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SYSTEM OF ROLLERS HEATED BY INTERNAL COMBUSTION

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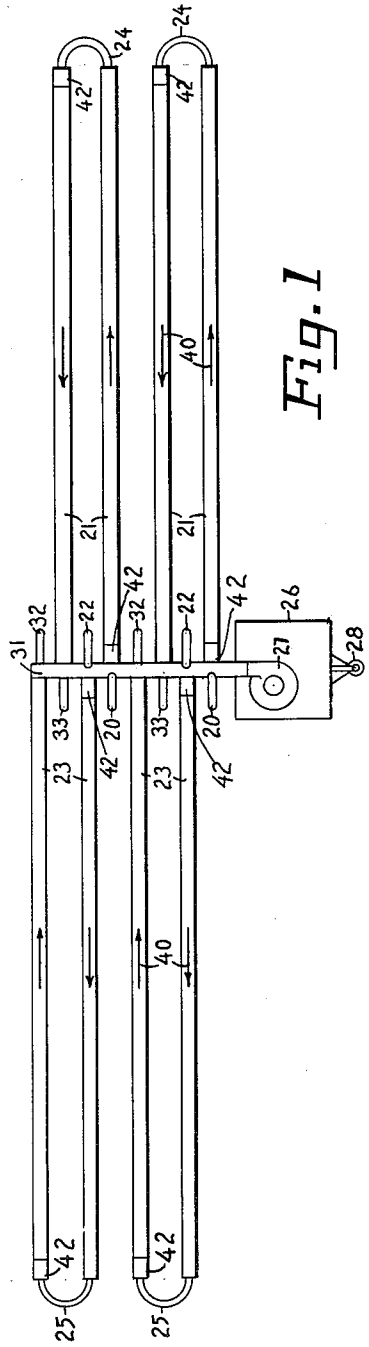


Fig. 1

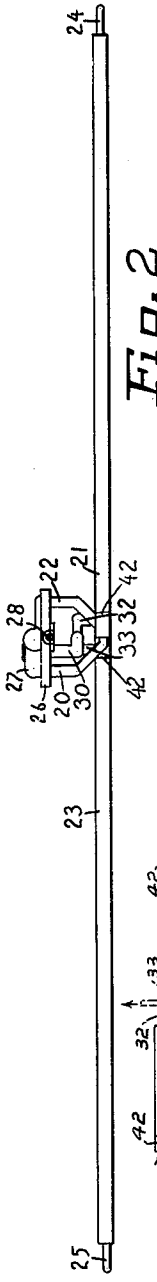


Fig. 2

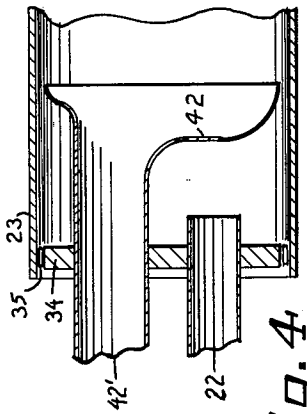


Fig. 4

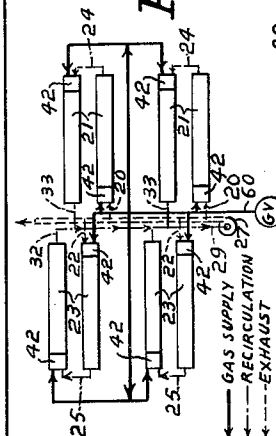


Fig. 5

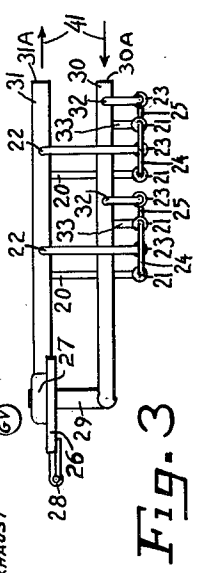


Fig. 3

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SYSTEM OF ROLLERS HEATED BY INTERNAL COMBUSTION

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This invention relates to devices comprising rollers and to means for heating the same. The devices are especially useful for removing deposits of snow and ice from surfaces upon which the same have been formed or deposited, such as pavements, airport runways and the like; and over which the heated rollers are intended to be rolled for removing such deposits.

