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[54] **PROXIMITY FUZE**

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[52] **U.S. Cl.** .... **102/70.2 P**; 343/7 PF

[51] **Int. Cl.** **F42c 13/04**

[58] **Field of Search** .... 102/70.2, 70.2 P; 343/14, 343/7, 117, 16, 123, 113, 17

[56] **References Cited**

UNITED STATES PATENTS

1,938,742	12/1933	Demarest	102/70.2
2,412,003	12/1946	Neufeld	343/14
2,419,025	4/1947	Mercer	343/16
2,451,822	10/1948	Gudnella	343/14
2,456,666	12/1948	Agate	343/113
2,509,207	5/1950	Busignies	343/123
2,695,995	11/1954	Couchois	343/14
2,703,530	3/1955	McGee	102/70.2 G

OTHER PUBLICATIONS

"Proximity Fuzes for Artillery" by Horror Selvidge, Electronics Magazine Feb. 1946, pp. 104–109.

Hinman, Jr., et al., Research Paper RP1723, Part of Journal of Research of the National Bureau of Standards, Vol. 37, July 1946, pp. 5 and 6.

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EXEMPLARY CLAIM

1. in an ordnance ammunition missile, a proximity fuze comprising the combination of: a first proximity element having a first antenna means for directing radiation generally forwardly with respect to the direction of missile flight, a first oscillator-detector operating at a first frequency and connected to said first antenna means, said first oscillator-detector being so constructed and arranged that the reflected signal from a target received by said first antenna means combines with the signal being radiated thereby to produce a first doppler signal at the output of said first oscillator-detector, and a first amplifier connected to said first oscillator-detector for amplifying said first doppler signal; a second proximity element having a second antenna means for directing radiation generally laterally with respect to the direction of missile flight, a second oscillator-detector operating at a second frequency and connected to said second antenna means, said second oscillator-detector being so constructed and arranged that the reflected signal from a target received by said second antenna means combines with the signal being radiated thereby to produce a second doppler signal at the output of said second oscillator-detector, and a second amplifier connected to said second oscillator-detector for amplifying said second doppler signal; an amplitude comparison circuit connected to the outputs of said first and second amplifiers which produces a firing signal when said outputs attain a predetermined ratio; and a detonator connected to said amplitude comparison circuit so that if a target is in a relation to the radiation fields of the first and second antenna means such that it reflects signals which produce said predetermined ratio, said firing signal will fire said detonator.

5 Claims, 4 Drawing Figures

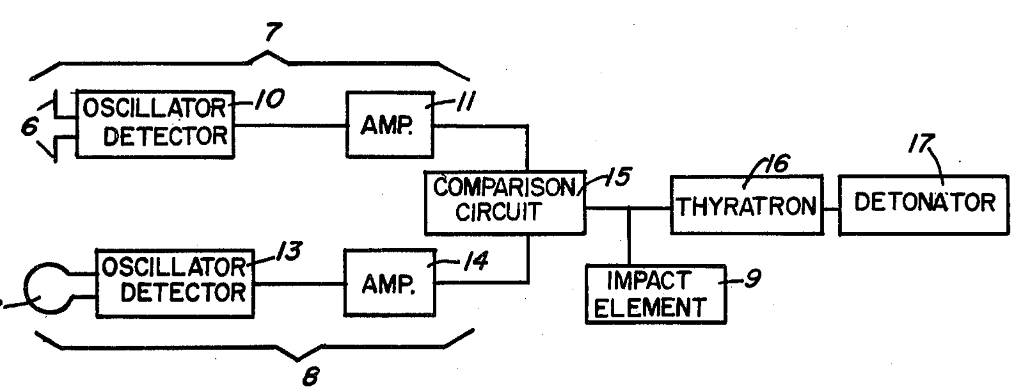


Fig. 1.

