Sept. 29, 1964 S. E. LAGER 3,150,848

METHOD OF DECOYING A MISSILE FROM ITS INTENDED TARGET

Filed June 28, 1961

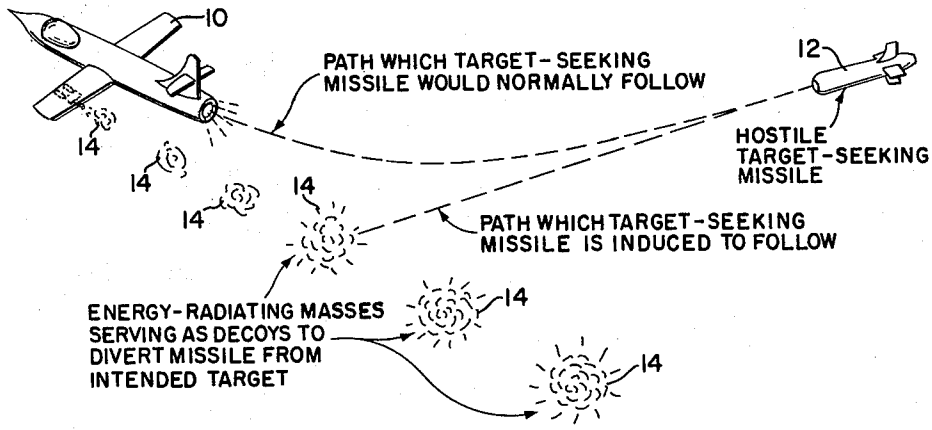

Fig. 1

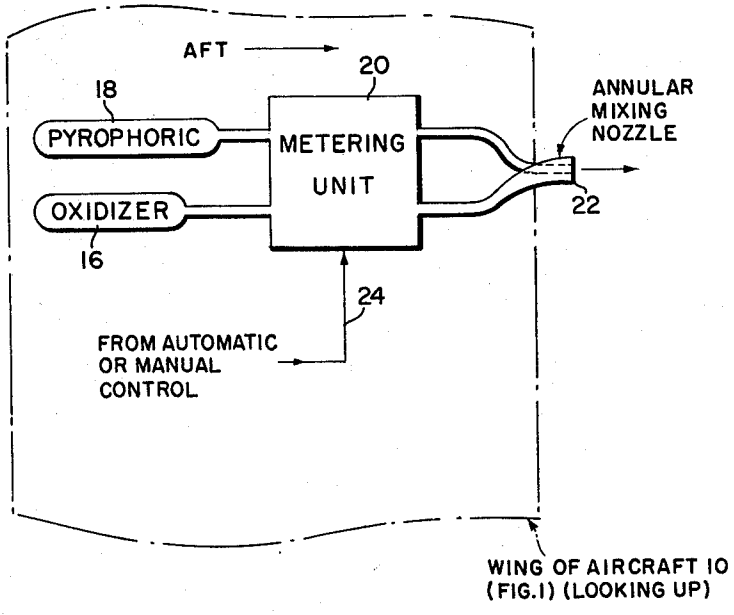

Fig. 2

INVENTOR.
SAMUEL E. LAGER

BY Howard J. Murray AGENT
George J. Rubens ATTORNEY

United States Patent Office 3,150,848 Patented Sept. 29, 1964

3,150,848

METHOD OF DECOYING A MISSILE FROM ITS INTENDED TARGET

Samuel E. Lager, Somis, Calif., assignor to the United States of America as represented by the Secretary of the Navy

Filed June 28, 1961, Ser. No. 122,054
6 Claims. (Cl. 244—14)
(Granted under Title 35, U.S. Code (1952), sec. 266)

The present invention relates to countermeasures. More specifically, it relates to a method of decoying a hostile missile of the infrared-"seeker" type away from an aircraft or other moving target onto which the missile is "homing" and which it would normally impact to result in the target's destruction.

