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(54) **Missile defence method**

(57) In an anti-missile system for interception and destruction of attacking missiles, especially armour piercing missiles, using a Doppler-Lidar System at the point to be defended, first an attack missile is located and tracked by the beam, and second an anti-missile missile is guided along the beam to intercept and destroy the attack missile.

Fig.1

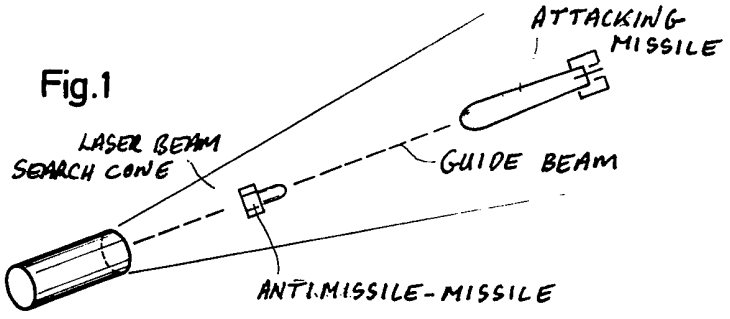

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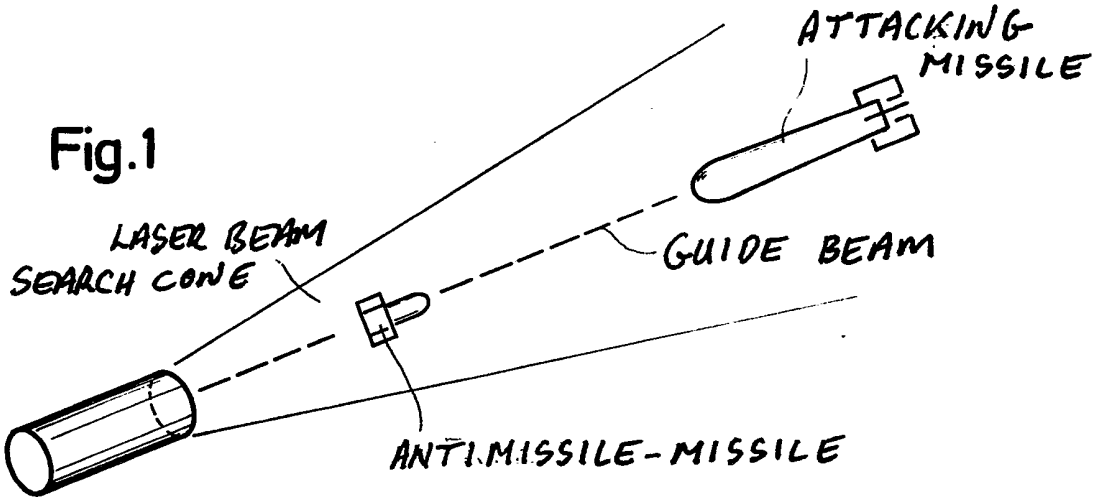
Fig.1



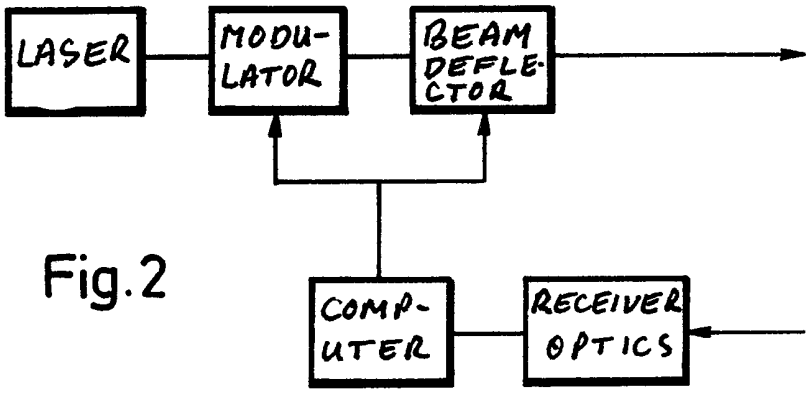


Fig.2

SPECIFICATION

Method of defending against missiles

This invention relates to a method for detecting, tracking and combating attacking missiles or projectiles using a Doppler-Lidar system and with an anti-missile missile.

Present arrangements for defence provide inadequate protection of positions and vehicles against attack from ballistic or guided missiles. The difficulty is the early detection and identification of a comparatively small missile or projectile over sufficient range to enable counter-measures to be taken. In this connection defence against intercontinental missiles involves considerable expense, largely due to the long-range radar installations required.

Hitherto no active method is known by which a tank, for example, can be defended against missiles of a ballistic or guided type, because the projectiles are mainly fired from a short range so that there is little time to detect same. Radar systems do not make it possible to obtain the necessary short detection times which would enable effective defence measures to be taken before the missile encounters its target. Furthermore, there are no suitable guiding methods which enable missiles to be combated by another missile.

This invention seeks to overcome these disadvantages and to provide a method for combating missiles before they reach the target.

According to this invention there is provided a method for detecting, tracking and combating an attacking missile or projectile using a Doppler-Lidar system and an anti-missile missile, wherein the attacking missile is detected and tracked by a Doppler-Lidar system of which the target tracking laser beam forms also a guidance beam for an anti-missile missile launched to intercept and combat the attacking missile.

