July 20, 1965 J. R. TIPPMANN 3,195,619

HEAT TRANSFER METHOD TO PRECLUDE ICE FORMATION ON PAVING

Filed Dec. 19, 1961 2 Sheets-Sheet 1

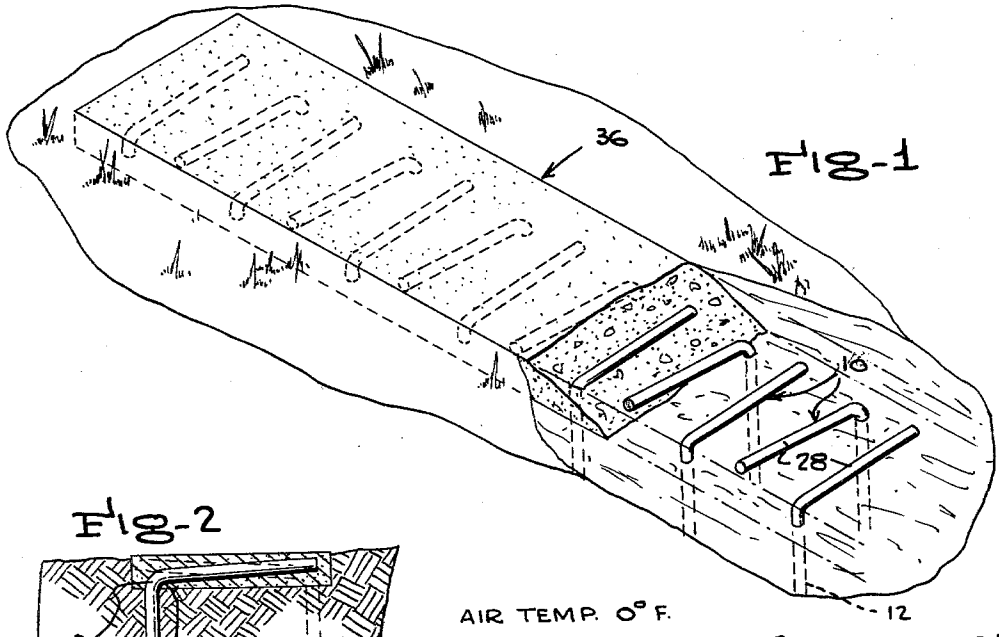
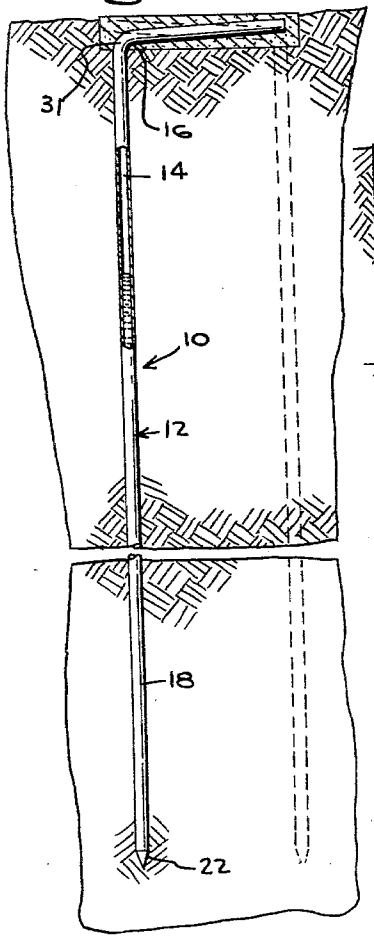


