ANTI-MISSILE PROTECTION DEVICE FOR AN AIRCRAFT

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ABSTRACT
This protection device (4) includes on the one hand a decoy (10) that permits sending out electromagnetic signals and on the other hand a device (8) that winds/unwinds a cable (6) at one end of which the decoy (10) is secured, with this device permitting to keep the decoy (10) in its wound position on board of the aircraft (2) and in its unwound position at a distance from the aircraft (2).
ANTI-MISSILE PROTECTION DEVICE FOR AN AIRCRAFT

[0001] This invention involves a protection device against missiles aimed at a transport airplane.

[0002] In recent years, it has been observed that an increasing number of ground-air type missile attacks against civil airplanes are taking place. A short while ago, in Mombasa (Kenya, November 2002) and in Baghdad (Iraq, November 2003), two civil airplanes were aimed at with such missiles,

[0003] Following such events and other attacks, it has been decided to study a system that would counter such threat, but adapted to civil airplanes.

[0004] At this time, there are numerous devices that permit misleading or decoying ground-air missiles, particularly in the military field. Indeed, most of the military airplanes of today are equipped with ground-air missile detection and decoy systems.

[0005] Several means of detecting a ground-air missile are known. Such a missile can be actively detected by a Doppler effect radar or passively by an optical infrared or ultraviolet base system.

[0006] Several ways are also known to decoy a missile aimed at an airplane. For instance, the plane can send out flares known to the specialist by this English name. They are pyrotechnic devices aimed at producing a very intense pinpoint light source. Another known method to decoy a missile is to transmit continuous and multidirectional infrared signals or an infrared directive transmission (using a laser technology that is called DIRCM or Directional Infrared Counter Measures).

[0007] However, all these solutions have been developed for military aircraft where constraints are totally different from those of civil airplanes. As such, the cost and the false alarm rate are incompatible constraints for civil applications. Moreover, for civil airplanes, the solution adopted must be usable in regions with a high population density. For instance, one cannot use flares above a city as it is done over more or less deserted areas. As such, most of the solutions evoked above are not directly applicable to a civil aircraft.

[0008] As such, the purpose of this invention is to provide an anti-missile protection device that is adapted for use on board a transport aircraft (for passengers or freight), such as those used in civil aviation. Preferably, this device must have a low cost price so that it can be mounted on a large number of aircraft and not only, for instance, on board those that fly into areas of the world where there is aimed conflict. Beneficially also, this device shall be able to be installed in existing aircraft.

[0009] This invention consequently proposes an anti-missile protection device for transportation aircraft, comprising:

[0010] a decoy

[0011] a winding-unwinding device for a cable at the end of which the decoy is secured, with this device permitting to maintain the decoy in its wound up position on board of the aircraft and in an unwound position at a distance of the aircraft and

[0012] a control device that manages the winding and unwinding of the cable to which the decoy is secured according to the flight stages of the aircraft.

[0013] The invention proposes as such a decoy that is not incorporated in the aircraft to which it is associated and by which it can be pulled. This decoy remains attached by a cable to the aircraft. As such, the decoy can be fully controlled and can be used under all conditions, even in highly populated areas. The fact of pulling the decoy permits having a decoy of a known type that does not require any special technical development to adapt it to a civil aircraft. Moreover, an existing airplane can be equipped with a device according to the invention without requiring a substantial modification of its systems.

[0014] Thanks to the automatic management of winding and unwinding of the cable to which the decoy is secured, the pilot of the plane does not have to control the protection device and is only responsible for piloting the aircraft.

[0015] The control device can be beneficially adapted to the speed of winding and/or unwinding the cable on the basis of at least a parameter selection from the flight parameters comprising altitude and vertical speed of the aircraft. The parameters selected for winding can be different from those selected for unwinding. As such, it is theoretically possible to avoid that the decoy does not touch the ground during the takeoff and landing stages. It can also be provided for the same purpose that the control device adapts the length of the unwound cable on the basis of flight parameters of the aircraft, for instance, at least on the basis of the aircraft's altitude.