The invention is further described with reference to the accompanying drawings showing an embodiment by way of illustrative example, in the drawings:-

Figure 1 shows a schematic diagram of a defence arrangement, and

Figure 2 shows a block diagram of the structure of the defence control means schematically.

Referring to the drawings the laser beam, preferably a CO_2 wave guide laser, scans the conical angle from which attack is threatened. Any approaching projectile or missile is detected where the approach velocity exceeds a certain preselected value, that is a value at which the Doppler frequency displacement of the reflected signal is greater than a preselected value. This seeking phase can also be initiated by a passive heat profile target seeking apparatus. In addition, the distance from the target is also determined, in a manner known using a Lidar system with the value being automatically ascertained by a computer. This indicates whether the projectile presents a threat.

As the Doppler displace $\triangle$ f a Lidar system is very high, being about 60 MHz in the case of an approach velocity of 300 m/s, the measuring time $1/\triangle$ f, the minimum over which the laser beam must remain at a particular scanned solid angle element, is also very short. This makes it possible for the whole of the relevant solid angle range to be scanned in a period of time less than the time during which the attacking missile is travelling. At the same time the high Doppler displacement provides sufficient identification of the target due to the fact that only enemy missiles are approaching at a maximum speed.

After location or detection of a target recognized as a threat, the Lidar system is switched over, in a known manner to a target tracking mode and as soon as the attacking missile has penetrated the zone of action of the defence weapon selected for use. The narrowed laser beam now follows the approaching missile. For this purpose the laser beam can be made up as is known of three or four partly overlapping lobes, differing from one another in frequency, modulation or polarization of radiation. The tracking or sighting axis is then determined, for instance, by those points in the cross section of the beam at which the respective lobes have equal radiation intensity.

The method of the invention provides that the target tracking beam is to be used as a guide beam for the anti-missile missile to be launched, the missile having already been aligned to the target tracking direction before launch. In this method and in accordance with the measured distance and the target approach velocity, the launching operation is carried out only when the anti-missile missile does not have to cover long paths, that is a few decametres, up to 100 m. This also prevents the attacking missile from performing any appreciable transverse movements and thereby has a favourable effect on the accuracy of the sight line guiding method.

In cases where the attacking missile is performing considerable manoeuvring movements the laser beam additionally enables information concerning the said movements to be transmitted to the anti-missile missile, which then holds in accordance with the information. For the reception of the guide beam and the further transmission the anti-missile missile has a suitable sensor system. Means to keep the missile on the sight line are provided on the missile and these may comprise aerodynamic control surfaces or reaction devices.

To ensure high probability of hit the invention provides that the anti-missile missile is to have a large geometric cross section to improve target interception. It may also be of advantage if the missile is provided with a mechanical device for triggering the detonator of the attack instead of an explosive charge of its own.

The method suggested offers a number of advantages. One of these being the fact that due to the shortness of the required flight path or range the propulsive mass in the anti-missile missile can be kept small, thus enabling a greater amount of explosive charge and a greater number of missiles to be provided. Due to the brief period of time of action of the anti-missile missile a number of such operations can be carried in a very short period, so that a number of attacking missiles can be combated

almost simultaneously. By using more than one laser beam the system can be designed for simultaneous defence against more than one attacking projectile. A further arrangement of the invention provides that in the event of simultaneous attack from a number of missiles the laser beam will simultaneously control a number of anti-missile missiles using a time multiplex process, that is the beam will move to and fro between different directions of attack, in accordance with a timed programme.

The invention also provides that in the target tracking operation the control point includes a distance gate associated with the attacking missile and used so that the Doppler signal from the target can be distinguished from erroneous or extraneous signals which may be caused, for example, by the propulsive gases expelled by the anti-missile missile, which gases have a velocity component in the direction of the laser. In one advantageous embodiment the laser system is situated as centrally as possible on the object to be protected, for example on the turret of a tank, so that any appreciable parallax and corresponding high transverse accelerations for the anti-missile missile can be avoided.

The method has the particular advantage that with the highly concentrated laser beam of a very high frequency extremely small targets can be detected very rapidly, even before reaching the ground base, and these can be measured at such a high speed and with such complete accuracy that very short range is sufficient for the defence missile. The defence can thus be provided by small and inexpensive missiles. A further factor is that the method can be operated automatically and without human intervention.

Figure 2 shows the arrangement of a guidance system.

CLAIMS

1. Method for detecting, tracking and combating an attacking missile or projectile using a Doppler-Lidar system and an anti-missile missile, wherein the attacking missile is detected and tracked by a Doppler-Lidar system of which the target tracking laser beam forms also a guidance beam for an anti-missile missile launched to intercept and combat the attacking missile.

2. Method in accordance with Claim 1, wherein the anti-missile missile has a proximity fuse and a sensor through which an explosive charge is detonated in the immediate vicinity of the attacking missile during an intercepting pass.

3. Method in accordance with Claim 1 or 2, wherein the Doppler-Lidar system includes a CO_2 wave guide laser.

4. Method in accordance with any one of Claims 1 to 3, wherein the range of the anti-missile is between several decametres and 100 m.

5. Method in accordance with any one of Claims 1 to 4, wherein the anti-missile missile has a large geometrical cross-section.

6. Method in accordance with any one of Claims 1 to 5, wherein the anti-missile missile is provided with a distance gate for signal identification.

7. A method for combating an attacking missile substantially as herein described with reference to and as shown in the accompanying drawing.

8. Means for carrying out the method of any preceding claim.

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