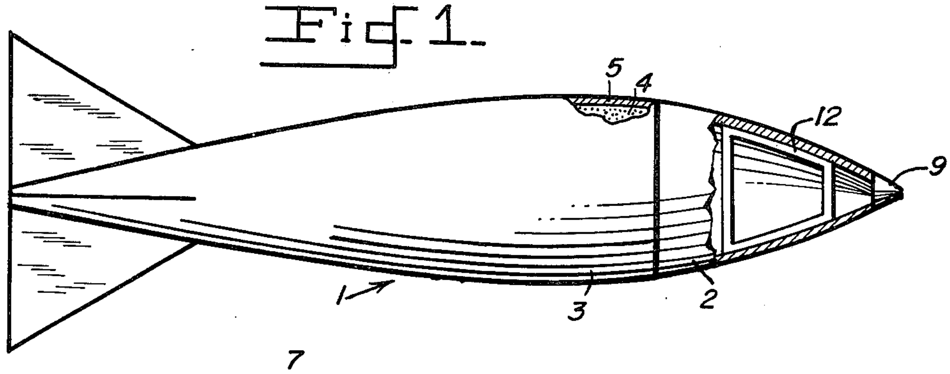


Fig. 2.

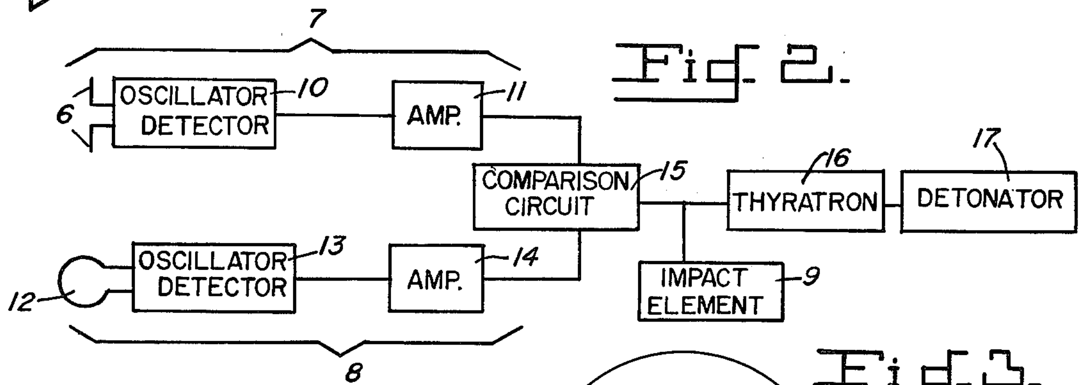


Fig. 3.

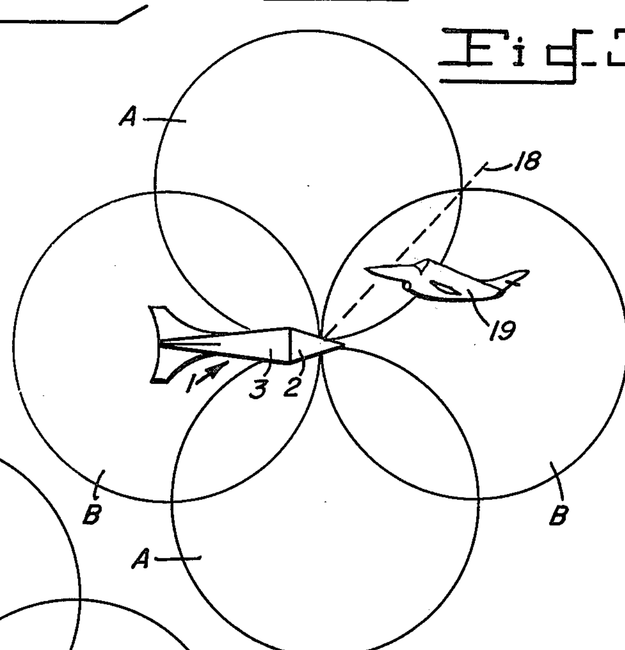
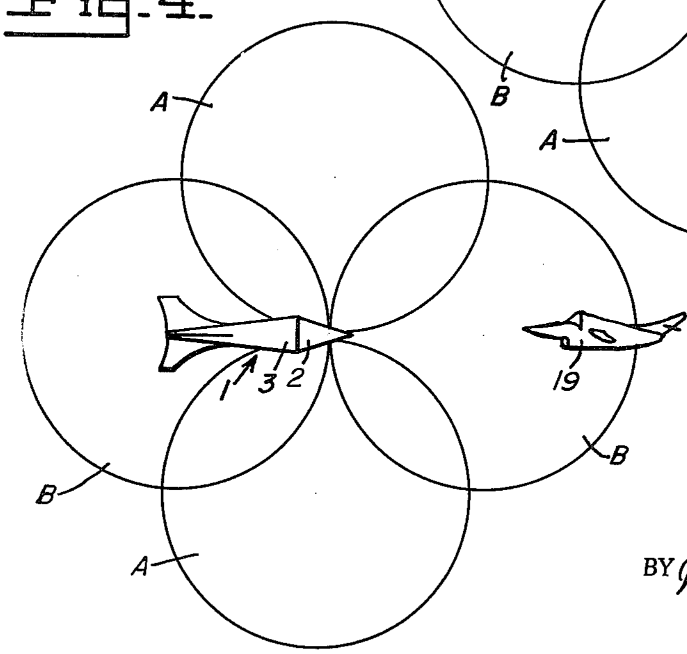