A number of missiles are presently designed to incorporate means which enables them to "seek out" a particular moving target by "homing-in" on the infrared energy emitted by the latter. It is not usually possible for the target to evade such a "seeker" missile, since the latter is capable of following the target regardless of any changes in the latter's trajectory which may be instituted in an attempt to avoid being impacted by the missile. At the present time, therefore, missiles of this type are extremely effective against targets such as jet aircraft which emit a relatively high amount of infrared radiation from their propulsion systems.

The basic principle underlying the present invention is the creation of a number of spurious sources of radiation in the general vicinity of the target, each of these spurious sources being capable of emitting infrared energy comparable in wave length and intensity to that emitted by the target itself, so that a hostile missile will be decoyed by such spurious radiation sources and will seek out one of the latter to consequently lessen the peril to the intended target.

It has been discovered that spurious radiation sources of the nature above mentioned may be produced by periodically dispensing from the moving target (such as a bomber or fighter aircraft) imperiled by such a hostile missile discrete quanta of a cohesive substance capable of igniting spontaneously substantially a predetermined period of time following the dispensing thereof, such ignition resulting in the emission of radiant energy having a wave length generally corresponding to that of the radiation emitted by the imperiled target. In one embodiment, this substance emitted in discrete quanta is in the form of an aerogel or gelatinous mass composed of a mixture of a pyrophoric and an oxidizer together with a suitable inhibiter (vapor depressant) such as a polyglycol. Following ignition, each quanta will radiate energy of a character to which particular detection apparatus of the homing-type missile is sensitive, these detectors being, in most instances, of the lead sulphide, telluride, selenide or indium stibnide type incorporating "cut-in" germanium filters. For maximum effectiveness, the wave length region which the present invention is intended to embrace lies essentially between 1.8 and 2.8 microns.

Consequently, the basic principle underlying the present concept is the emission from a moving target of discrete quanta of a substance which forms a series of "puffs" of gray-body aerosol mass, these "puffs" being spaced apart from one another and extending behind the moving target for a distance which depends on the capacity of the dispensing system, a practicable figure being from 5 to 20 miles. Such dispensed masses are composed of a material which ignites and burns (preferably with a nonluminous

flame) to form a series of spurious energy-emitting targets of the present concept in the presence of a suitable inhibitor which delays the ignition time, so that radiant energy emission will not occur in the immediate vicinity of the target. Consequently, a hostile missile will be decoyed to a spot considerably removed spatially from the target to materially reduce the danger to the target itself.

One object of the present invention, therefore, is to provide a method for decoying missiles of the infrared homing type away from a moving target.

Another object of the invention is to create a series of spurious targets which will decoy a hostile missile away from an intended objective such as a bomber or fighter aircraft, these spurious targets being formed of material dispensed from the aircraft either automatically or under the control of the aircraft pilot.

Another object of the present invention is to provide for the combining of a pyrophoric and an oxidizer to form a gray-body aerogel having a high infrared emission factor following the ignition thereof. The charred mass will ideally behave similarly to a black-body radiator, but in practice will only approach this optimum level.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same become better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 is a pictorial representation of one manner in which the method of the present invention may be employed to create spurious targets serving to decoy a hostile "seeker" missile away from an actual target and thereby lessen the peril to the latter; and

FIG. 2 is a largely schematic showing of one form of mixing apparatus intended to be carried on the target of FIG. 1 and from which the particular ignitable substance of the present invention is dispensed.

Referring now to FIG. 1 of the drawings, there is designated by the reference numeral **10** an airborne vehicle such as a bomber or fighter aircraft. This aircraft is powered by a jet engine or other propulsion system the exhaust of which contains a detectable percentage of infrared radiation. Also shown in FIG. 1 is a missile **12** of the target-seeking type which has been launched for the purpose of destroying the aircraft **10** either by impact or by exploding when it has reached a position proximate thereto. Missile **12** consequently incorporates an infrared detector and associated guidance system (not shown) which permits the missile to locate and follow the aircraft **10** by intercepting radiant energy emanating from the aircraft's propulsion system. Under normal circumstances, it is extremely unlikely that the aircraft **10** can take any evasive action which will enable it to avoid being destroyed by the missile **12**, since the missile's trajectory is caused to change as a direct result of any change in the direction of aircraft flight.

