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(54) **PROXIMITY FUSE WITH PASSIVE UNIT**

ANNÄHERUNG SZÜNDER MIT PASSIVER EINHEIT

FUSEE DE PROXIMITE A UNITE PASSIVE

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Description

[0001] The present invention relates to a proximity fuse for initiating a detonation of the effective part of a missile, comprising a passive unit having a first antenna means for receiving electromagnetic radiation within the microwave range, with a relatively narrow first antenna lobe, and a second antenna means for receiving electromagnetic radiation within the microwave range, with a second, relatively broad antenna lobe, enclosing, as to the directions thereof, the first antenna lobe, the first and second antenna lobes preferably being rotationally symmetric in the roll direction of the missile, the proximity fuse comprising electronic components and circuits for detecting a first signal from the first antenna lobe and a second signal from the second antenna lobe, and a first means for issuing a third signal for initiating a detonation of said effective part.

[0002] Active proximity fuses that issue and receive electromagnetic waves generated by the fuses are subject to the risk of being totally disturbed in the case where the target is equipped with strong jamming transmitters. The inclusion of a passive unit results, just in itself, in improved performance. However, proximity fuses existing up to now including a passive unit do not provide an entirely secure operation and can in certain cases initiate a detonation at a large distance of the target. It may also occur that escorting airplanes give false ignition pulses.

[0003] As the state of the art may be cited document US-A-3 985 080 which discloses a proximity fuse for initiating a detonation of the effective part of a missile. This prior art missile includes a passive unit comprising a first antenna means for receiving electromagnetic radiation within the microwave area having a relatively narrow, first antenna lobe, a second antenna means for receiving electromagnetic radiation within the microwave area having a second relatively broad antenna lobe, the first and second antenna lobes being rotationally symmetric in the roll direction of the missile. Said prior art proximity fuse further comprising components and circuits for detecting a first signal from the first antenna means and a second signal from the second antenna means and means for issuing a third signal for initiating a detonation of said effective part.

[0004] The object of the present invention is to provide a proximity fuse of the kind mentioned in the beginning, providing a secure operation also in the case where the target or escorting airplanes issue more or less strong interfering signals.

[0005] According to the invention such a proximity fuse is primarily characterized in that the proximity fuse is arranged to issue the third signal in the case where the following conditions are simultaneously fulfilled, i.e. that both the quotient of the amplitude of the first signal and the amplitude of the second signal exceeds a first value determined in advance and that the time derivative of said quotient exceeds a second value determined

in advance.

[0006] In a preferred embodiment of this proximity fuse according to the invention it is arranged to emit the third signal in the case where in addition the amplitude of the first signal exceeds a third value determined in advance.

[0007] Actually, it can be possible to use a proximity fuse including only a passive unit but often a proximity fuse is preferred that also comprises an active unit having a first transmitter for issuing modulated electromagnetic radiation within the microwave range and a first receiver for receiving the portion of this radiation that is reflected from a target, the radiation being issued and received by a third antenna means within a relatively narrow, third antenna lobe which is a preferably rotationally symmetric in the roll direction of the missile, and further comprises a second means for generating a fourth signal in the case where the target detecting conditions in the active unit, that are based on parameters such as distance value, signal amplitude, doppler frequency, are satisfied. In this case a proximity fuse according to the invention is primarily characterized in that the proximity fuse is arranged to issue the third signal in the case where at least one of the following conditions is satisfied: either the fourth signal is generated, or that from a passive unit according to the invention both the quotient of the amplitude of the first signal and the amplitude of the second signal exceeds a first value determined in advance and that the time derivative of said quotient exceeds a second value determined in advance, or that from a passive unit according to the invention, in addition to the last condition, the amplitude of the first signal exceeds a third value determined in advance.

[0008] The invention will be described in the following in greater detail with reference to the accompanying drawings showing block diagrams of a principle nature according to the following:

Fig. 1 shows a first embodiment of the proximity fuse according to the invention, only including a passive unit, having a directly detecting receiver.

Fig. 2 shows a second embodiment of the proximity fuse, also only including a passive unit, but having a heterodyne receiver (local oscillator and mixer).

Fig. 3 shows a third embodiment of the proximity fuse, having an active unit combined with a passive unit according to Fig. 1.

