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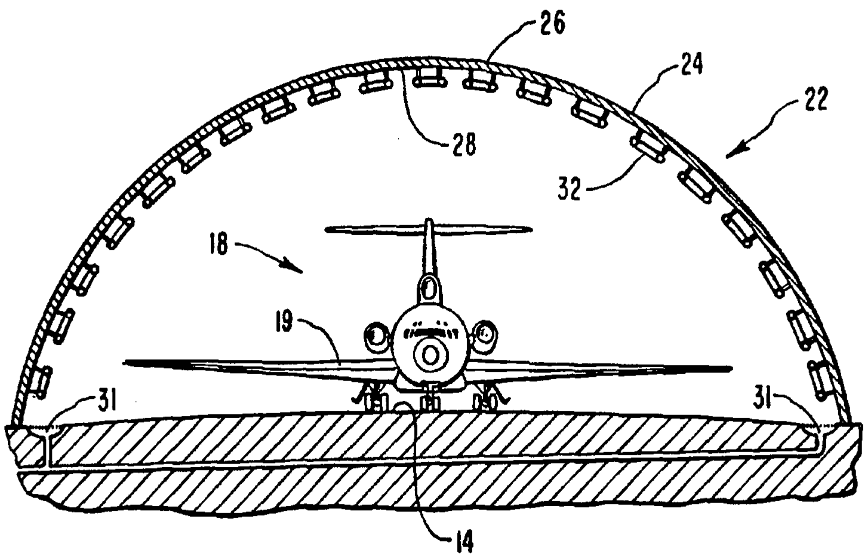

(57) Abstract

An infrared aircraft deicer (32) is defined by a means for emitting infrared light and a support structure (26) on which the means for emitting infrared (32) is attached. The means for emitting infrared light (32) includes all conventional sources of infrared light such as infrared emitters used to heat buildings. The support structure (26) is positioned about a taxiway (14) or loading area (16) and directs the infrared light onto the exterior surface (19) of an aircraft (8) having ice deposited thereon. In turn, the infrared light heats the exterior surface of the aircraft (18) to a temperature sufficient to remove the ice from the exterior surface (19). The aircraft (18) can also be heated to a temperature sufficient to prevent reicing of the aircraft (18) during the period of time between deicing and takeoff. In the preferred embodiment, the support structure (26) is a shelter that is positioned as close to the runway (12) as permitted so as to limit exposure of the aircraft (18) to ambient conditions between deicing and takeoff.

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INFRARED AIRCRAFT DEICERS POSITIONED ON A TAXIWAY

BACKGROUND

1. Field of the Invention

The present invention relates to deicing of aircraft positioned on a taxiway just prior to takeoff. More particularly, it is directed to the application of infrared "light" to aircraft for deicing the aircraft immediately prior to takeoff.

2. Background Art

Federal Aviation Regulations (FAR) prohibit the takeoff of an aircraft when snow, ice, or frost is adhering to wings, propellers, control surfaces, engine inlets, or other critical surfaces of the aircraft. These regulations are a result of the detrimental influence that foreign matter on the exterior surface of an aircraft has on the control and safety of the aircraft during takeoff and flight.

Aircraft typically have a smooth exterior surface so as to produce a smooth or laminar air flow over the exterior or aerodynamic surfaces of the aircraft during takeoff and flight. A laminar air flow minimizes drag, maximizes lift, and optimizes control of the aircraft. The adhering of frozen contaminates, such as ice, to the exterior surface of an aircraft increases the surface roughness on the aerodynamic surfaces. Increased surface roughness alters the laminate flow of air to a turbulent flow which negatively affects drag, lift, and control on the aircraft.

Ice, snow, or frost can form on the aircraft to a thickness and surface roughness similar to medium or coarse sandpaper. When so formed on the leading edge and/or upper surface of a wing it can reduce wing lift by as much as 30 percent and increase drag by 40 percent. These changes in lift and drag significantly increase stall speed, reduce controllability, and alter aircraft flight characteristics. Thicker and/or rougher frozen contaminants can have a greater negative affect on lift, drag, stall speed, stability, and control.

These adverse effects on the aerodynamic properties of an aircraft may result in sudden deviation of the aircraft from its intended flight path. This deviation may not be preceded by any indication or aerodynamic warning to the pilot. Accordingly, it is imperative that takeoff not be attempted until, as required by regulation, all critical surfaces of the aircraft are free of adhering ice, snow, or frost formations. Once the aircraft has taken off, the heated exhaust or bleed air from the engines can be circulated through ducts in the aircraft to warm the critical surfaces and prevent their reicing.

The required removal of frozen contaminants from an aircraft is referred to as the "clean aircraft concept." The common practice for obtaining a clean aircraft prior to takeoff has two steps. First, deicing is accomplished by applying heated aqueous solutions of Freezing Point Depressant (FPD) fluids to the surface of the aircraft. The theory of applying FPD fluids is to decrease the freezing point of water in its liquid or frozen state, thereby causing at least a portion of the ice to melt so that the ice slides off the aircraft. Second, if desired, anti-icing or the preventing of reicing is accomplished by applying SAE or ISO Type II fluids (hereinafter "anti-icing fluids") to the cleaned surface of the aircraft. Anti-icing fluids are effective anti-icers because of their high viscosity and pseudoplastic behavior. The anti-icing fluids are designed to remain on the wings of an aircraft during ground operations, thereby preventing the formation of ice on the surface of the aircraft.