Fig-1

Fig-2



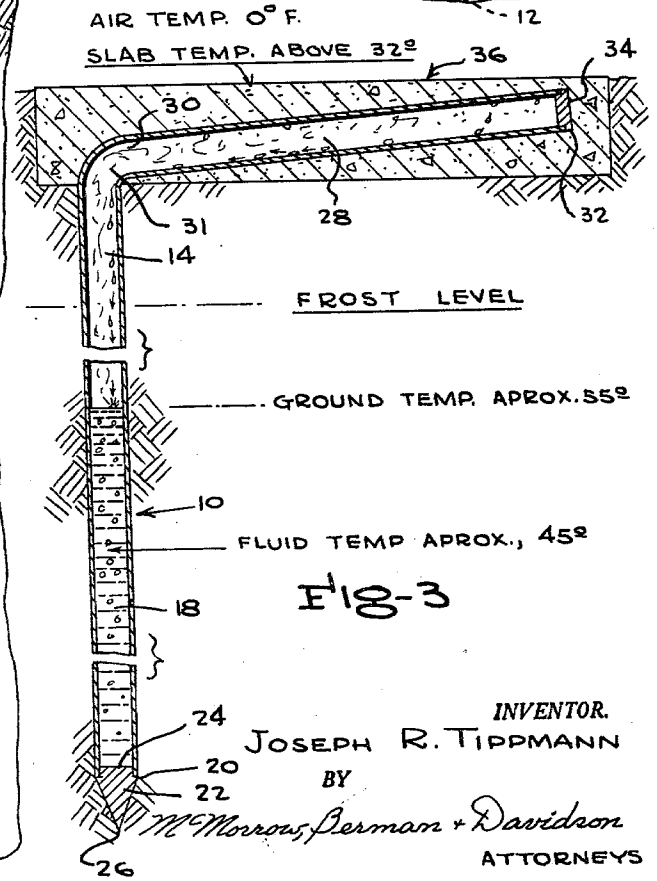


Fig-3

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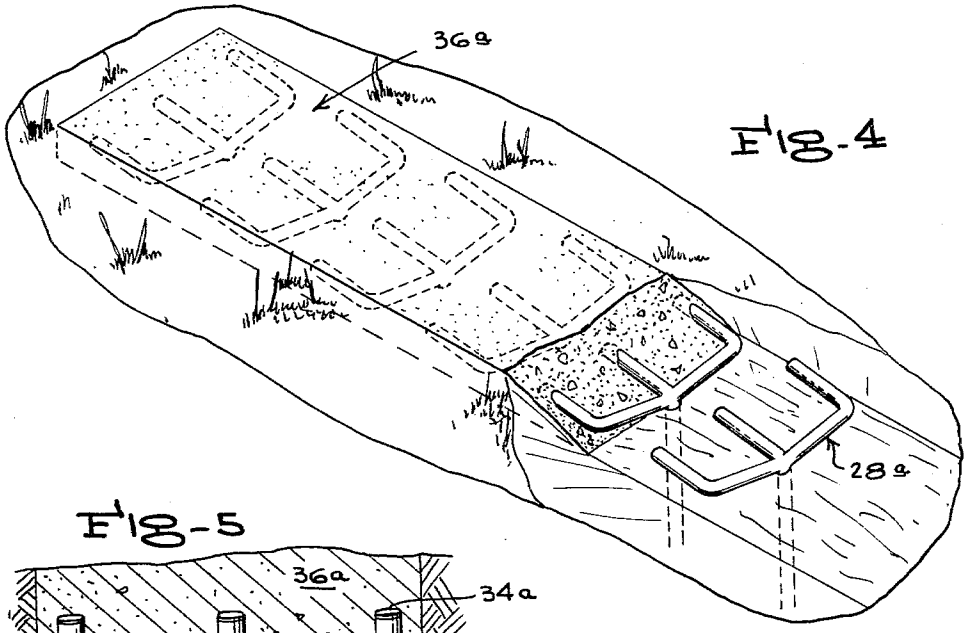


FIG-4

FIG-5

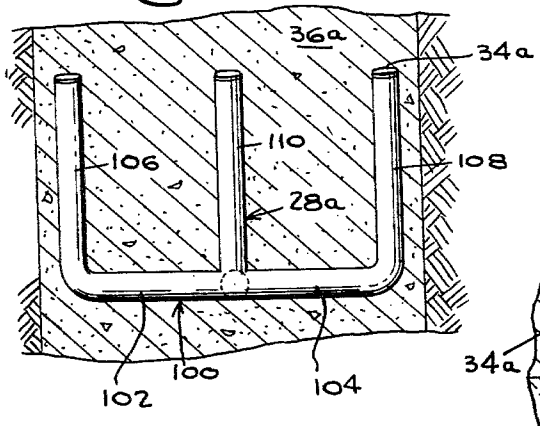


FIG-7

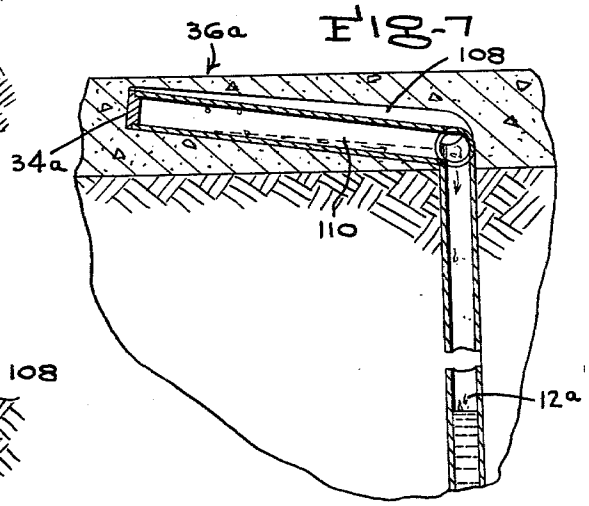
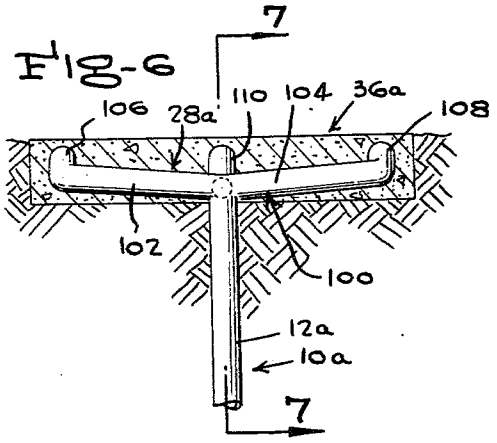