[0016] The decoy used in this invention is for instance a device that transmits multidirectional infrared radiation. This solution appears being the most simple technically speaking and the easiest to implement. In this form of implementation, the frequency of the infrared radiation transmissions is preferably set on the transmission spectrum of the aircraft with which the device is associated to increase decoy efficiency.

[0017] For instance, such a device is placed in the aircraft in such a way that in the wound up position the decoy and the winding-unwinding device take place in a compartment located in the back of the aircraft and closed by a trap door leading to the outside of the aircraft. Other positions in the aircraft can be considered but the position proposed here permits the easiest adaptation of this device to any type of aircraft.

[0018] To limit the aerodynamic drag induced by the presence of the decoy, the latter shall preferably have a conical form.

[0019] In a device according to the invention, it is preferable to provide for a surveillance device that will notify the pilot of the aircraft of the wound or unwound condition of the cable so as to provide a warning in the event of failure of the device.

[0020] The length of the cable is for instance between 10 and 150 m, preferably between 20 and 50 m. Lengths are such that a missile can confuse hot sources of the aircraft with the decoy but are also rather large so that the explosion of the missile hitting the decoy does not seriously damage the airplane. This explosion should not affect safety and handling of the aircraft.
In a perfected form of implementation, the decoy secured at an end of the cable can also be associated with a missile detection system. In this case, the decoy comprises beneficially also a one-directional infrared transmission device so as to be able to react if a missile is detected. For the same purpose, the decoy can also include a device that permits launching flares.

This invention also involves an aircraft characterized by the fact that it includes a protection device as described above. This aircraft is for instance used for the transportation of passengers.

Details and advantages of this invention shall be revealed even better by the description below with reference to the attached drawing where:

**FIG. 1** shows an aircraft equipped with a device according to the invention;

**FIG. 2** shows schematically a device according to the invention;

**FIG. 3** is an enlarged scale cross-section according to cross-section line III-III of **FIG. 2**;

**FIG. 4** shows the back of the plane of **FIG. 1** and the device according to the invention in the external position;

**FIG. 5** shows schematically a detail of the aircraft;

**FIG. 6** illustrates schematically the transmissions of the device according to the invention, and

**FIGS. 7 to 12** show the plane of **FIG. 1** in various stages of flight to illustrate the operation of the device according to the invention.

**FIG. 1** represents schematically a plane 2 used for transporting passengers or freight. In a classic form, such a plane includes inside storage rooms or compartments for transporting the most diverse objects: luggage, containers, etc. This invention proposes the use of a part of these storage rooms to install an anti-missile protective device 4 and in particular, the part of these storage rooms located in the back of the plane. Protective device 4 represented is as such located in a rear part of these storage rooms.

Protective device 4 includes a cable 6 rolled around a cylindrical base 8. Cable 6 is connected at an end to a power supply system (not shown) and at its other end to a decoy 10. Cylindrical base 8 is secured in the rear part of the storage rooms and can turn around its main axis to control the winding or unwinding of cable 6. The rotation control of the cylindrical base 8 can be electric or pneumatic for instance. The winding/unwinding device thus obtained can be compared with a device of this type used for fire hoses.

Cable 6 includes (**FIG. 3**) a central metal core 12 that provides essentially the mechanical resistance of cable 6 as well as the peripheral power conductors 14 that assure the link between the decoy 10 and a control and management device inside the aircraft as well as the electric power supply of this decoy 10.

**FIGS. 4 and 5** show that the rear part of the storage rooms includes a trap door 16 leading to the outside of the plane. When this trap door 16 is open, decoy 10 and cable 16 can extend outside the plane (**FIG. 4**). When cable 6 is fully wound on its cylindrical base 8 and decoy 10 is inside the aircraft 2, trap door 16 can be closed.

Decoy 10 is to be dragged by the aircraft at the end of cable 6 as shown for instance on **FIG. 4**. When it is outside the aircraft, decoy 10 issues a multidirectional infrared radiation. This radiation is used to deceive a possible ground-air missile and so that the missile detection system “may confuse” its target (hot source of the engines or APU—Auxiliary Power Unit) with decoy 10. Decoy 10 can also be called the “Illuminator.” The frequency of these transmissions is adjusted to the transmission spectrum of plane 2. **FIG. 6** illustrates schematically the radiation issued by decoy 10.