Fig. 4 shows a fourth embodiment of the proximity fuse, having an active unit combined with a passive unit according to Fig. 2.

Fig. 5 shows a longitudinal sectional view through the point of a missile including rotationally

symmetric first and second antenna lobes.

[0009] The first, relatively simple embodiment of the proximity fuse according to the invention thus appears from Fig. 1. In it a first antenna means having a relatively narrow, first antenna lobe, is denoted by 1 and a second antenna means having a second, relatively broad antenna lobe, by 2. For the sake of clarity it is not illustrated in the figure that the second antenna lobe encloses the first one but that is true. The antenna lobes are preferably rotationally symmetric in the roll direction of a missile and directed somewhat forwards. This is an advantageous embodiment, though other ones are conceivable. The signal from the first antenna means 1 passes through a unit including a bandpass filter 3, an envelope detector 4 and an amplifier 5 and thus proceeds, in the shape of a first signal S1 both to a first signal processing unit 9 and to a quotient forming unit 10. The signal from the second antenna means 2 passes through another unit, including a bandpass filter 6, an envelope detector 7 and an amplifier 8 and thus proceeds, in the shape of a second signal S2, to said quotient forming unit 10. The signal Z from the quotient forming unit is supplied both to said first signal processing unit 9 and to a derivative unit 11, from which the signal dZ/dt is also provided to the signal processing unit 9. Therefrom a third signal S3 can be fed to an effective part, not shown, of the missile and initiate a detonation thereof in the case where the conditions set out in claim 1 are satisfied, i.e. that the quotient Z of the amplitude A1 of the signal S1 and the amplitude of the signal S2 exceeds a first value Z1 determined in advance and in addition that the time derivative dZ/dt exceeds a second value Z2 determined in advance. In this embodiment some security is obtained that only jamming transmitters in the target which are located near by, can initiate a detonation of the effective part, interfering signals from escorting or more remote airplanes not being able to achieve this effect. As a further condition it can be added that the amplitude A1 of the first signal is in addition to exceed a third value Z3 determined in advance.

[0010] However, it is possible to increase the sensitivity of the proximity fuse by introducing a heterodyne receiver including a HF-oscillator, two mixers and two envelope detectors according to Fig. 2. Thus, here the signal from the first antenna means 1 also in this case proceeds to a bandpass filter 3 but then to a mixer 13 where it is mixed with a local oscillator signal from a HF-oscillator 12, after which the resulting signal continues to a bandpass filter/amplifier 15 and then passes to an envelope detector 4, and then it proceeds, as in the first embodiment, in the shape of a first signal S1 both to the first signal processing unit 9 and to the quotient forming unit 10, etc. In the corresponding manner the signal from the second antenna means 2 passes to the bandpass filter 6, after that to a mixer 14, where it is mixed with a local oscillator signal from the HF-oscillator 12, after which the resulting signal continues to a bandpass filter/

amplifier 16 and an envelope detector 7 and therefrom, in the shape of a signal S2, proceeds to the quotient forming unit 10.

[0011] If the passive unit of the proximity fuse is combined with an active unit as is illustrated in a third embodiment of the proximity fuse according to the invention in Fig. 3, the performance thereof can be improved. The passive unit is here identical to that in the first embodiment in Fig. 1. The first antenna means is here referenced 1a and the bandpass filter has here been denoted by 3a. The active unit has a third antenna means 17 for issuing modulated electromagnetic radiation for an active search of targets. This radiation is provided by an HF-oscillator 18 that is modulated by a modulator 19. The signal from the HF-oscillator proceeds together with a signal from the low pass filter 3a to a mixer 20, from which the resulting signal is fed to a second signal processing unit 21. It outputs, in the case where the target detecting conditions based on parameters such as distance value, signal amplitude, doppler frequency, are satisfied, a third signal S4 that passes to the first signal processing unit 9, together with said first signal S1, the signal Z and the signal dZ/dt . The third signal S3 is issued for initiating a detonation either in the case where the signal S4 is generated or the conditions according to claim 1 are satisfied, or in the case where the conditions according to claim 2 are satisfied.