FIG-6



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United States Patent Office 3,195,619 Patented July 20, 1965

3,195,619

HEAT TRANSFER METHOD TO PRECLUDE ICE FORMATION ON PAVING

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Filed Dec. 19, 1961, Ser. No. 160,539
2 Claims. (Cl. 165—1)

This invention pertains to apparatus used in a system of heat transfer, and more specifically, to a method effective to maintain paved areas such as driveways, streets, aircraft runways, highways, and the like at a temperature to preclude the formation of ice thereon.

It is a primary object of this invention to provide a system of the character specified above which, after installation, functions through the utilization of the differences in temperature as they occur in nature and does not involve operating expense. Recognizing the safety and convenience arising from maintaining paved areas of the type mentioned above in ice free condition throughout the year in climates wherein freezing weather occurs, the prior art has developed various means for attaining this object, such previously known systems involving, for the most part, electrical resistance elements embedded in the pavement, or fluid transmission lines therein connected with an outside pumping source. Each of said previous means is effective for the purpose, but each involves substantial operating expenditures. The present invention utilizes the natural heat of the earth below frost level as its energy source, and once installed, is completely without operating expense.

It is therefore an object of this invention to supply a heat transfer device effective to transmit heat to pavement located on or adjacent ground level from the natural heat contained within the subterranean earth therebelow.

Another object of this invention resides in the provision of a non-complex method which employs a liquid medium which is convertible into a gaseous state upon application of heat thereto and back to the liquid state upon application of cold thereto and absorbed by the medium in the liquid state in the above described environment.

An ancillary object is the provision, in a method of the character described, of dispersion of the heat transfer media.

Other and further objects and advantages of this invention will become apparent from a consideration of the following specification when read in conjunction with the annexed drawings, in which:

FIGURE 1 is a perspective view, partly broken away, of a pavement strip embodying the method and apparatus of heat transfer of the present invention;

FIGURE 2 is an enlarged side elevational view of an element of the apparatus in its subterranean location, partly in section;

FIGURE 3 is a further enlarged, foreshortened, vertical section thereof;

FIGURE 4 is a view similar to FIGURE 1, showing a modification;

FIGURE 5 is an enlarged top view showing the modified form of FIGURE 4, the pavement being in section;

FIGURE 6 is a fragmentary elevation thereof; and

FIGURE 7 is a further enlarged cross-section, taken substantially along section line 7—7 of FIGURE 6, looking in the direction of the arrows.

Proceeding to a description of the invention, in FIGURES 1 through 3, the involved apparatus is shown as comprising an elongated vessel or tube 10 of generally inverted L-shape formed, in the main, of tubular metal preferably of a type substantially impervious to corrosion when installed in the ground, and when exposed to the interior vaporization and condensation of a volatile

substance such as ammonia. The vessel 10 includes a normally upstanding first tubular portion 12 having an upper end portion 14 terminating in an open end 16, and an opposite lower end portion 18 which terminates in an open end 20. As seen in FIGURE 3, a pointed closure plug 22 seals the open end 20, plug 22 including a reduced neck 24 which is received in the said open end 20 and permanently seals the same. The pointed tip 26 of plug 22 serves as an aid in forcing the vessel into the ground. The first tubular portion 12 comprises a vaporization chamber when in use, as will appear below.

Integrally connected to the open upper end 16 of the vessel 10 is a second tubular element 28. The element 28 includes an open proximal end 30 secured to the open end 16 of the first element 12 at a shoulder portion 31 so that the elements 12 and 28 are in open communication with one another. The element 28 has an open outer end 32, which, during fabrication of the apparatus, is permanently sealed by a plug 34. Element 28 forms a condensation chamber.