Such a decoy 10 is known to the specialist in the field. It is a “classic” decoy 10 that aircraft 2 is dragging. It functions independently from the aircraft systems of aircraft 2.

Preferably, decoy 10 will have a conical form such as the one shown on the drawing. This form is selected for its aerodynamic properties. The purpose here is to have the weakest aerodynamic drag possible. Needless to say, other forms inducing preferably weaker drag can be selected here.

The length of cable 6 is sufficient so that in case of explosion of a missile hitting decoy 10, aircraft 2 is not damaged. On the other hand, cable 6 or more precisely the length of cable 6 unwound, must not be too long so that the missile detection system may confuse the hot sources of the aircraft with decoy 10. Moreover, if cable 6 is not too long, it can be extended very early after takeoff and pulled in very late at the time of landing. The length of cable 6 extending outside aircraft 2 can as such be between 20 and 50 m, preferably.

**FIGS. 7 to 12** show a possible operation of the protection device according to the invention.

On **FIG. 7**, aircraft 2 is in the taxi stage or starts to take off. Its wheels are still on the ground. Protective device 4 is in the wound up position inside aircraft 2. Cable 6 is wound up on its cylindrical base 8 and trap door 6 is closed.

During takeoff (**FIG. 8**), as soon as the wheels of the plane do not touch the ground anymore, protective device 4 is activated. Initially, trap door 16 opens fully to permit the full deployment of the mechanism. Then, cylindrical base 8 is rotated in such a way that cable 6 unwinds to release decoy 10 by letting it extend from the storage room. Decoy 10 then starts to transmit in all directions, even before cable 6 is fully unwound. The speed of unwinding cable 6 and as such the extension outside of decoy 10 is controlled (for instance according to the vertical speed of plane 2) so that decoy 10 never touches the ground which might damage it.

During the climbing phase (**FIG. 9**), cylindrical base 8 turns until cable 6 is fully unwound. Decoy 10 continues to transmit radiation up to a given predetermined altitude. Once this altitude has been reached, the infrared radiation stops and cable 6 winds until decoy 10 has been fully retracted inside plane 10. Trap door 16 closes again and plane 2 is flying normally.

Inversely, during a descending phase (**FIG. 10**), protective device 4 makes decoy 10 exit as described above in **FIGS. 8 and 9** for the takeoff phase. This exit takes place automatically as soon as a predetermined altitude is reached (which may be different from the altitude at which decoy 10...
moves back into the storage room during a climbing phase) or when reaching a predetermined distance separating aircraft 2 from the ground where it has to land.

[0044] During the landing phase (FIG. 11), protective device 4 starts to pull in decoy 10 that continues to transmit, as soon as a pre-selected altitude radio signal orders it to do so. Cable 6 then winds around its cylindrical base 8. The rewind speed of decoy 10 or the rewind speed of cable 6 is calculated by the control and management device on the basis for instance of the vertical speed so as to avoid any contact of decoy 10 with the ground and so as not to damage decoy 10 this way. Other flight parameters can be taken into account to control the retraction/extension of decoy 10 and the unwinding/winding of cable 6. The transmittal of infrared radiation only stops when trap door 16 is closed again. During landing, in other words, contact of the wheels with the ground (FIG. 12), protective device 4 is fully inside the storage room of aircraft 2.

[0045] In all its stages of flight, a display enables the pilot and also other members of the cockpit to know whether protective device 4 is in its extended or retracted position. As such, members of the cockpit are always informed of the position (wound or unwound) of the protective device. In case of breakdown of the automatic winding device, a control panel is provided to enable the pilot to retract (extend) dragged decoy 10. In case of a complete failure, a control of last resort triggered from the cockpit enables cable 6 to be cut, thus freeing the aircraft from the whole protective device 4 located outside plane 2, and thus assuring a landing without a problem.

[0046] The protective device described above offers the considerable advantage of being able to use a considerable number of already existing devices in the aeronautical field. First of all, as already indicated, the decoy used can be a classic decoy. The originality here consists of dragging it. The system that permits this dragging can be derived by a system already known and used for in-flight re-fueling of planes. It is also known on test aircraft to conduct static pressure measurements using a dragged device. The protective device thus obtained can this way be of a relatively cheap cost price.