[0012] The operation of the active unit can be assigned a priority by arranging a threshold of the amplitude A1 of the first signal, i.e. determining that it is to exceed a certain value AL, in order that the passive unit is to generate a detonation.

[0013] Proximity fuses having an active unit can also, in a fourth embodiment that appears from Fig. 4, be designed including a passive unit according to Fig. 2. Compared to the third embodiment the signal from the bandpass filter 3 only passes through the mixer 20, the signal therefrom also being supplied to the passive unit. The mixer 14 of the passive unit receives, in addition to the signal from the second antenna means 2 through the bandpass filter 6, also a local oscillator signal from the HF-oscillator 18 of the active unit.

[0014] The antenna arrangements can, within the scope of the invention, be designed in many different ways. The passive and active unit can, actually, have separate antennas but they can also be combined, being arranged to perform the required operations. It is suitable to construct the antenna means as array antennas. In Fig. 5 a longitudinal sectional view is illustrated of the point of a missile 4 comprising first and second antenna lobes 26, 27, that are rotationally symmetric about an axial symmetry axis 25.

[0015] In the same way electronic components and circuits for generating and detecting microwaves and for signal processing respectively included in the passive and active unit can at least partly be shared or common.

[0016] Parts of the signal processing can also be made digitally, the signals being A/D-converted and the

analogue circuit functions being performed using equivalent program algorithms.

[0017] The embodiments described above presupposes that bandpass filters of a relatively broad band type are used. An alternative is to replace them with a filter bank of narrow band filters, which is each one followed by an envelope detector comprising the following signal processing 10, 11, 9. The signals S1, S2, S3, S4 and Z, dZ/dt are then replaced with vectors of the same dimensions as the filter bank. In a digital implementation the filter bands and the operations thereof can be substituted by for example FIR-filters or FFT-algorithms.

Claims

1. A proximity fuse for initiating a detonation of the effective part of a missile including a passive unit comprising:

a first antenna means (1) for receiving electromagnetic radiation within the microwave area, having a relatively narrow, first antenna lobe, and

a second antenna means (2) for receiving electromagnetic radiation within the microwave area, having a second, relatively broad antenna lobe, this lobe as to the direction enclosing a first antenna lobe,

the first and second antenna lobes preferably being rotationally symmetric in the roll direction of the missile,

the proximity fuse comprising electronic components and circuits (3-8, 10, 11) for detecting a first signal S1 from the first antenna lobe and a second signal S2 from the second antenna lobe, and

a first means (9) for issuing a third signal S3 for initiating a detonation of said effective part,

characterized in

that the proximity fuse is arranged to issue the third signal S3 in the case where the following conditions are simultaneously satisfied:

a) the quotient Z of the amplitude A1 of the signal S1 and the amplitude A2 of the signal S2 exceeds a first value Z1 determined in advance, i.e. $Z = A1/A2 > Z1$.

b) the time derivative dZ/dt exceeds a second value Z2 determined in advance, i.e. that $dZ/dt > Z2$.

2. A proximity fuse according to claim 1,

characterized in

that the proximity fuse is arranged to issue the third signal in the case where in addition the amplitude A1 of the signal S1 exceeds a third value Z3 deter-

mined in advance, i.e. that $A1 > Z3$.

Patentansprüche

1. Nahzünder zum Auslösen einer Explosion des Wirkteiles einer Lenkwaffe mit einer mittelbar gespeisten, eine Antennenvorrichtung (1) zum Empfang elektromagnetischer Strahlung im Mikrowellenbereich aufweisenden Einheit mit einer verhältnismässig schmalen ersten Antennenstrahlkeule und einer zweiten Antennenvorrichtung (2) zum Empfang elektromagnetischer Strahlung im Mikrowellenbereich mit einer zweiten verhältnismässig breiten Antennenstrahlkeule, welche in ihren Richtungen die erste Antennenstrahlkeule umschliesst, wobei die erste und die zweite Antennenstrahlkeule vorzugsweise drehsymmetrisch in der Drehrichtung der Lenkwaffe sind und wobei der Nahzünder elektronische Bestandteile und Kreise (3-8, 10, 11) zum Erfassen eines ersten Signales S1 aus der ersten Antennenstrahlkeule und eines zweiten Signales S2 aus der zweiten Antennenstrahlkeule und eine erste Vorrichtung (9) zum Aussenden eines dritten Signales S3 zum Auslösen einer Explosion der erwähnten Wirkkomponente aufweist, **dadurch gekennzeichnet**, dass der Nahzünder vorgesehen ist ein drittes Signal S3 in dem Fall auszusenden, wenn folgende Voraussetzungen gleichzeitig erfüllt sind:

a) dass sowohl der Quotient Z der Amplitude A1 des ersten Signales S1 und der Amplitude A2 des zweiten Signales A2 einen vorausbestimmten ersten Wert Z1 übersteigt, d.h. dass $Z = A1/A2 > Z1$, als auch

b) die Zeitderivate dZ/dt einen zweiten vorausbestimmten Wert Z2 übersteigt, d.h. dass $dZ/dt > Z2$

2. Nahzünder gemäss Patentanspruch 1, **dadurch gekennzeichnet**, dass der Nahzünder vorgesehen ist das dritte Signal in dem Falle auszugeben, wenn ausserdem die Amplitude A1 des Signales S1 einen dritten vorausbestimmten Wert Z3 übersteigt, d.h. dass $A1 > Z3$.

Revendications

1. Fusée de proximité servant à déclencher une explosion de la partie efficace d'un missile, incluant une unité passive, comprenant :

des premiers moyens d'antenne (1) pour recevoir un rayonnement électromagnétique dans la gamme des micro-ondes, comportant un premier lobe d'antenne relativement étroit, et

des seconds moyens d'antenne (2) pour recevoir un rayonnement électromagnétique dans la gamme des micro-ondes, comportant un second lobe d'antenne relativement large, ce lobe enserrant, du point de vue de la direction, le premier lobe d'antenne, 5
 les premiers et seconds lobes d'antenne présentant de préférence une symétrie de révolution dans la direction de roulis du missile, 10
 la fusée de proximité comprenant des composants et des circuits électroniques (3 à 8, 10, 11) pour détecter un premier signal S1 provenant du premier lobe d'antenne et un second signal S2 provenant du second lobe d'antenne, 15
 et
 des premiers moyens (9) pour délivrer un troisième signal S3 pour déclencher une explosion de ladite partie efficace,

caractérisé en ce que 20
 la fusée de proximité est agencée de manière à délivrer le troisième signal S3 dans le cas où les conditions suivantes sont simultanément satisfaites :

- a) le quotient Z de l'amplitude $A1$ du signal S1 par l'amplitude $A2$ du signal S2 dépasse une première valeur $Z1$ déterminée par avance, c'est-à-dire que l'on a $Z = A1/A2 > Z1$, 25
- b) la dérivée dans le temps dZ/dt dépasse une seconde valeur $Z2$ déterminée par avance, c'est-à-dire que l'on a $dZ/dt > Z2$. 30

2. Fusée de proximité selon la revendication 1, caractérisée en ce que la fusée de proximité est agencée de manière à délivrer le troisième signal dans le cas où en outre l'amplitude $A1$ du signal S1 dépasse une troisième valeur $Z3$ déterminée par avance, c'est-à-dire que l'on a $A1 > Z3$. 35