In accordance with a feature of the present invention, it is contemplated that the aircraft **10**, when imperiled, will emit or dispense at periodic intervals a discrete mass or quantum of substance in the general form of a "puff" or ball. Several of these masses are designated in FIG. 1 of the drawings by the reference numeral **14**, although it will be understood that the relative size and spacing of these emitted quanta are distorted in the drawings in order that the invention may be more readily understood. Although the configuration of each mass may vary widely while still yielding the effect desired, it might be mentioned, purely as an example, that each ball or "puff" **14** may have a diameter of approximately 2 to 3 feet and be of either spherical or toroidal shape. These masses **14** are emitted from an apparatus carried by the aircraft **10**, the location of which apparatus is shown generally in FIG. 1 and illustrated in greater detail in FIG. 2, where

it is indicated as being attached to, and carried in or by, one wing of the aircraft **10**.

FIG. 2 sets forth one type of apparatus for dispensing the aerogel of which the energy-radiating masses **14** of FIG. 1 may be constituted. This apparatus includes two cylinders **16** and **18** respectively containing an oxidizing agent and a pyrophoric, the latter being selected from a group which includes, among others, the alkyl and aryl amines, hydrazine hydrate, the metallo-organics (tributylethyl, etc.) and aniline. These cylinders **16** and **18** are arranged so that the respective contents thereof are fed through a metering unit **20** which faces aft of the aircraft **10**. The members **16**, **18** and **20** are supported on or by one wing of aircraft **10**, and preferably positioned within the wing or on the under surface thereof so as to lie in a zone of minimum air turbulence.

Metering unit **20** may include conventional fluid valves which are opened either electrically or mechanically in periodic fashion such, for example, as by electrical impulses applied to the metering unit **20** over a conductor **24** from a standard impulse generator (not shown). Since the mixing nozzle **22** is illustrated as being of annular configuration, the emitted substance in this embodiment takes the form of a toroid, desirable in that it has a relatively large surface area. As will later appear, the radiating surface of each of the masses **14** is largely determinative of the efficiency or energy level which is reached following ignition thereof. The higher this energy level, the greater the chance that the hostile missile **12** will seek out such a spurious target instead of homing-in on the aircraft **10** from which the substance constituting such spurious target had been emitted.

In carrying out the method of the present invention, the oxidizer from cylinder **16** is mixed in stoichiometric proportions with the pyrophoric from cylinder **18**. After these substances have been individually metered through the unit **20**, the actual combining thereof occurs in the nozzle **22**, at which point they are released into the air stream. If desired, the respective chemicals may be brought to the nozzle **22** by means of one or more pumps (not shown) rather than by having them contained as illustrated in pressurized cylinders.

Following emission from the nozzle, each "puff" or ball of aerogel will be a semisolid material possessing the characteristics of a colloidal solution of a gaseous phase in a solid phase. An ignition inhibitor (vapor depressant) is present to ensure that no radiation will occur from the emitted mass until a preselected period of time has elasped following the dispensing thereof. At the expiration of such time period, however, ignition occurs, and the mass reaches an absolute temperature such that the energy radiated therefrom simulates the infrared energy emitted from the aircraft **10**. In other words, each of the masses **14** following ignition becomes an isotropic radiator, producing a flux of sufficient wattage per steradian to reach the detector of the guidance system incorporated in the hostile missile **12**, assuming that the missile lies within a range where it constitutes a hazard to the aircraft.

As the flame temperature of each mass **14** should be as high as possible to achieve a wave length which approaches that of visible light, it may be desirable to employ a submicron mesh of aluminum (or beryllium) in the pyrophoric contained in the cylinder **18** of FIG. 2. This can yield an absolute temperature of 1173° K., which is required for the particular wave band of 2.1 to 2.4 microns over which the missile detector is customarily designed to operate.