Fig. 4.



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PROXIMITY FUZE

The invention described herein may be manufactured and used by or for the Government for governmental purposes without the payment to me of any royalty thereon.

This invention relates to proximity fuzes and more particularly to a type of proximity fuze which will function only in response to a preset return signal ratio.

The effort to evolve the proximity fuze into a highly satisfactory weapon is beset with a number of apparently everpresent problems. One of these problems is the elimination of pretarget functions, that is, unwanted fuze functions which occur before the fuze bearing missile has approached within effective range of the target. Another problem is that of timing fuze function so that the fragment spray of the missile falls upon the target. An additional problem is that of desensitizing the proximity element of the fuze when the fuze bearing missile and the target are on collision courses, it being a well known fact in the fuze art that an impact function is generally more lethal than a proximity function.

Pretarget functions may be caused by characteristics of the fuze carrying missile such as by excessive vibrations or may be caused by atmospheric disturbances such as rain or snow, or may be enemy induced by one of the jamming methods well known to the electronics art. Once a pretarget function occurs, regardless of the cause, the round and its effectiveness is lost.

A doppler radio proximity fuze normally contains an oscillatordetector adapted to radiate a particular signal and to receive a portion of the radiated signal reflected from a target. The received signal combines with the signal being radiated resulting in a doppler wave, the frequency of which is a function of the frequency of the radiated signal and the relative velocities of the missile and the target. The detected doppler signal is sent through an amplifier and the output thereof impressed upon the negatively biased grid of a thyratron tube. The thyratron is triggered when the positive peaks of the amplifier output are sufficiently great to overcome the effect of the negative bias on the grid of the thyratron. The output of the thyratron is used to function the detonator of the fuze and, consequently, to set off the high explosive warhead of the missile.

With the system described above fuze function will occur whenever a target possessing the required qualities of reflectivity penetrates sufficiently deep into the radiation field of the fuze. The burst position of the missile with respect to the target cannot be closely controlled, however. In addition, the fuze can be jammed by any piece of electronic equipment which can effectively simulate the reflected signal, that is, can cause to be impressed upon the fuze detector the required power at the proper frequency.

One object of the invention, therefore, is a proximity fuze highly immune to pretarget functions.

Another object is a proximity fuze adapted to function when the target is in the shadow of the fuzebearing missile's fragment spray pattern.

A further object is a proximity fuze which is highly immune to countermeasures.

One other object is a combination proximity and impact fuze, the proximity element of which is adapted to remain paralyzed during any portion of the missile flight wherein the missile and the target are on collision courses.

The specific nature of the invention as well as other objects and advantages thereof will clearly appear from the following description and drawings wherein:

FIG. 1 is a missile containing a fuze having an antenna arrangement designed in accordance with the invention.

FIG. 2 is a schematic block diagram of the electronic circuitry of the fuze designed in accordance with the invention.

