy of fuel can be effected when disposing of snow piles at intervals when the vehicle must be moved and the rate of supply to the receptacle is less than the melting capacity of the machine, or when the material is near slush.

By the arrangement of my apparatus I afford a convenient receptacle, the edge of which is not, as shown in my design, as high as the ordinary cart into which snow is shoveled, thereby facilitating the transfer of snow from the street to the melter. I furthermore may lay a number of rods *s*, from side to side at the opening of the receptacle, hooked onto the rim, which will prevent large stones or other foreign matter from being thrown onto the shell of the hollow worm or the bin skin, which may be thin for purposes of heat conduction. Small obstacles, which are frequently found mixed with snow, will pass through the tunnel as I leave a suitable clearance between the hollow worm and the tunnel shell, but should a meter be used, then a means of straining or removing such obstacles from the melted water is necessary.

By the construction shown and described, it will be seen that I secure a muffle in which heat generated in any economical way and from convenient source, such as liquid fuel, may be completely insulated from the outside air by ample insulating material such as asbestos, felt packing, and near the burner fire-brick, leaving in my apparatus only openings for the exit of water, and an inlet for snow to be melted, and such snow when piled up at the inlet in itself prevents loss by radiation of any heat to the atmosphere, but on the other hand, would begin to absorb heat units from the moment it is delivered to the receptacle. In all the apparatus with the complete insulation feature, involves also a maximum of heat conducting and radiating surface and means to bring the hot products of combustion in contact with the surface, and means to eventually exhaust the final heat units directly into the snow itself. Furthermore, my apparatus enables the regulation of operation whereby the snow may be kept in contact with the heating means for just such time as may be necessary to supply the necessary latent heat to convert it into water, which permits the maximum speed of operation of the apparatus, with no waste such as supplying of unnecessary heat to the water.

I have found that one of the main difficulties in rapidly melting snow, is due largely to the accumulation of water which floats the snow away from the heating surface. For this reason I provide a perforated bottom to at least a portion of the tunnel, extending from the rear end forward. This perforated bottom covers a drain just below the tunnel, and I find I can readily arrange this drain in a protected space, flanked by fire-brick, so that the flame will be deflected to the sides of the tunnel, and no great amount of heat will be transmitted to the drain in excess of what is necessary to insure the water passing out completely melted. Any additional heat supply to the water after it has once melted, would simply raise the water above the necessary temperature, and thereby diverting the heat from the main object of supplying the latent heat to the snow and ice for the actual conversion from solid to liquid, and accordingly reducing the efficiency of the machine. With this arrangement it will be seen that only snow and ice remain in contact with the heated surfaces in the tunnel and the very rapid transfer of heat takes place, while the revolving worm constantly brings only snow in contact with the heating surface, packing the material as fast as it absorbs heat and squeezing out the water which is drained off, and therefore cannot insulate the snow from the heated walls. This is a most important feature of my apparatus, since in actual practice, heretofore, no apparatus has effectively provided against that main obstacle to high capacity snow disposal machines.

In practice I have found that constantly bringing snow in contact with a hot surface, and compresing the snow as rapidly as it will shrink, owing to the absorption of heat, an exceedingly rapid conversion of the entire mass into water can be accomplished. On the other hand, if the first melted snow water is permitted to remain either pocketed or on the heated surface, the balance of the snow will require a very long time for conversion. Putting this in other terms, the curve representing the variation and density of snow shoots up very rapidly for the first small units of time, and when a mass of snow is brought in contact with heated surfaces, it very rapidly reaches a density approximating ice. From this time on the curve rapidly approaches horizontal, and many units of time are necessary before the actual conversion of the whole mass into water takes place. It will be seen that my apparatus is adapted to, so to speak, utilize constantly the best portion of this curve representing the rate of condensation of snow, and in this manner, as a practical feature, I obtain the maximum capacity in the use of my apparatus. In carrying out this construction, the rate at which the snow is packed into the tunnel becomes a feature. When shoveled into the main bin D the portion coming in contact with the hollow worm F, and in contact with the shell or sides of the bin E, quickly condenses, and the volume rapidly approaches the minimum, or conversely the density approaches that of ice or water. This rapid conversion occurs largely in the bin just as it enters the tunnel, dependent, of course, upon the speed of operation of the machine and the climatic conditions, and likewise the condition of the material as removed from the streets, that is, whether it has been lying in the sun during the warm hours of the day, or whether it is solidly frozen and no portion of the latent heat has been absorbed from the air. On this account the most efficient operation under certain conditions, may be obtained by a quick pitch in the portion of the worm under the bin and in the forward end of the tunnel. When in the tunnel the effect of the heat is to very quickly reduce the snow to the density of ice, and then the pitch being such as to pack it solidly, the further reduction in volume of the mass in the tunnel is due solely to the actual melting or complete conversion of the successive layers of slush contacting with the heated surfaces. As the water, due to this melting, passes away and constantly fresh slush is brought in contact with the heating surface, I proportion the pitch of my worm to accommodate this and simply bring the slush in perfect contact throughout the tunnel with the hollow worm and walls.