Since it is desired to produce an extremely high combustion temperature as well as a nonluminous flame following ignition of each of the masses **14**, other ultrafine metallic substances may be substituted for aluminum in the pyrophoric **18**. These alternative chemical additives include magnesium, amorphous boron, and certain organometallics such as lithium and aluminum borohydride and aluminum trimethyl. It may also be desirable to include

in the pyrophoric contained in cylinder **18** a wetting agent and/or a suitable emulsifier in order to form an aerogel of the desired density and having optimum ignition characteristics.

It has been mentioned that the radiation level reached by each of the masses **14** of FIG. 1 is a direct function of the surface area of that mass. This is brought out by the following equation:

$$W = e\sigma T^4$$

$$= \frac{0.95\,(5.7)\,(10)^{-12}\ \text{watts}\ (1173^\circ\ K.)^4}{\text{cm.}^2\ \text{deg.}^4}$$

$$= 10.4\ \text{watts/cm.}^2$$

where W designates the energy emitted in watts per square centimeter of surface area of the mass, e is the emissivity factor, and σ is Boltzman's constant.

Since a high emissivity factor is desired, black-body radiation can be closely approximated by incorporating some such pigment as platinum black, graphite or a ceramo-metallic substance in the pyrophoric material contained in cylinder **18**. Furthermore, at extremely high altitudes, the oxidizer in cylinder **16** may be of a particular type such as perchloryl fluoride, chlorine trifluoride or hydrogen peroxide. However, the choice of oxidant used is governed at least in part by the characteristics of the pyrophoric with which it is to be combined.

It will now be appreciated that Wien's Displacement Law governs the particular portion of the spectrum over which energy is radiated by the spurious targets created by following the teaching of the present concept. In other words, the wave length of the energy radiated from each such spurious source is inversely proportional to the absolute temperature reached by such source following the spontaneous ignition thereof.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

I claim:

1. The method of decoying a missile of the "homing" type away from a moving target toward which it has been launched with the intention of destroying such target, the latter being propelled by means which radiates energy as a characteristic of its operation, said method comprising emitting from said moving target a cohesive substance in the form of an aerogel which commences upon the expiration of approximately a preselected period of time following the emission thereof to radiate energy simulating insofar as the "homing" missile is concerned the energy radiated by said target, thereby in effect creating a decoy to draw said missile away from said moving target and minimize the possibility of the latter being destroyed by the missile.

2. The method of claim 1 in which said substance is emitted only at periodic intervals to form a series of spaced-apart cohesive masses extending rearwardly from said moving target.

3. The method of claim 2 in which each of said cohesive masses possesses the general configuration of a toroid.

4. The method of claim 2 in which said aerogel includes a pyrophoric, an oxidizer and an inhibitor, the latter determining the duration of the said preselected period of time during which radiation of energy by said substance is delayed following the emission thereof from said moving target.

5. The method of decoying a hostile missile of the I-R "homing" type away from a jet aircraft imperiled thereby, said method comprising dispensing from said aircraft at recurring intervals discrete quanta of an aerogel capable of igniting spontaneously substantially a predetermined period of time following the dispensing thereof to thus create spurious sources of radiation having a wave length comparable to that of the radiation emitted by said imperiled aircraft, as a result of which said missile

may be decoyed to seek out one of such spurious sources of radiation and thereby minimize the peril to said aircraft.

6. The method of claim 5 in which the wave length of the energy radiated from each spurious source is an inverse function of the absolute temperature reached by such source following the spontaneous ignition thereof.

References Cited in the file of this patent

UNITED STATES PATENTS

2,851,652	Dicke	Sept. 9, 1958
2,871,344	Busignies	Jan. 27, 1959
2,933,311	Pittinger et al.	Apr. 19, 1960