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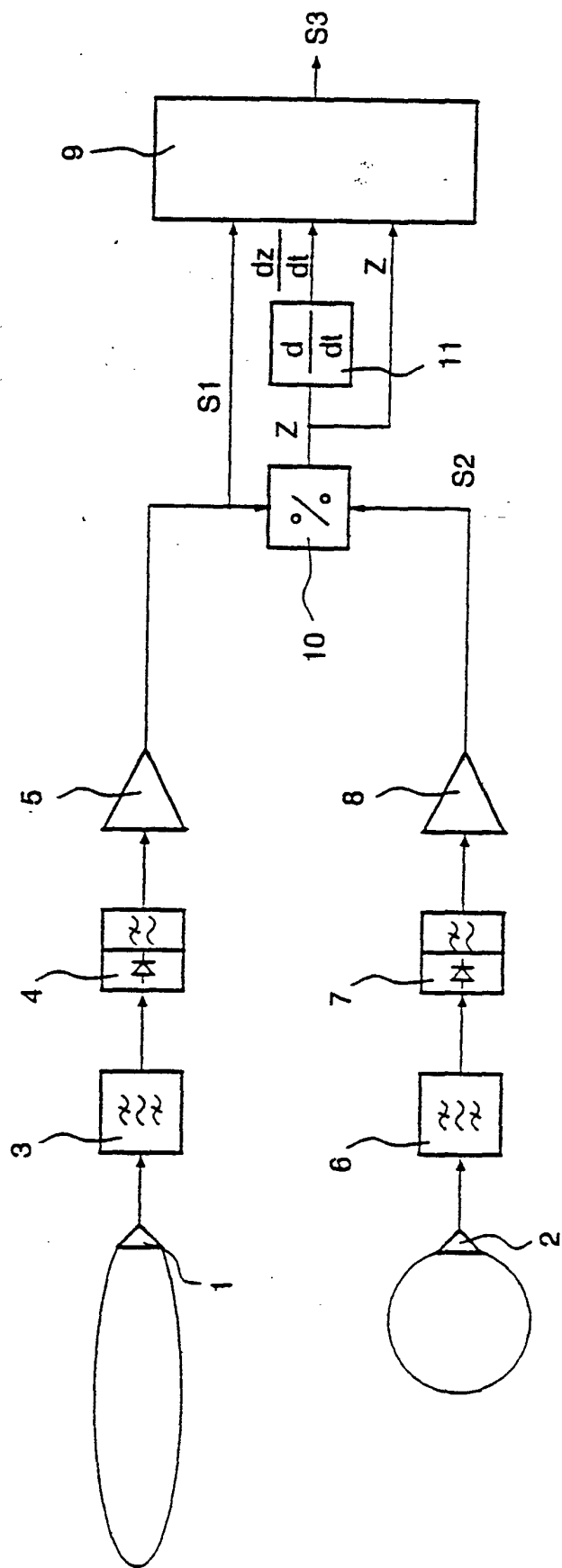