Heretofore, snow and ice formed or deposited on surfaces, such as airport runways have constituted an extremely dangerous hazard. For example, an aircraft attempting to land on snow or ice may not be brought safely to a stop, depending upon the skill of the pilot, because of the slippery condition of the runway. On the other hand, several inches of snow on a runway may not be cleared away upon short notice by means of the conventional snow removing equipment commonly used, or render the runway safe for landing. The wheels of such conventional equipment when driven over the runway tend to pack some of the snow in patches and form ice or slippery spots thereon. It is therefore evident that an airplane attempting to take off or land may skid on the ice, bog down or otherwise be endangered by the conditions referred to, notwithstanding diligent use of conventional ice and snow removing equipment.

Conventional snow removing equipment is primarily designed to handle large amounts of snow, clearing the snow only sufficiently to allow land based vehicles and the like to make their way therethrough. Such snow-handling equipment is usually of the scraper blade type, which necessitates maintaining the blade spaced apart from the surface to be scraped, thereby to avoid damaging the surface of the pavement. Thus a certain amount of snow is left on the surface. Ice is not removed by such equipment. The weight such equipment rolling over such a coating of residual snow tends to pack the snow sufficiently to form a slippery compacted mass. Present snow removal units are not adapted to clear exceptionally wide surfaces, such as airport runways. In consequence an airport runway cannot be cleared in a short time, even though it may be urgently needed. The present invention avoids the above indicated objections, being comparatively lighter in weight, large in size and adapted to melt the snow and ice in place and convert the resulting water into vapor.

Accordingly it is an object of the present invention to provide novel devices and methods for efficiently removing snow and ice from runways and the like.

It has been found that a roller or rollers may be heated by internal combustion. The system of rollers heated by internal combustion may be formed into a machine for clearing snow and ice from airport runways or roadways or other surfaces. A large athletic field may be dried after a rain in a short time. Wet racetracks may be prepared for use quickly. A system such as this is also applicable in other industry, such as paper milling, where large sheets of wood products are pressed between rollers. Textiles, synthetic materials, rubber, organic products and by products all make use of a roller which is self-heated to maintain a moderately high, uniform temperature efficiently and inexpensively for long periods of time. To accomplish all of the above, a suitable roller is adapted to have fuel and air introduced therein for the combustion within the roller. Hot flue gases are recirculated, whether there is one or a plurality of rollers, for tempering the overall temperature and controlling the combustion.

Thus, the rollers are heated from within by the products of combustion recirculated within the rollers.

The objects of the invention will be apparent from the following description of an embodiment thereof which will be made with reference to the accompanying drawings in which:

FIGURE 1 is a top plan view of the system of rollers.

FIGURE 2 is a front elevation of the system.

FIGURE 3 is an end view of the system.

FIGURE 4 is a diagrammatic sectional view of the system, in part, illustrating features which will be described in greater detail.

FIG. 5 is a diagrammatic representation of the manner in which gases flow through the system.

The embodiment of the invention illustrated in the drawings is a device comprising a system of heated rollers for melting snow and ice deposited on runways, and the like, and for converting the resulting water into vapor which is then permitted to disperse into the atmosphere.

A plurality of pairs of parallel pipes 23 are spaced apart and arranged in parallelism to each other. Another system of pairs of parallel pipes 21 is similarly arranged so that the inner ends of each system lay in the same plane and the units of the systems are in parallelism. The outer ends of adjacent pairs of pipes 21 are connected by U-shaped pipes 24, and the outer ends of adjacent pairs of pipes 23 are likewise connected by U-shaped pipes 25. A suitable platform or other base 26 has mounted thereon a vacuum pump 27 or other exhaust means of conventional type capable of withstanding high temperatures of exhaust gases. The pump is not shown in detail as such pumps are conventionally obtainable. A conventional trailer hitch 28 enables a tow vehicle to pull the apparatus. An exhaust manifold comprising pipes 29 and 30 having a sealed end 30A is connected into the inlet of the pump 27, which is driven by a suitable gas engine or the like (not shown). Exhaust pipe 31 leads backwardly from the outlet of the pump 27 and discharges to the atmosphere at its open end 31A. Pipes 32 connect each adjacent pair or loop of pipes 23 to the exhaust inlet pipe 30, and pipes 22 connect the outlet pipe 31 with the other end of each adjacent loop of pipes 23. Pipes 33, connected to pipes 21 serve like functions as pipes 32, and pipes 20, connected to adjacent loops of pipes 21 serve like functions as pipes 22. Burners 42 are located as indicated in FIGURE 1, for the combustion of fuel and air mixture. The direction of flow of the flue gases is indicated by the arrows 40, the arrows 41 indicating the direction of the exhaust gases into and out of the pump 27.