Several different types of FPD fluids have been developed during the past 40 years and many are in common use today. Each of these various fluids has unique characteristics and handling requirements. The FPD fluids are applied to critical aircraft surfaces, *i.e.*, wings, tail section, and fuselage, through conventional spraying mechanisms. If the ice persists, or recrystallizes on the aircraft, application of FPD fluid is repeated until a clean aircraft is obtained. Although this method of deicing is functional, there are numerous problems and drawbacks associated with it.

One of the problems associated with the use of FPD and anti-icing fluids is the delay resulting from refreezing. Deicing and anti-icing fluids are typically applied to the aircraft at the terminal prior to or shortly after loading of passengers. Although the fluids are helpful in preventing the reicing of aircraft, the combination of freezing weather conditions traditionally associated with the use of the fluids, the extended period of time between the application of the fluids and takeoff, and the gravitational runoff of the fluid coating often results in reicing of the aircraft as the aircraft waits on the taxiing runway in preparation for takeoff.

As a result of this reicing, the aircraft is often required to return to the terminal where the deicing fluid is again applied to the aircraft and the process begins again. This delay of a single aircraft, however, creates a chain reaction which not only delays surrounding aircraft but also connecting flights. This delay creates a burden for both passengers and scheduling.

The actual spraying of the deicing fluids can also be detrimental to the aircraft. Although the deicing fluids should be applied to critical surfaces of the aircraft relating to lift, it is important that the deicing fluids not pool in balance bays, control cavities, and gap fields or be directly sprayed into sensor orifices and probes along the fuselage of the aircraft. The application or pooling of the deicing fluids in such areas can result in a number of problems, including for example, inaccurate reading of aircraft instruments, freezing the movement of control surfaces, and fracturing of seals. Improper spraying can also damage protruding equipment from the aircraft such as antennas. Finally, due to their high viscosity, anti-icing fluids should not be applied to areas such as pitot heads, angle-of-attack sensors, control surface cavities, cockpit windows, nose of fuselage, lower side of randome underneath nose, static ports, air inlets, and engines. The application of anti-icing fluids to such areas can obscure the vision of the pilot and produce inaccurate readings of aircraft instruments.

Even if the deicing fluid is properly applied to the aircraft, there are negative side effects resulting from the deicing fluid adhering to the aircraft. Based on wind, temperature, and elevation conditions at a runway having a defined length, all aircraft have a critical weight which they cannot exceed for the given runway. If an aircraft exceeds the critical weight, it will be unable to obtain lift-off in the limited length of runway. This concept is referred to as the "balanced field." As the deicing fluid is applied to the aircraft, the weight of the aircraft increases. To compensate for this added weight, the aircraft is required to either limit its fuel, thereby limiting the duration it can remain aloft, or limit the number of passengers it takes, thereby decreasing its profit margin. Both of these choices negatively affect the airline industry.

Furthermore, as with the existence of ice, the existence of a deicing fluid on the exterior surface of the aircraft also reduces the lift and increases the drag on the aircraft. The reduction in lift requires the aircraft to further limit its weight in order to obtain lift-off. Although many aircraft are capable of reaching speeds during takeoff which substantially remove the deicing fluid from the aircraft, other smaller aircraft are not capable of reaching such speeds. Such aircraft are required to use lighter and less effective deicing fluids, thereby increasing the risk of reicing.

The cost of deicing fluids is another serious drawback to their use. Some deicing fluids can range as high as $13.00/gallon. Deicing of the exterior surface of a conventional aircraft such as a Boeing 707, requires an average of 600 gallons. Thus, a single deicing of an aircraft can cost around $8,000.00 per flight. Of course, this price increases if the ice recrystallizes on the aircraft and the deicing fluid has to be reapplied.

Not only are deicing fluids expensive to apply, they are a potential health hazard to those who are exposed to the fluids. Commercially available FPD fluids used for aircraft deicing are ethylene, diethylene, and propylene glycol. Ethylene and diethylene glycol are moderately toxic to humans. Swallowing small amounts of ethylene and diethylene glycol may cause abdominal discomfort, pain, dizziness, and affects on the central nervous system and kidneys. Exposure to vapors or aerosols of any FPD fluid may cause transitory irritation of the eyes. Exposure to ethylene glycol vapor in a poorly ventilated area may cause nose and throat irritations, headaches, nausea, vomiting and dizziness.

Furthermore, all glycols cause some irritation upon contact with the eyes or the skin. Although the irritation is described as "negligible," chemical manufacturers recommend avoiding skin contact with FPD fluids and wearing protective clothing when performing normal deicing operations. Accordingly, not only are traditional deicing fluids dangerous to those who apply them and work around them, they are also potentially hazardous to passengers who could be exposed to vapors from the deicing fluids.

Finally, in light of the hazardous nature of the deicing fluids and the vast quantities used during deicing, the deicing fluids are difficult to dispose of once applied to the aircraft. As the deicing fluid is applied to the aircraft, most of the fluid is deposited onto the ground with the melting ice. Recycling of the fluid is an expensive process since it must be gathered, purified and again concentrated before it can be used. Disposal of the fluid requires that it be gathered and properly deposited in a hazardous toxic waste landfill. This is also an expensive and hazardous process.

What is therefore needed are apparatus and/or methods for deicing aircraft that do not require the use of FPD fluids.

What is also needed are apparatus and/or methods for deicing an aircraft so as to minimize the delay between deicing and takeoff.

Finally, what are needed are apparatus and/or methods for deicing an aircraft that are relatively inexpensive.

BRIEF SUMMARY OF THE INVENTION

In accordance with the invention as embodied and broadly described herein, apparatus for deicing an aircraft prior to takeoff are provided. The apparatus include means for emitting infrared light and means for supporting the means for emitting infrared light in order to direct the infrared light upon the aircraft. The supporting means directs the infrared light onto the exterior surface of the aircraft while the aircraft is positioned on an approach area. The infrared light heats the exterior surface of the aircraft resulting in the removal of any ice and other frozen contaminates adhering to the exterior surface.