While the worm construction shown in the drawings is more or less conventional, I prefer to make that side of the convolutions, facing to the rear, approach a normal to the axis of the worm. By this arrangement the conveying of the snow is more effective; and having an inclination of the helix facing the snow such as to cause a slight radial pressure, it effectively packs the snow against the walls of the tunnel. The variation of the pitch is made to best suit conditions as described above, while at the same time this variation of pitch may be somewhat compensated by varying the size of the core or central portion of the worm, which is done by making it larger in diameter at the rear and tapered to the smallest permissible opening at the front end. By this arrangement the actual cubic space of snow moved decreases from the front to the rear of the tunnel, thereby compensating for the shrinkage and insuring close contact at all times with the heating surface. For reasons of construction, a combination of varying size or core and varying pitch would appear preferable.

For practical reasons it becomes important to have the burners or furnace parts readily accessible, and to this end I prefer a trough removable rearwardly, as above mentioned, which may contain all the burner portions, fire-brick and associated parts. This I have devised in a manner to slide on under-hung edges supporting the insulated casing under the outer shell around the tunnel, and I arrange quick couplings for the fuel pipes, and if necessary the controlled air supply, so that these may be disconnected and the trough with all the burner parts, which are liable to deteriorate or disorder, may be almost instantly pulled to the rear, adjusted, or parts replaced, and again slid into position, piping coupled up, and the rear suitably covered by flange or door, leaves the apparatus to resume work before the contents of the tunnel can cool off or have any chance to freeze.

In view of the arrangement and construction, any water converted in the apparatus tends to immediately drain off, avoiding liability to any drainage from freezing when the machine has been put out of commission temporarily or between snow falls.

Considering the average density of snow to be removed from city streets, my apparatus with the efficiency of its muffle, its high capacity, convenience of operation and other advantageous features of design and construction, can effect the melting of snow at great economy over the usual methods of carting snow by shoveling into vehicles and conveying for long distances and dumping into rivers or other suitable places, or any method heretofore tried. In addition to which it substantially eliminates any congestion of traffic usual in the carting method.

Various details of arrangement may be added to increase the efficiency and simplicity and effectiveness of my apparatus. A water tank through which the engine jacket water is passed may be placed so that even the heat loss to the walls of the engine may be utilized as heat units to be conveyed to the snow in its treatment by my apparatus.

In the construction of the vehicle axles, as shown in Figs. II and III, have been "dropped" or cranked so as to bring the apparatus as near to the ground as possible, thereby making the lift as little as possible in the shoveling of snow from the street to the receptacle. The friction drive for rotating the hollow worm, it will be noted, would slip before forcing the internal mechanism in the tunnel to a point of breakage in the case of obstacles dropped in with the snow. It will be seen in Figs. II and III, that broad tires, which I prefer should be iron tires, are used on my vehicle, which minimizes the cost of up-keep of the vehicle, but in addition I use my vehicle to run close to the curb in the case of city streets, and the weight of the vehicle in this manner is utilized to force the broad iron tires through the snow down to the pavement surface adjacent to the curb, thereby cleaning the curb while the vehicle moves along performing its other primary function. By so forcing a clearing of gutter, it also leaves a path for the melted water to run down by the curb to the nearest sewer opening, in the case of any inclination of the street surfaces.

Appurtenant to the operation of my apparatus is necessarily involved the question of fuel supply. For this I have devised means for carrying tanks of substantial capacity and also connections to operate pressure pumps for fuel, and if necessary for air. The necessary heat units for fuel in a self-propelled melting machine, with a capacity of from three to four hundred cubic yards, would vary of course and be subject entirely to climatic conditions and the uniformity of operation, in other words local conditions, but would appear to involve upward of three hundred gallons of kerosene. As the general efficiency of handling large quantities of snow involves the point of economy and in addition the essential feature of rapid accommodation, a large, as well as efficient plant is necessary. Attempting to accomplish practical results with small quantity of fuel would be useless. Therefore several hundred gallons of fuel per hour would be involved in the operation of each machine. The risk of carrying any such large quantities in proximity to a large furnace, even with the greatest precaution and heavy insulation and other elements of safety, I have therefore designed to carry a small fuel supply and plan to attach to the self-propelled vehicle at a short distance, a vehicle such as the usual tank wagon. These wagons are of standard sizes, carrying approximately five, seven or one thousand gallons each. A convenient size is selected and connected by a pipe or hose to my vehicle, so that operation for an hour and a half or more, under extreme conditions, may be effected with one suction tender. The small reserve tank on the vehicle, however, is arranged with suitable valve connections whereby it will keep the apparatus in operation during any period of disconnecting an empty tender and connecting up a fresh one. This is likewise arranged so that should tank supply wagons be located at predetermined points along a line of operation, a reserve tank on the apparatus is sufficient to bridge a reasonable interval between the exhaustion of one tender and reaching the next, when any variation of local conditions depletes the supply at an unexpected rate.