End caps 34 are mounted on bearings at both ends of the pipes 21 and 23 so that the pipes will support the entire device on the surface to be operated upon and will function as the heated rollers. The end caps are provided with ingress and egress pipes, and at the leading ends with the burners 42, such as that diagrammatically illustrated in FIG. 4 which are mounted on the caps within and near the leading ends of the pipes. A combustible mixture of fuel and air is supplied to the burners 42 through supply pipes 42' and combustion is maintained at the burners under a partial vacuum which is maintained in the entire system by the exhaust pump 27.

The exhaust recirculation pipes are for balancing the hot combustion gas temperature within the system with the cooled exhaust gases, maintaining a more uniform temperature throughout, and further aiding the circulation of the combustion gases throughout the system. Recirculating pipes 20 and 22 are connected to the exhaust pipe 31 and conduct part of the exhaust gases therefrom to the inner or leading ends of the pipes near the burners 42, thereby introducing diluent gases into the products of combustion from the burners 42. In like manner exhaust gas is conducted from exhaust pipe 31

to the other burner spaces through pipes 32 and 33. The outer ends of the pipes 21 and 23 at one side receive exhaust gas from the corresponding inner burners through the U-shaped connecting pipes 24, and the outer ends of the pipes on the other side receive the exhaust gas from their corresponding inner burners through the U-shaped pipes 25 which are connected through the end caps to the outer ends of the rollers 21 and 23 respectively. The manner of introducing the exhaust or diluent gas to the burner space is illustrated in FIG. 4 and the gas flow is illustrated in FIG. 5. Exhaust inlet pipe 22 is arranged to introduce an amount of the products of combustion being withdrawn from the other end of the series of pipes for equalizing the temperature of the exhaust gases and hot combustion gases. This is further understood by reason of the fact that as the exhaust gases are recirculated throughout the system and new amounts of hot combustion gases are introduced and mixed with the circulating exhaust gases, an intermediate temperature of the hot gases is accomplished. This, for example, may be in the order of 300 degrees F. to 900 degrees F., as desired as against a combustion temperature of approximately 1500 degrees F. at the burner. It is seen, therefore, that the recirculation of the gases aids in eliminating hot spots at one end of a roller, while maintaining a more uniform temperature along the roller. Ignition means and thermostatic control means, not shown, are also adapted to be placed at or near the burner. The whole system is mounted on a suitable frame such as angle iron or tubular metal construction having wheels adapted to be jacked upwardly out of the way so that the surface to be cleaned of ice and snow may be engaged by the rollers. The wheels are jacked downwardly to lift the rollers off the surface when the apparatus is not in use.

In operation the entire device is adapted to roll along a surface to be rid of water, snow or ice on the bearing-supported heated pipes 21 and 23, and may be arranged as a trailer which is attached to a propelling vehicle (not shown) by means of the trailer hitch 28. The burners 42 are connected to a convenient source of combustible fuel-air mixture (not shown) and the exhaust pump 27 is put in operation to reduce the pressure in the system to the desired sub-atmospheric operating pressure. The flow of the fuel-air mixture through the supply pipe 42 is aided by this reduced pressure. The mixture is ignited at the burners 42 and the products of combustion pass through the leading tubular rollers 21, conductors 24, following burner spaces of the following burners 42, following tubular rollers 21, connections 32, manifold units 30 and 29 and exhaust pump 27 to the exhaust pipe 31. On the other side the products of combustion pass from the burners 42 through leading tubular rollers 23, connections 25, following burners 42, following tubular rollers 23, connections 33, manifold units 30 and 29 to the exhaust pump 27. Arrows in FIGS. 4 and 5 indicate the directions of flow within the system. The continuous combustion at the burners 42 may desirably be arranged to maintain the revolving tubular rollers 21 and 23 at temperatures of the order of 300 degrees Fahrenheit, whereupon the water on the surface to be cleared, or that resulting from the melting of ice or snow, may be converted partly or wholly into steam; but it is evident that arrangements for maintaining higher or lower temperatures may be made by suitable adjustments.