[0047] Moreover, the device described above is considered as automatic, to the extent that no action of the pilots is required to meet its proper operation. The only thing that the pilots have to do is to check (through light indicators for instance) whether the device is operating properly.

[0048] The device according to the invention also offers the advantage of being able to be installed in aircraft already built because it is independent from aircraft systems and as such does not require any substantial modification of these systems.

[0049] Variants of the protective device described above can also be considered. As such, decoy 10 is scheduled to transmit multidirectional infrared radiation. An extension of operation can be considered. This decoy 10 can also include a detection system for instance. The latter includes for instance a Doppler effect radar or conducts infrared and/or ultraviolet detection. Once such a detection device is installed, decoy 10 can then be coupled to a decoy system by pyrotechnical flares or by infrared one-directional transmission, for instance of the DIRCM type. This extension permits the triggering of the transmittal (flares or infrared) only in case of detection of a ground-air missile.

[0050] Numerous variants can be considered in combination with detection systems and various decoy systems. One can foresee a detection system with a one-directional radiation system complementing a multidirectional radiation system or else, one or the other of such systems. In all cases, the device according to the invention can be considered as being an independent system. As such, its operation on all aircraft programs is large simplified.

[0051] This invention is not limited to the forms of implementation and their variants described above as non-limiting examples. It also involves implementation variants within the reach of the specialist in the field within the framework of the following claims.

1. Anti-missile protection device (4) for transportation aircraft (2) comprising

   - a decoy (10)
   - a winding/unwinding device (8) for a cable (6) at one end to which is secured decoy (10), with this device permitting to maintain decoy (10) in its wound up position inside the aircraft (2) and in its unwound position at a distance from the aircraft (2) and
   - a control device that manages the winding and unwinding of cable (6) to which decoy (10) is attached according to the flight stages of the aircraft (2).

2. Device according to claim 1, characterized by the fact that the control device adapts the unwinding speed of cable (6) on the basis of at least a parameter selected from all of the flight parameters comprising altitude and vertical speed of the aircraft (2).

3. Device according to one of claims 1 or 2 characterized by the fact that the control device adapts the winding speed of cable (6) according to at least one parameter selected from all flight parameters comprising altitude and vertical speed of the aircraft (2).

4. Device according to one of claims 1 to 3, characterized by the fact that the control device adapts the length of unwound cable (6) according to the flight parameters of the aircraft (2).

5. Device according to claim 4 characterized by the fact that the control device adapts the length of unwound cable (6) according at least to the altitude of the aircraft (2).

6. Device according to one of claims 1 to 5, characterized by the fact that decoy (10) is a device that transmits multidirectional infrared radiation.

7. Device according to claim 6, characterized by the fact that the frequency of the infrared radiation transmittal is set to the transmittal spectrum of the aircraft (2) with which the device (4) is associated.

8. Device according to one of claims 1 to 7, characterized by the fact that in the wound position of the decoy (10) and the winding/unwinding (8) take place in a compartment located in the back of the plane (2) and closed by a trap door (16) leading to the outside of the airplane (2).

9. Device according to one of claims 1 to 8, characterized by the fact that the decoy (10) has a conical form.

10. Device according to one of claims 1 to 9, characterized by the fact that it also includes a surveillance device informing the pilot of the aircraft (2) of the wound or unwound status of the cable (6).
11. Device according to one of claims 1 to 10, characterized by the fact that the length of the cable (6) is between 10 and 150 m, preferably between 20 and 50 m.

12. Device according to one of claims 1 to 11, characterized by the fact that the decoy (10) secured to an end of cable (6) is associated with a missile detection system.

13. Device according to claim 12, characterized by the fact that the decoy (10) includes an infrared one-directional transmission device.

14. Device according to one of claims 12 or 13 characterized by the fact that the decoy (10) includes a device permitting the launching of light flares.

15. Aircraft (2) characterized by the fact that it includes a protection device according to one of claims 1 to 14.

16. Aircraft (2) according to claim 15, characterized by the fact that it is aimed at the transportation of passengers.

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