While above I have referred to the bin or receiving space as being located about the middle of the vehicle, in some forms of my apparatus I prefer to put the operator's seat above the middle of the vehicle and extend the receiving bin forward. Under circumstances I also prefer to have the bin flare out so as to give a large periphery, which means a large approach for shovelers. By having the bin in the front, the vehicle can proceed with the shovelers directly in front and at the sides, which presents the most economical method of handling the work. At the same time, having the operator above the middle of the vehicle enables him to control the operation of the mechanism and also to see the results, that is the condition of the outlet from the tunnel, and in many cases is preferable for these and other reasons.

While I have referred to the advantage of preventing the accumulation of water, and the necessity of draining off the water as soon as formed, the deleterious effect of this may be more particularly mentioned. When water is formed and allowed to remain in contact with the heating surface, the radiation from the heating surface to the water will decrease if the water is heated above 32 degrees, while if snow is constantly in contact with the surface, the snow will always remain at 32 degrees or less, and the heat conduction consequently at a maximum. However, if a layer or a pool accumulates, the conduction enters into the question and a retardation of the heat transmission results. Furthermore, the conduction or radiation from the water to the snow would be dependent upon the temperature conditions, and the water being only slightly above the snow temperature would in practice amount to an effective insulation of the snow, so far as any quick operation in snow melting is concerned. It will thus be seen that keeping the mass agitated and compressing it so as to cause the water formed wherever in contact with heating surfaces, to be squeezed out and then to drain off, all the water produces a condition in my apparatus which makes possible a capacity that for the first time enables the realization of quick and economic snow disposal.

It will be seen that various modifications of my invention are possible, and that in the practice thereof I am in no way confined to the particular embodiment which I have above fully and minutely detailed in drawing or description; but

What I claim and desire to secure by Letters Patent is:

1. A self-propelled snow melting machine comprising wheels, driving and steering means, a receptacle including a muffle comprising a completely inclosed portion and the bin contiguous to the muffle, insulation completely inclosing the muffle and all of the bin except the opening adapted to the reception of snow, and an exit, means within said muffle and bin adapted to move and heat the snow, and a source of heat.

2. A self-propelled snow melting machine comprising a muffle, a bin portion at one end of said muffle, an exit at the other end thereof lower than said bin, a hollow rotating member within said muffle, insulation completely inclosing said muffle with the exception of the exit and the receiving end adapted to be insulated by the snow in normal operation, and a source of heat.

3. In a snow melting machine, a muffle comprising a receiving portion and an exit lower than the receiving portion, a source

of heat, insulation completely inclosing source of heat and muffle with the exception of the exit and the receiving portion adapted to be normally insulated by the snow, a hollow movable member within said muffle with interrupted surface, means for conveying the heating medium from the source of heat to a hollow movable member.

4. A snow melting machine, a muffle including an inner shell or skin for the reception of snow adapted to conduct heat and radiate it to the snow, an insulating shell substantially completely inclosing said muffle, a source of heat between said shell and insulating cover.

5. In a snow melting machine a muffle comprising a skin adapted to conduct and radiate heat, an insulated casing, a space between said skin and casing containing a source of heat and passages for conveying the heating medium, an inlet for said snow so arranged that the snow will effect the insulation of the only portion of the apparatus not insulated from heat radiation, a relatively small exit at a lower level than the snow inlet.

6. In a snow melting machine a muffle comprising an inclined tunnel including a conducting skin, insulating covering exterior thereto, passages about said skin and within said insulating cover, a radiating member comprising substantially a hollow worm and means for conveying the heating medium from passages around the skin into the hollow worm, an exit for the heat conveying medium into the portion of the muffle adapted to receive the snow.

7. In an apparatus of the character described, means for conveying heat conducting medium in contact with the effective radiating area, means for thereafter delivering the residual heat content directly in contact with the material to be treated.

8. In a snow melting machine a receptacle for the snow, heat conducting surfaces to contact with said snow, means for compressing the heat conducting surfaces in contact with the snow substantially in proportion to the shrinkage thereof, means for prompt removal or draining off of the snow water.

9. In a snow melting machine an inclosed hollow space, a self-contained fuel burning device bodily removable from its position in relation to said hollow space.

10. In a snow melting machine, a receiving bin for the snow, a space inclosed by a shell, a hollow worm adapted to propel the snow within said shell and means for draining off the snow water, a device for choking the exit of said shell against the extrusion of solid matter and permitting the exit of snow water, means to regulate said device.

This specification signed and witnessed this 30th day of September, 1908.

HERMANN F. CUNTZ.

In the presence of—
H. Muchmore,
Coker F. Clarkson.