It is evident that pipes 23 and 21, being constructed of steel or other strong heat conductive material which is inherently adapted to flex slightly and conform to the variations in the surface of the runway or the like, will come into contact with much, if not the entire surface to be cleared when the device is rolled over the surface, thus removing all snow and ice thereon. A further modification of the rollers, not shown, provides for an insulated jacket surrounding a major portion of the circumference of each roller, leaving a smaller portion of the roller uncovered for contacting the surface to be cleaned of ice and snow. The jacket, being in spaced relationship with the roller aids in recovering surface temperature of the roller which is lost due to contact with the ice and snow.

The recirculation of gases causes a gradual decrease of temperature from the burner end of each roller to its exhaust end. A second burner being in the contiguous end of the next roller, the effect of the decrease in temperature from the burner end of the roller is minimized to the exhaust end. It is therefore seen that a substantially uniform temperature is maintained within the surface contact area.

While the above description of the invention and accompanying drawings illustrate a specific modification of the invention, it will be recognized that the invention is susceptible of other modifications without departing from the spirit and scope thereof, and it is to be understood that in the absence of specific limitations, the claims are not to be construed as limiting the same to the modification shown.

I claim:

1. A device for removing snow from a surface which comprises a pair of rectilinear tubular non-contiguous rollers having outer and inner ends, the axes of said rollers being in parallelism in a single plane for contacting and rolling along said surface; bearing members at the outer and inner ends of each of said tubular rollers, said bearing members being disposed to maintain the rollers in rotatable position; outer and inner closure elements to close the ends of said tubular rollers, sufficient to enable the maintenance of a pressure below that of the surrounding atmosphere; curved tubular means mounted on the outer pair of said closure elements for connecting the outer ends of the pair of tubular rollers thereby forming a tubular U-shaped loop, one leg of which constitutes a leading conduit and the other constitutes a following conduit of a gas circulatory system; a first burner disposed within and at the leading end of said leading conduit of the loop; a second burner disposed within and at the leading end of said following conduit of the loop; a tubular exhaust manifold; a tubular tail pipe discharging to the atmosphere; an exhaust pump connected to said manifold to evacuate the exhaust gas from the system and reduce the pressure within said loop below that of the atmosphere, said exhaust pump being connected to discharge into said tail pipe; a restricted conduit connected with said tail pipe and said first burner for supplying non-combustible gas to the first burner, said non-combustible gas being only a portion of the gas discharged by said pump to the tail pipe; said curved tubular means being connected to said second burner and conducting all the non-combustible gas from said first burner to the combustion space of said second burner; said non-combustible gas conductors being sufficiently restricted to retain said reduced pressure upon operating said exhaust pump; and means for supplying a combustible gas mixture to said burners.

2. A device in accordance the claim 1 which comprises a plurality of the tubular U-shaped loops arranged in parallelism in said plane.

3. A device in accordance with claim 1 in which the rollers are located in a lower plane and adapted to be in contact with the ground, the exhaust manifold is located in an intermediate plane above the rollers and the discharge pipe is in a plane above both the rollers and the exhaust manifold; and said tubular means for connecting the following conduit of the loop to the manifold and the restricted tubular means for connecting the tail pipe to the first burner extend upwardly from the loops, are rigidly secured to the closure members at their lower ends and to the manifold and tail pipe respectively at their upper ends, thereby constituting a rigid framework supported by the bearings.

4. A device in accordance with claim 1 in which the framework comprises a connection for attaching means for hauling the device across the surface from which

snow is to be removed; and means on said framework for mounting said exhaust means.

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