The means for emitting the infrared light includes all conventional sources of infrared light such as infrared emitters which are used in the art of heating industrial and commercial buildings. The number and orientation of the infrared emitters to deice an aircraft in a desired time period varies dramatically on the weather conditions and type of aircraft. Accordingly, such information is not disclosed within the present invention but is readily calculatable from those skilled in the art of infrared emitters.

In the preferred embodiment, the supporting means comprises a shelter through which the aircraft passes just prior to takeoff and in which the aircraft is positioned while waiting for takeoff. The infrared light is applied to the aircraft while under the shelter. In alternative embodiments, the supporting means can include various designs and arrangements of poles that are selectively positioned for directing infrared light onto the aircraft.

In the preferred embodiment the approach area includes the taxiway. Deicing the aircraft on the taxiway limits the duration of the exposure of the aircraft to the weather prior to takeoff. In alternative embodiment, however, the approach area can constitute the loading area for the aircraft.

Furthermore, in the preferred embodiment the energy of the infrared light should be sufficient to remove ice from the portion of the exterior surface in a period of time less than fifteen minutes. The portion of the aircraft being deiced is preferably the exposed critical surfaces of the aircraft. In addition, the infrared light should be sufficient to heat the aircraft to a temperature to prevent the reicing of the aircraft prior to takeoff.

The present invention also discloses a method for deicing the aircraft prior to takeoff. The method includes the steps of positioning an aircraft on an approach area in preparation for takeoff, the aircraft having an exterior surface with ice deposited thereon. Infrared light is then applied to a portion of the exterior surface of the aircraft so as to heat the exterior surface. The exterior surface is then heated to a temperature sufficient to remove the ice from the exterior surface prior to takeoff.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the manner in which the above-recited and other advantages of the invention are obtained, a more particular description of the invention briefly described above will be rendered by reference to specific embodiments thereof which are illustrated in the appended drawings. Understanding that these drawings depict only typical embodiments of the invention and are therefore not to be considered limiting of its scope, the invention will be described with additional specificity and detail through the use of the accompanying drawings in which:

Figure 1 is a top view of the layout of an airport including a runway, taxiway, loading area, and terminal.

Figure 2 is a perspective view of the outer and interior surface of the shelter, including the attachment of infrared emitters.

Figure 3 is a end view of the shelter shown in Figure 2.

Figure 4 is a perspective view of infrared emitters attached to poles, wherein the poles are selectively positioned about the taxiway.

Figure 5 depicts infrared emitters attached to angular poles which are positioned to extend over the taxiway.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Depicted in Figure 1 is an embodiment of an airport 10 having a runway 12, an approach area 13, a taxiway 14, a loading area 16, and a terminal 17. Positioned on taxiway 14 is an aircraft 18 having an exterior surface 19. The term "exterior surface" as used in this specification and appended claims is intended to include all surfaces on aircraft 18 that are exposed to the outside environment when aircraft 18 is on the ground.

The actual layout of an airport can vary dramatically depending on factors such as the location of the airport, the size of the aircraft serviced, the number of aircraft serviced, the destination of the aircraft (national or international), and, to some extent, the artistic creativity of the designer of the airport. Often, especially in large international airports, taxiway 14 can include a maze of interconnecting pathways leading to and from a variety of runways and waiting positions. Furthermore, the path that an aircraft travels on taxiway 14 can vary depending on the weather and which direction the aircraft are landing and taking off. Accordingly, the term "taxiway" as used in this specification and appended claims is intended to include all possible pathways an aircraft is capable of traveling from loading area 16 to runway 12 in preparation for takeoff. Such pathways include all waiting positions of the aircraft and all alternate pathways leading to runway 12 which may currently exists or subsequently be created for implementation of the current invention. By way of example and not by limitation, an alternate pathway 20 is depicted in Figure 1. Furthermore, the term "loading area" as used in this specification and appended claims is intended to include those conventional areas in which aircraft are positioned during boarding and disembarking of passengers. Finally, the term "approach area" as used in the specification and appended claims is intended to include both loading area 16 and taxiway 14.

In accordance with the present invention, there is provided means for emitting infrared light and means for supporting the means for emitting infrared light. The means for emitting infrared light functions to deice exterior surface 19 of aircraft 18 and prevent the reicing thereof. The supporting means directs the infrared light onto exterior surface 19 of aircraft 18 to heat exterior surface 19.

Infrared light is invisible light that has the unique property of heating only the objects that it hits as opposed to the air through which it passes. Accordingly, infrared light heats an object directly, as opposed to conventional heaters which first heat the air and, in turn, the air heats the object. By heating the object directly, infrared emitters are capable of heating an object using minimal time, energy, and cost without impacting or contaminating the surrounding environment.

By way of example and not by limitation, the supporting means is depicted in Figure 1 as a shelter 22 positioned on alternate pathway 20. As shown in the enlarged views of Figures 2-3, shelter 22 includes a frame 24 that spans a portion of taxiway 14, frame 24 having an outer surface 26 and an interior surface 28. In the preferred embodiment, a cover 30 is attached to outer surface 26, thereby shielding aircraft 18 and the means for emitting the infrared light from the weather during the deicing process. In alternative embodiments, to decrease cost and limit obstruction, cover 30 can be eliminated.