FIG 1

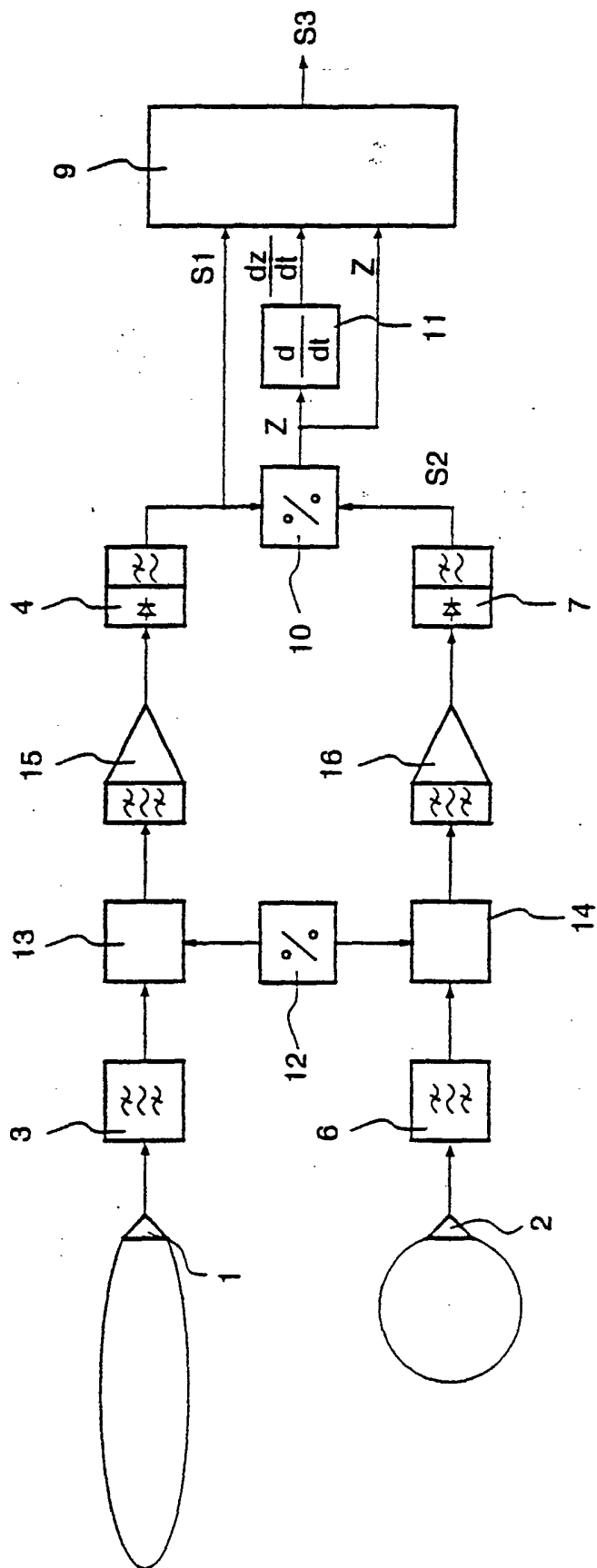


FIG 2