FIG. 3 is a schematic view of a target entering the influence area of the fuze radiation pattern.

FIG. 4 is a schematic view of a missile and target moving on head-on collision courses.

In FIG. 1 an ordance missile is indicated generally by numeral **1.** The missile comprises a fuze **2** and a warhead **3,** the warhead containing a high explosive charge **4** surrounded by a potentially lethal metal wall **5.** The fuze **2** contains the electronic components shown in FIG. **2.** In the prefered embodiment of the invention, the entire missile **1** acts as a dipole antenna **6,** FIG. **2,** for proximity element **7.** The fuze can be thought of as having two proximity elements **7** and **8,** and a single impact element **9.** It is the manner in which the three elements cooperate which provides the novelty of this invention. Proximity element **7** comprises antenna **6,** oscillator-detector **10,** and amplifier **11.** Proximity element **8** comprises antenna **12,** oscillator-detector **13,** and amplifier **14.** Antenna **12** is of the loop type in the preferred embodiment of the invention. It is to be understood, however, that a transverse dipole antenna could be used in lieu thereof. Both amplifiers feed into a comparison circuit **15.** The comparison circuit may be of the type wherein two voltages enter and the output is the voltage difference or, as in the preferred embodiment of the invention, the comparison circuit is of a type wherein the output voltage remains zero until the two input signals reach a predetermined intensity ratio. The comparison circuit actuates a thyratron **16** which discharges into the detonator **17.**

FIG. **3** shows a typical radiation pattern associated with this invention. Proximity element **7,** having dipole antenna **6,** displays a laterally locking radiation pattern indicated by lobes A. Proximity element **8,** having loop antenna **12,** displays a forwardly and rearwardly looking radiation pattern indicated by lobes B. The geometric intercept of the lobes is indicated by numeral **18.** Numeral **19** represents a typical target for the missile containing this invention.

Sometime after missile **1** has left the launching weapon, not shown, radiation from the antennae begins. As the missile approaches a target the foward looking radiation lobe first encounters the target, illustrated by the airplane **19** shown in FIG. **3.** The target being a radiation reflector causes some of the radiated energy to be returned to the missile where it is combined with the signal being radiated to produce a doppler wave. That wave is amplified and sent into the comparison circuit. The output of the comparison circuit is superimposed upon the grid bias of the thyratron, the thyratron normally being biased to "cut off". As the missile and target approach nearer to one another the target is seen to move into and then away from the forward lobe B. As it moves away from lobe B it enters lobe A. When the two doppler signals produced reach a predetermined intensity ratio the output from the comparison circuit is of a character adapted to overcome the thyratron grid bias so that the thyratron is triggered, the detonator is initiated, and the fuze functions the explosive warhead of the missile.

If the critical intensity ratio is unity and the power being radiated by the two proximity elements is equal, fuze function should occur when the target falls upon the geometric intercept **18** of the two radiated lobes as seen in FIG. **3.** Should one proximity element have a greater radiating capacity or sensitivity than the other, the disproportion can be compensated for by adjustment within the comparison circuit. In like manner the fuze can be caused to function either forward of or rearward of the geometric intercept by making appropriate adjustment of the comparison circuit. If it is desired to move the geometric intercept forward or rearward of the line which lies at an angle of 45° with the axis of the fuze, it is necessary only to adjust the sensitivity of the two proximity elements. It is usually desirable to have fuze function occur when the target is in the neighborhood of the geometric intercept as shown in FIG. **3.** This is so because the center line of the missile spray pattern normally makes an angle of approximately 45° with the axis of the missile. Depending upon the ratio of the missile velocity and the static fragmentation velocity of the missile warhead and also upon the shape of the warhead, the center of the fragmentation spray pattern may be at an angle less than or greater than 45° relative to the missile axis. This being the case, it may be desirable to have missile function occur when the target is forward or rearward of the 45° line. That can be accomplished in the manner described above.