Attached to interior surface 28 of frame 24 is the means for emitting infrared light. Various means for emitting infrared light are well known in the art of domestic and commercial heating. By way of example and not by limitation, Figure 2 depicts a conventional infrared emitting system 32. Conventional systems typically include a burner, a combustion chamber and a long series or radiant tubes through which the infrared light is emitted. Such infrared emitting systems can be purchased from Roberts-Gordon, Inc. of Buffalo, New York, and Merit Distributing of Draper, Utah. With regard to the present invention, the means for emitting infrared light are intended to include all conventional mechanisms for emitting infrared light.

The design of shelter 22 and the size and configuration of infrared emitters 32 vary dramatically depending on the geographical location of the airport and the type of aircraft the airport services. For example, higher elevation airports typically have colder temperatures which result in a much thicker buildup of ice on exterior surface 19 of an aircraft 18 then lower elevation airports, thus higher energy infrared emitters may be required to deice aircraft 18 in an acceptable time period. Furthermore, international airports that service large aircraft, such as the Boeing 747, will require a much larger shelter 22 and corresponding number of infrared emitters 32 than small airports where only smaller aircraft are permitted to land.

Since the size of shelter 22 and the arrangement and capacity of infrared emitters 32 varies depending on the location and type of airport, the size and configuration of infrared emitters 32 are not specifically disclosed herein. It is submitted, however, that the size and configuration of infrared emitters 32 needed to heat an area to a temperature sufficient to remove ice therefrom is calculatable to those skilled in the art of infrared emitters. Nevertheless, in the preferred embodiment there are a few general parameters that should be followed.

For the present invention to be functional it must be able to remove the ice from the exposed critical surfaces of the aircraft in a period of time that does not create undue delay to the aircraft. The term "remove" as used in this specification and appended claims is intended to include melting the ice completely such that it runs off the aircraft as a liquid, or melting a portion of the ice contacting exterior surface 19 of aircraft 18 such that the remaining ice falls or slides off aircraft 18. The term "ice" as used in this specification and appended claims is intended to include ice in its conventional sense along with snow, frost, sleet, hail, and all other frozen contaminates which can either adhere to or buildup on aircraft 18.

Furthermore, the term "exposed critical surface" as used in the specification and appended claims is intended to include those surfaces that an aircraft manufacturer recommends be deiced prior to takeoff. The list varies for different types of aircraft. Typically, however, the list includes the leading edges, upper surfaces, and lower surfaces of the wings; the leading edges, upper surfaces, lower surfaces, and side panels of the vertical and horizontal stabilizing devices; high-lift devices such as leading-edge slats and leading or training-edge flaps; spoilers and speed brakes; all control surfaces and control balance bays; propellers; engine inlets, particle separators, and screens; windshields and other windows necessary for visibility; antennas; fuselage; exposed instrumentation devices such as angle-of-attack vanes, pitot-static pressure probes, and static ports; fuel tank and fuel cap vents; cooling and auxiliary power unit (APU) air intakes, inlets, and exhausts; and landing gear.

In the preferred embodiment, the arrangement and energy output of the infrared emitters should be sufficient to remove the ice in a period of time less than 15 minutes. Such a period of time permits sufficient time for the previous aircraft to takeoff and be clear of airport 10 and yet not create an undue delay for subsequent aircraft. To remove the ice, the temperature of the exterior surface 19 of aircraft 18 must be raised to above freezing so as to melt at least a portion of the ice. As previously discussed, it is not necessary that the ice be completely melted to be removed. It is sufficient for removal of the ice that a thin layer of ice contacting exterior surface 19 be melted such a low friction boundary layer is created on which the ice can slide off aircraft 18. Of course, the higher the temperature of exterior surface 19, the faster the rate of removal.

The amount of energy required to raise the exterior surface 19 of aircraft 18 to a temperature above freezing depends on several factors. Such factors include the outside temperature, the material of exterior surface 19, and the thickness of the ice. The determinate of the required amount of energy needed to heat exterior surface 19 to above freezing under various conditions can be calculated by those skilled in the art of infrared emitters.

In an alternative embodiment, it is also envisioned that exterior surface 19 be heated to a temperature sufficient to prevent the reicing of the aircraft 18 prior to takeoff. This is a process known as "anti-icing." Again, the required temperature needed to prevent reicing is fact specific. Such information, however, can be determined by those skilled in the art of heat transfer.

The delivery of the infrared light should be uniform over the exposed critical surfaces or desired portions of the aircraft seeking to be deiced, thereby avoiding hot spots and insuring that all surfaces of aircraft 18 are concurrently deiced. Of course, on areas where the ice is thickest, such as on top of the wings, it may desirable to have a higher concentration of infrared light.

It is further preferred that shelter 22 be positioned as close to runway 12 on taxiway 14 as safety will permit. Such positioning limits the exposure of aircraft 18 to the ambient conditions after deicing, thereby limiting the possibility of reicing prior to takeoff. In alternative embodiments, however, shelter 22 can be positioned anywhere on taxiway 14. Furthermore, shelter 22 can be positioned at loading area 16 to deice aircraft 18 during boarding and disembarking of the passengers. Of course, any position of shelter 22 must take into consideration the hazards of airline traffic and be in conformance with all Federal Aviation Administration regulations.

Alternative embodiments of the present invention shown in Figure 1 includes an enlarged shelter 34 that has sufficient size and corresponding infrared emitters 32 to cover and expose a plurality of aircraft simultaneously to infrared light. Under this embodiment, any delay caused by deicing process is reduced. In yet another embodiment, a plurality of shelters 36 can be built either to permit aircraft 18 to be heated in stages or to produce different lines for deicing. Still another embodiment, infrared emitters 32 can be structured to be selectively positioned (raised and lowered depending on the size of aircraft 18), thereby permitting one shelter to be function for both large and small aircraft.