Prior to sealing of the ends of the vessel 10, it is supplied with a measured quantity of a liquid medium selected from the group consisting of ammonia, Freon (dichlorodifluoromethane), or other refrigerants. In the selection of the medium, it is only necessary that it possess the property of being convertible to a liquid state at low temperature and back to a gaseous state at a higher temperature or substantially 45° F., and condense back to its liquid state at a temperature lower than the gasifying or vaporizing temperature or slightly above 32° F. Exemplary temperatures are shown in FIGURE 3 of the drawing. The aforementioned substances meet this requirement as do other volatile liquids known in the art. The measured quantity of the substance to be utilized must be such that, with a portion of the substance in its liquid state and the remainder in its gaseous state, the vessel 10 will be substantially filled, as appears in more detail below.

The environment selected for illustration herein comprises a slab 36 of concrete or the like disposed on or adjacent the ground level. Element 28 has been permanently embedded in the slab 36 in a generally horizontal but slightly inclined position, and element 12 is vertically disposed in the ground beneath the slab. In FIGURE 3, a typical situation is shown, the upstanding portion 12 being inserted in the ground a sufficient distance such that a substantial portion thereof is disposed beneath the frost line wherein the temperature remains fairly constant at approximately 55° F. Heat from the ground has been transferred to the volatile substance within the lower end portion 18 of the element 12, raising its temperature to vaporization level. Since the air temperature about the slab 36 is quite cold (0° F.), the slab is of a lower temperature than the vapor and this results in condensation of the vapor as it reaches the horizontal element 28. The selected inclination of the element 28 from the horizontal results in a drainage of condensed liquid back into the element 12. Heat carried by the vapor has been found sufficient to maintain the slab 36 above 32° F., and to thereby effectively prevent freezing thereon.

It will be seen that a constant cycle of operation is involved so long as the temperature of the ambient atmosphere remains less than that of the ground below frost level.

It will be obvious to those skilled in the art that the dimensions of the vessel 10 will necessarily be varied in accordance with temperatures likely to be encountered in various areas, and that the depth of the lower end portion 18 must be increased in areas of extreme cold by comparison with the depth which would be effective in more temperate climates.

In FIGURES 4 through 7, an alternative structure is shown, like elements in the drawings carrying the same reference characters as in the first described form with the letter *a* appended thereto. In the last-named figures, the horizontal portion 28 is replaced by a manifold dispersion system 28*a*.

Manifold system 28*a* comprises essentially a means for wider dispersion of the gaseous form of the volatile substance. In the various figures, it will be noted that the dispersion system 28*a* includes a lateral tube 100 having oppositely inclined portions 102 and 104 disposed at each side of the upright element 12*a* and terminating at its outer ends and forwardly disposed portions 106, 108, each sealed by plugs 34*a*. The portions 106 and 108 are inclined in the direction of the element 12*a* so that run-back may occur. Further included in the dispersion means 28*a* is a central element 110 interposed between the portions 106 and 108 and similarly inclined.

Operation of the form of the invention shown in FIGURES 4 through 7 is substantially as hereinbefore described with reference to the form of the invention in FIGURES 1 through 3. In the former case as in the latter, the vessel 10*a* is filled with a measured quantity of the volatile substance, and the dispersion means 28*a* is embedded in the slab 36*a*. In each form of the invention, the dispersion means 28 or 28*a* of the transfer system are adapted for arrangement in a network in the slab for effective heat transfer, the network arrangement being selected for the maximum effectiveness of the heat dispersion.

The foregoing are intended as illustrative examples of the invention and of its manner of utilization, and the scope of this invention is to be limited only by the appended claims.

What is claimed is:

1. The method of maintaining a ground surface covered by a slab of paving at a temperature to preclude the formation of ice thereon which comprises positioning a plurality of closed elongated members in a horizontally spaced relationship, each having a portion extending in

an upright direction below said surface with the upper end adjacent to and spaced below, the paving, positioning substantially horizontal condensation chambers in embedded relation in the paving in a network, with the condensation chambers each being attached to one of said upright-extending portions to complete the closed elongated member, each of said members being partially filled with a medium in a liquid state and convertible into a gaseous state upon imposition of heat in the range of at least substantially 45° F. thereto and convertible from the gaseous state to the liquid state upon imposition of cold in the range of at least substantially 32° F., thereto, the lower end portions of said members being submerged below said surface to an extent such as to lie below the frost line of the subterranean earth, the liquid medium in the lower end portions of said members being subjected to the heat of adjacent regions of the subterranean earth to thereby gasify some of said medium and cause the medium converted to the gaseous state to be evolved from the liquid medium and flow into the condensation chambers of said members, the medium in the gaseous state when in the condensation chambers of said members being subjected to the cold of the adjacent paving to thereby condense the medium in the gaseous state and be returned to and absorbed in the respective liquid mediums to heat the paving to the temperature to preclude formation of ice.

2. The method according to claim 1, wherein said medium is ammonia.

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