Should the missile and target be moving on collision courses the bearing of the target with respect to the missile remains unchanged. Assuming the preset intensity ratio necessary to trigger the fuze to be unity, that ratio would not be realized when the missile and target are on collision courses. Proximity function would not occur and the target and missile would collide. Impact function would therefore be permitted.

The oscillator-detector **10** of proximity element **7** operates at a frequency different from the oscillator-detector **13** of proximity element **8.** This prevents interference between the two circuits and makes jamming more difficult. Jamming at one frequency will produce a signal in one proximity element only. Pretarget functioning will not occur because the preset ratio of signals to the comparison circuit or comparator **15** will not occur.

It is to be understood that the principle of functioning an ordinance fuze upon the favorable comparison of two signals could apply equally well to passive fuzes as to active fuzes. In other words, the utilized signals could originate from the ground, a mother missile, or the target itself, as well as from the weapon missile. In addition, the utilized signals need not necessarily be radio signals. They could, for example, be optical signals or accoustical signals, the frequency ranges not being limited to those receivable by the human eye or ear.

It will be apparent that the embodiments shown are only exemplary and that various modifications can be made in construction and arrangement within the scope of the invention as defined in the appended claims.

I claim:

1. In an ordnance ammunition missile, a proximity fuze comprising the combination of: a first proximity element having a first antenna means for directing radiation generally forwardly with respect to the direction of missile flight, a first oscillator-detector operating at a first frequency and connected to said first antenna means, said first oscillator-detector being so constructed and arranged that the reflected signal from a target received by said first antenna means combines with the signal being radiated thereby to produce a first doppler signal at the output of said first oscillator-detector, and a first amplifier connected to said first oscillator-detector for amplifying said first doppler signal; a second proximity element having a second antenna means for directing radiation generally laterally with respect to the direction of missile flight, a second oscillator-detector operating at a second frequency and connected to said second antenna means, said second oscillator-detector being so constructed and arranged that the reflected signal from a target received by said second antenna means combines with the signal being radiated thereby to produce a second doppler signal at the output of said second oscillator-detector, and a second amplifier connected to said second oscillator-detector for amplifying said second doppler signal; an amplitude comparison circuit connected to the outputs of said first and second amplifiers which produces a firing signal when said outputs attain a predetermined ratio; and a detonator connected to said amplitude comparison circuit so that if a target is in a relation to the radiation fields of the first and second antenna means such that it reflects signals which produce said determined ratio, said firing signal will fire said detonator.

2. The invention in accordance with claim **1** with the addition of an impact element means for functioning said detonator responsive to impact of the missile with a target.

3. In combination with an ordance missile having an explosive warhead, a proximity fuze comprising: a first proximity element having first antenna means in the nose of said missile adapted for directing radiation generally forwardly with respect to the direction of missile flight, a first oscillator-detector operating at a first frequency and connected to said first antenna means, said first oscillator-detector being so constructed and arranged that the reflected signal from a target received by said first antenna means combines with the signal being radiated thereby to produce a first doppler signal at the output of said oscillator-detector, and a first amplifier connected to said first oscillator-detector for amplifying said first doppler signal; a second proximity element having a second oscillator-detector operating at a second frequency, said missile having a body to which said second oscillator-detector is connected, said body acting as a dipole antenna directing radiation generally laterally with respect to the direction of missle flight, said second oscillator-detector being so constructed and arranged that the reflected signal from a target received by said body combines with the signal being radiated thereby to produce a second doppler signal; an amplitude comparison circuit connected to the outputs of said first and second amplifiers which produces a firing signal when said outputs attain a predetermined ratio; and a detonator connected to said amplitude comparison circuit so that if a target is in a relation to the forwardly and laterally directed radiation fields such that it reflects signals which produce said predetermined ratio, said firing signal will fire said detonator and ignite said warhead.

4. The invention in accordance with claim 3 with the addition of impact element means for functioning said detonator responsive to impact of the missile with a target.

5. The invention in accordance with claim 4 wherein said warhead is so constructed and arranged that the missile spray pattern makes an angle of approximately 45° with the missile axis, and wherein said predetermined ratio is chosen so that said detonator fires when the target is at an angle of approximately 45° with the missile axis.

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