Further depicted in Figure 3 are drains 31 associated with taxiway 14 which collect the melted ice once it is removed from aircraft 18. To assist in collection of the melted ice, taxiway 14 is slightly crowned so as to slope towards drains 31. Infrared emitters 32 can remain on after aircraft 18 has departed so as to clean taxiway 14 from the ice removed from aircraft 18.

As revealed in Figure 4, it is also envisioned that the supporting means comprises a plurality of vertical poles 40 on which infrared emitters 32 are attached. Such an embodiment would be similar to flood lights on a baseball field. In one embodiment, infrared emitters 32 can be structured to be selectively positioned along the length of poles 40, thereby permitting infrared lights 32 to be adjusted according to the size of aircraft 18. Likewise, as shown in Figure 5, the supporting means can include angled poles 42 that can extend over taxiway 14. Infrared emitters 32 can be attached independently to angled poles 42 or can be interconnected between poles 42.

The placement and arrangements of poles 40 and 42 are the same as that of shelter 22 previously discussed. For example, the various poles and attached infrared emitters 32 can be positioned at any point along taxiway 14 or loading area 16. Furthermore, they can also be arranged to cover different sized areas with infrared light or to cover a multiple of different areas. As with the discussion of shelter 22, the size and configuration of infrared emitters 32 associated with poles 40 and 42 are not specifically disclosed herein. This is because such information is calculable and varies dramatically in the present invention depending on the location and type of airport.

The embodiments of the supporting means shown in Figures 2-5, are only by way of example and not by limitation. The supporting means includes all equivalent structures that are capable of supporting and positioning infrared emitters 32. Further examples of the support means includes all equivalent shapes and sizes of walls, frames, poles, buildings, and structures, including the use of cables, wires, and ropes. Furthermore, the present invention also envisions the support structures being moveable such as positioning the support structure on vehicles which can move the structures and attached infrared emitters to any desired location.

The present invention also discloses a method for deicing or anti-icing an aircraft. The method includes the steps of:

1. positioning the aircraft on the approach area;
2. providing means for generating or emitting infrared light; and
3. directing the infrared light to a portion of the exterior surface of the aircraft so as to heat the exterior surface of the aircraft to a temperature sufficient to remove the ice while on the approach area.

The portion the exterior surface on which the ice is removed is preferably the exposed critical surfaces but can include any desired portion or the entire exterior surface of the aircraft. The amount of energy used to deice the aircraft depends upon the climate and conditions but is calculable by those skilled in the art of infrared emitters. It is the preferred method, however, that the energy be sufficient to remove the ice in a time period of less than 15 minutes. The method of removal of the ice will require that the exterior surface of the aircraft be heated to a temperature above freezing so as to melt at least a portion of the ice. Increased temperatures may be required to remove thick plates of ice which adhere to the exposed surface of the aircraft in a reasonable time period. Furthermore, where it is thought that an aircraft might reice prior to departure, the preferred method contemplates heating the exterior surface to a temperature sufficient to prevent the formation of ice during the period of time between deicing and takeoff.

Furthermore, it is also the preferred method that the infrared light be applied uniformly upon the area to be deiced so as to insure that all areas are simultaneously deiced. However, positions where the ice is thicker may require a higher energy concentration of infrared light.

The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

What is claimed is:

1. A method for deicing an aircraft prior to takeoff, the aircraft having an exterior surface with ice deposited thereon, the method comprising the steps of:

(a) positioning the aircraft on an approach area in preparation for takeoff; and

(b) applying infrared light to a portion of the exterior surface of the positioned aircraft to heat the portion of the exterior surface to a temperature to remove the ice from the portion of the exterior surface, thereby deicing the aircraft on the approach area prior to takeoff.

2. A method as recited in claim 1, wherein the approach area comprises a taxiway.

3. A method as recited in claim 1, wherein the approach area comprises a loading area.

4. A method as recited in claim 1, wherein the step of positioning the aircraft on the approach area further includes placing the aircraft beneath a shelter positioned on the approach area, the infrared light being applied to the aircraft while the aircraft is beneath the shelter.

5. A method as recited in claim 1, wherein the infrared light is applied to the portion of the exterior surface at an energy level to remove the ice from the portion of the exterior surface in a period of time less than 15 minutes.

6. A method as recited in claim 1, wherein the temperature of the aircraft is sufficient to prevent re-icing of the aircraft prior to takeoff.

7. A method as recited in claim 1, wherein the infrared light is applied uniformly over the portion of the exterior surface of the aircraft.

8. A method as recited in claim 1, wherein the portion of the exterior surface comprises exposed critical surfaces of the aircraft.

9. A method as recited in claim 1, further comprising the step of applying the infrared light to the entire exterior surface of the aircraft.

10. A method as recited in claim 1, further comprising the step of applying the infrared light to a plurality of aircraft simultaneously.

11. A method for deicing an aircraft prior to takeoff, the aircraft having an exterior surface with ice deposited thereon, the method comprising the steps of:

(a) positioning the aircraft on a taxiway in preparation for takeoff; and

(b) providing means for emitting infrared light; and

(c) directing the infrared light to at least a portion of the exterior surface of the positioned aircraft to heat the portion of the exterior surface to a temperature to remove the ice on the portion of the exterior surface, thereby deicing the aircraft prior to takeoff.

12. A method as recited in claim 11, wherein the portion comprises exposed critical surfaces of the aircraft.

13. A method as recited in claim 11, wherein the infrared light is exposed uniformly to the portion of the exterior surface.