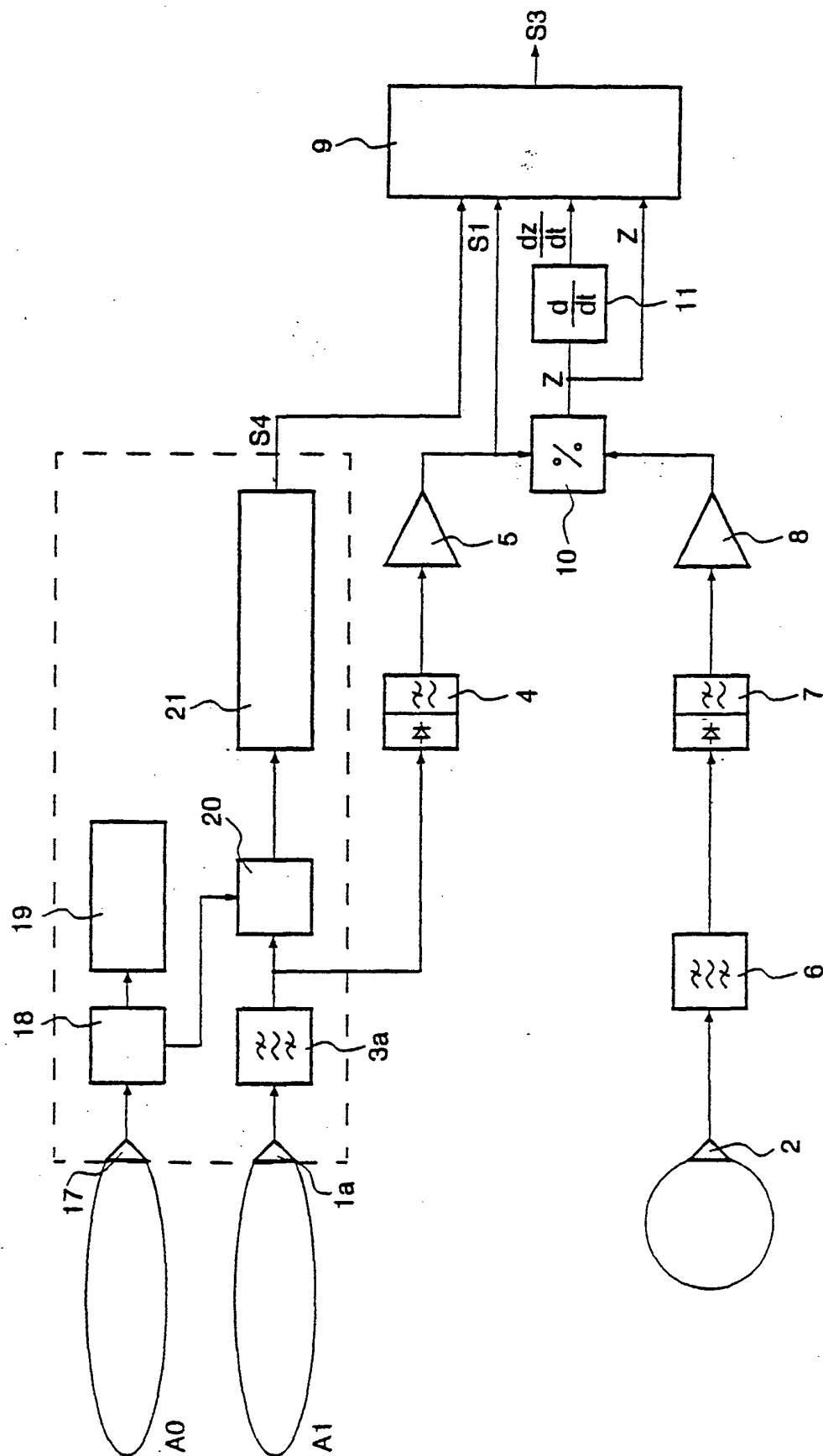


Fig 3

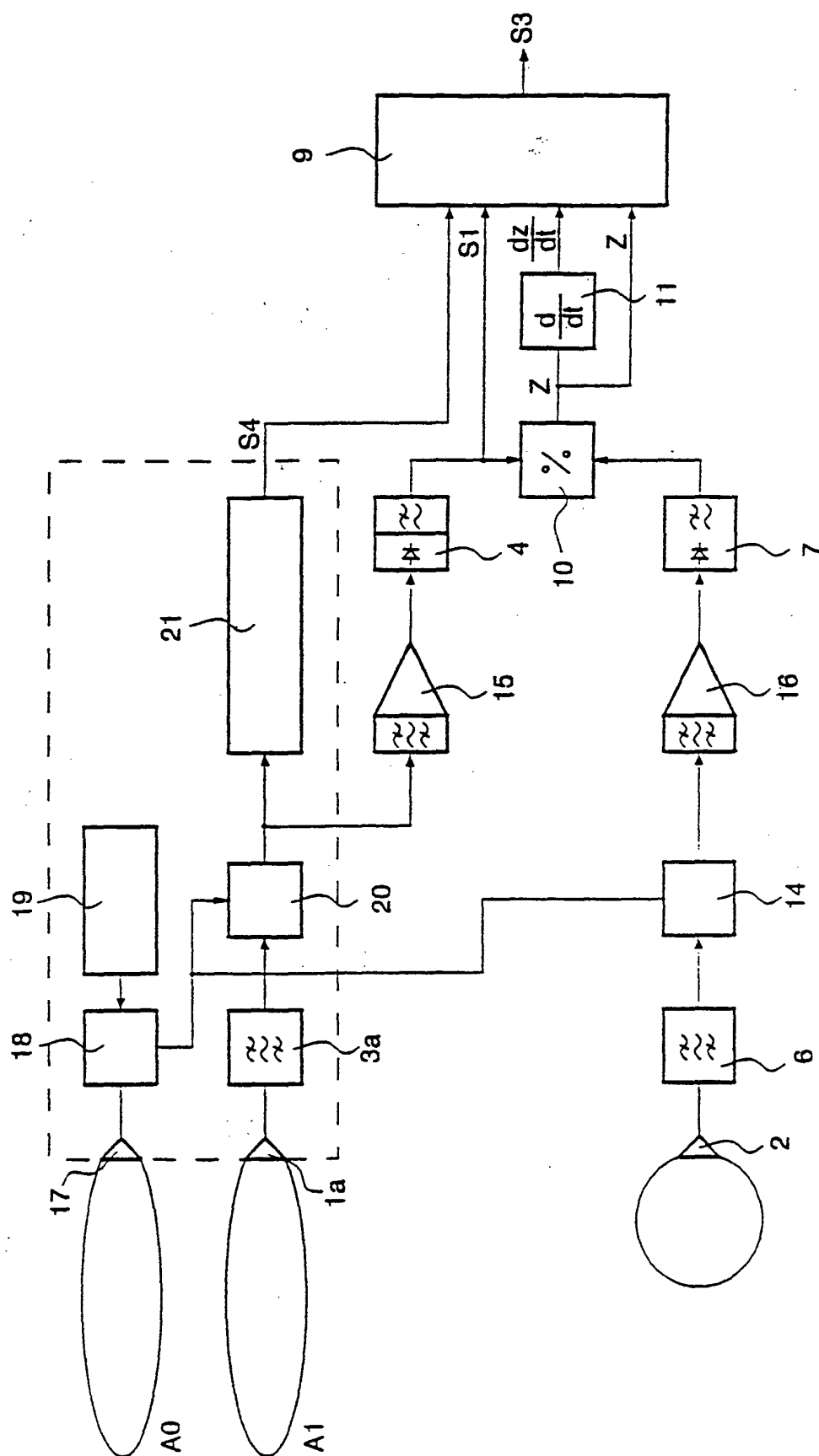