14. An apparatus for deicing an aircraft prior to takeoff, the aircraft having an exterior surface with ice deposited thereon, the apparatus comprising:

(a) means for emitting infrared light; and

(b) means for supporting the means for emitting infrared light to direct the infrared light onto at least a portion of the exterior surface of the aircraft while the aircraft is positioned on an approach area in preparation for takeoff, the infrared light increasing the temperature of the portion of the exterior surface to remove the ice from the portion of the exterior surface of the aircraft prior to takeoff.

15. An apparatus for deicing an aircraft as defined in claim 14, wherein the means for emitting infrared light is capable of emitting the infrared light at an energy to remove the ice from the portion of the exterior surface of the aircraft in a period of time less than 15 minutes.

16. An apparatus for deicing an aircraft as defined in claim 14, wherein the means for emitting the infrared light are configured to uniformly expose the infrared light to the portion of the exterior surface of the aircraft.

17. An apparatus for deicing an aircraft as defined in claim 14, wherein the approach area comprises the taxiway.

18. An apparatus for deicing an aircraft as defined in claim 14, wherein the approach area comprises the loading area.

19. An apparatus for deicing an aircraft as defined in claim 14, wherein the means for supporting the means for emitting infrared light comprises a covered shelter that spans a portion of the approach area.

20. An apparatus for deicing an aircraft as defined in claim 19, wherein the covered shelter is capable of housing a plurality of aircraft simultaneously.

21. An apparatus for deicing an aircraft as defined in claim 20, wherein the plurality of aircraft are simultaneously exposed to the infrared light.

22. An apparatus for deicing an aircraft as defined in claim 14, wherein the means for supporting the means for emitting the infrared light comprises plurality of poles positioned along the approach area.

23. An apparatus for deicing an aircraft as defined in claim 22, wherein the means for emitting the infrared light are selectively positioned to the poles.

24. An apparatus for deicing an aircraft as defined in claim 22, wherein the plurality of poles are structure to extend over the approach area.

25. An apparatus for deicing an aircraft as defined in claim 14, wherein the means for emitting the infrared light comprises infrared emitters.

26. An apparatus for deicing an aircraft as defined in claim 14, wherein the apparatus further comprises drains for collecting the removed ice.

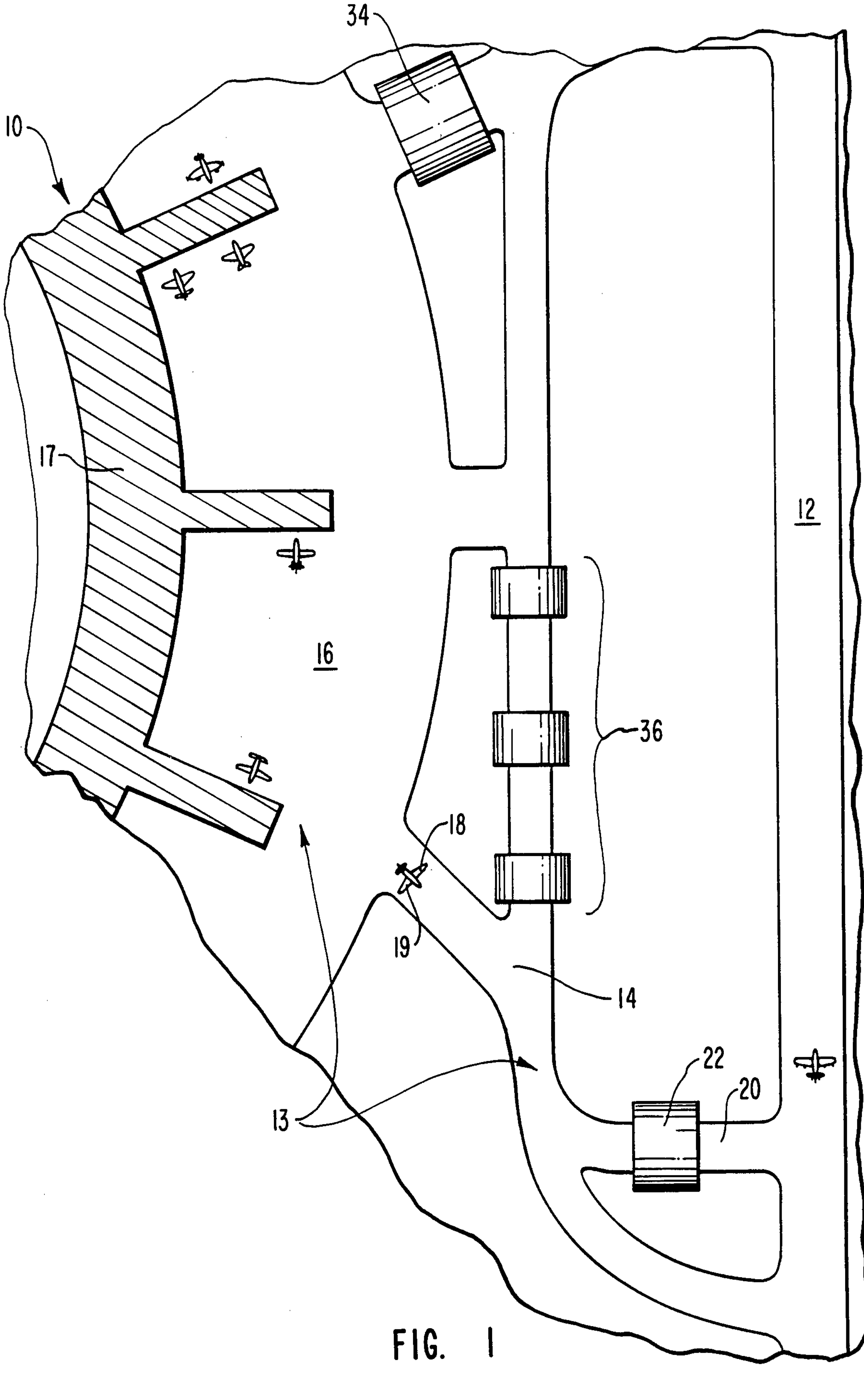

FIG. 1

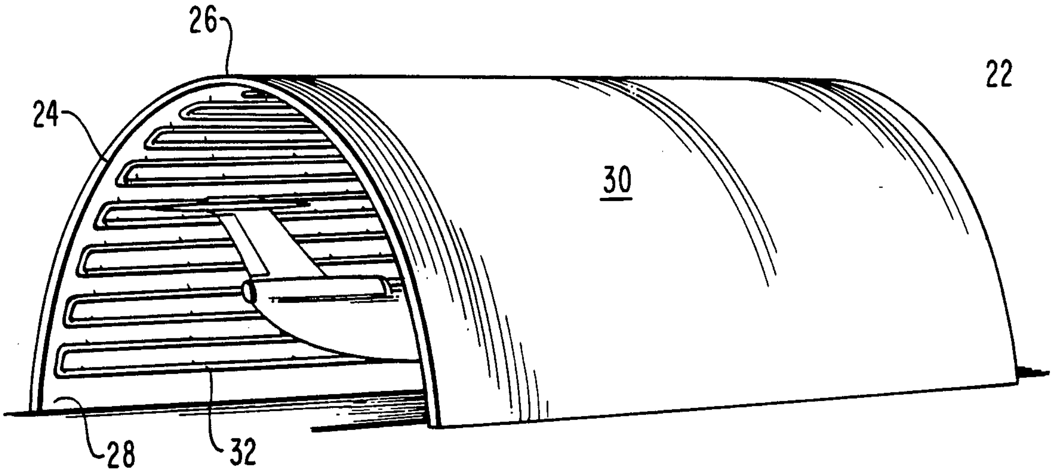

FIG. 2

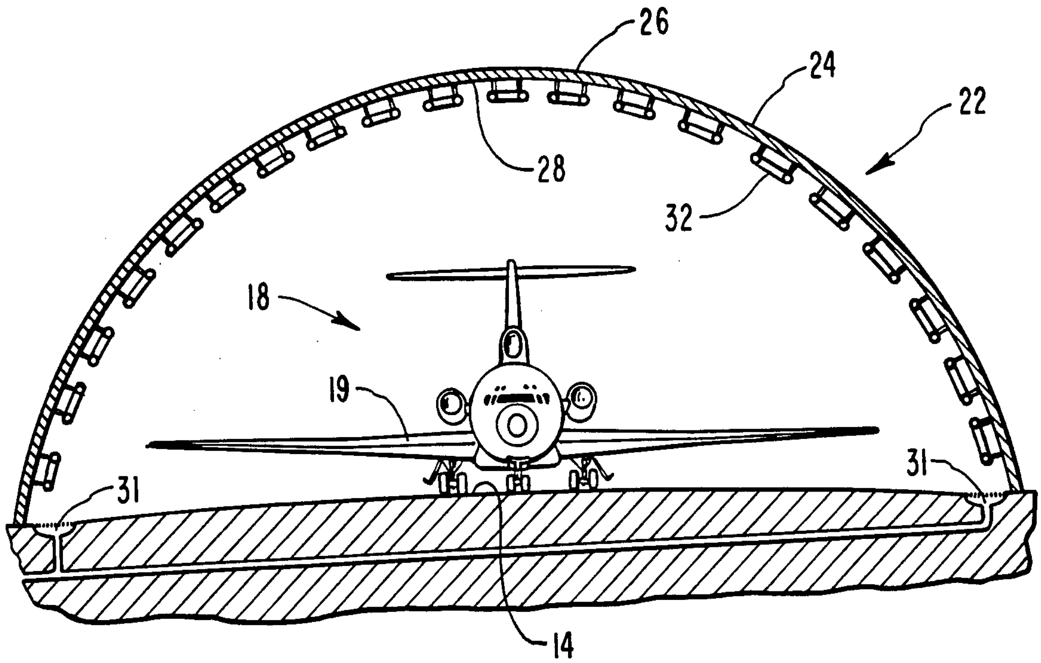

FIG. 3

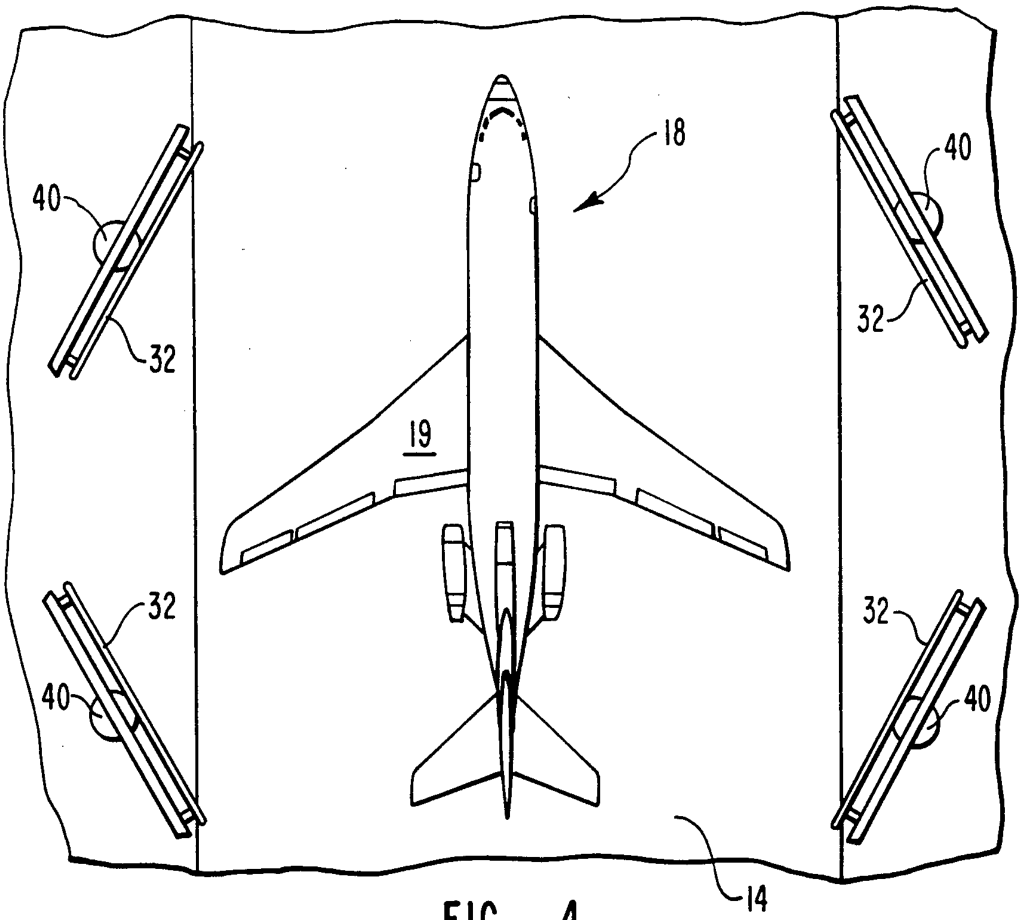

FIG. 4

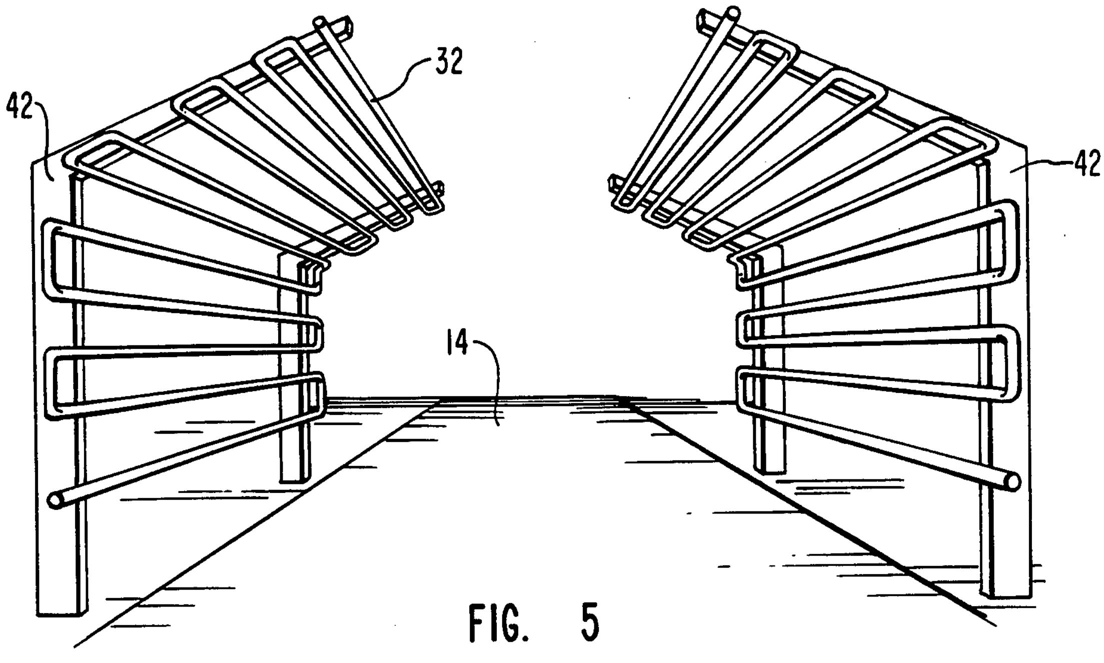

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/09201

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :B64D 15/00; B23K 26/00
US CL :244: 134R, 134D 219: 121.65, 121.66
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 244: 134R, 134D 219: 121.65, 121.66

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS INFRAFED, DEICER, DEICING, AIRCRAFT
AIRPLANE, RUNWAY, TAXIWAY

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US,A, 4,379,217 (YOUMANS) 05 April 1983 (See entire document)	NONE
A	US,A, 4,634,084, (MAGNUSSON) 06 January 1987. (See entire document)	NONE
A	US,A, 4,900,891 (VEGA ET AL.) 13 February 1990. (See entire document)	NONE
A	US,A, 4,808,824 (SINNAR) 28 February 1989. (See entire document)	NONE
A	US,A, 4,895,322 (ZIEVE) 23 January 1990. (See entire document).	NONE
A	US,A, 4,942,078 (NEWMAN ET AL) 17 July 1990 (See entire document).	NONE

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

* Special categories of cited documents:

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

20 OCTOBER 1994

Date of mailing of the international search report

27 OCT 1994

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/09201

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US,A, 5,180,122 (CHRISTIAN ET AL) 19 January 1993. (See entire document).	NONE
A	US,A, 5,318,254 (SHAW ET AL) 07 June 1994 (See entire document).	NONE
X	WO, B, 93/090028 (MANCHESTER AIRPORT PLC) 13 May 1993 (See entire document).	1-25
X	WO,B, 79/00331 (MAGNUSSON ET AL) 14 June 1979 (See page 5, lines 7-20)	1-26