Fig 4

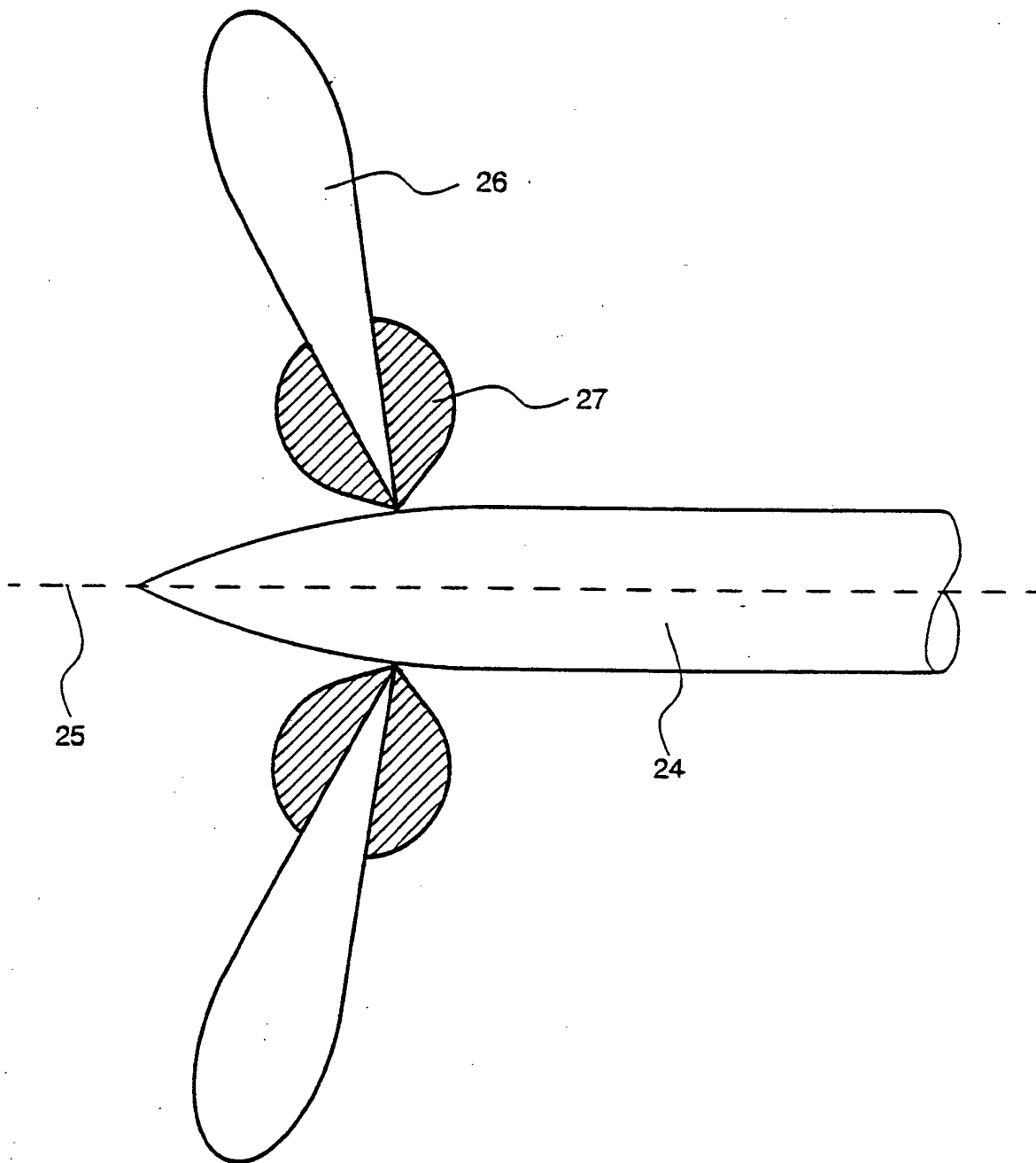


FIG. 5