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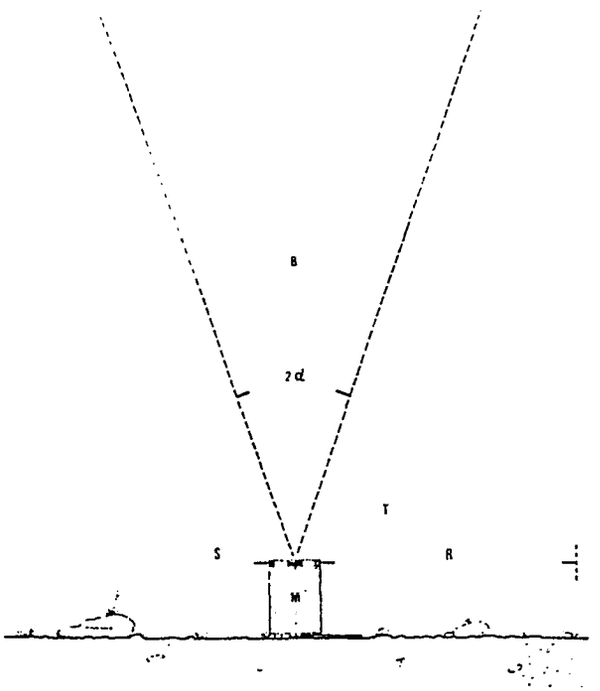
(54) **Combined influence magnetic passive-microwave active triggering device for the activation of anti-tank mines and the like.**

(57) The triggering device is capable of detecting automatically, by a magnetic sensor (5), the approach of a target of particular characteristics and its entering a zone near to the vertical (B) of the mine (M). Such a device comprises a passive magnetic receiving transducer, non-directional in the azimuthal plane, and a microwave transceiving transducer having a reception/transmission lobe conically shaped, with its axis coinciding with the longitudinal axis (B) of the cylindrical body of the mine (M). Whenever the first transducer detects a moving ferromagnetic target within a preset zone, generates an alerting signal for the second transducer which is activated in order to detect the effective presence of a target within the damaging zone of the mine.



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"COMBINED INFLUENCE MAGNETIC PASSIVE-MICROWAVE ACTIVE TRIGGERING DEVICE FOR THE ACTIVATION OF ANTI-TANK MINES AND THE LIKE"

The present invention concerns an electronic sensing device or triggering mechanism for the activation of anti-tank land mines and the like, capable of discriminating the effective presence of a target consisting of a heavy, tracked or wheeled, vehicle within a well determined zone of impairment centered on the vertical of the device, or otherwise centered on the longitudinal axis of the device, as well as of discriminating, within limits which will be indicated later, the various possible types of target and of determining consequently the activation against the type or class of target which it is desired to intercept.

Influence type triggering devices for land mines capable of sensing the proximity of a target of the armored tank type or similar are known, and they are capable, to a certain extent, of causing the activation of the mine within a maximum distance relative to the ensured impairment radius of the mine.

While providing the correct operation of the firing mechanism when the target passes directly over the influence-based system, such devices do not allow, but to a limited extent, to prevent the activation of the mine for the target passing outside the sensor, at distances such as that it is impossible to ensure impairment and the consequent inutilization of the target itself.

In other words, if such devices are calibrated to operate under the target with maximum reliability, for any kinematic condition, they have, in general, the tendency to activate themselves also for the target passing at distances greater than those of certain impairment of the target, thus reducing the efficiency of a mine field.

Furthermore, the necessity to minimize such an inconvenience results in an accentuated sophistication and complexity of the electronic circuits for signal processing associated to the sensors with an attendant reduction of reliability and an increase of costs.

A further reduction of the cited inconvenience consists in considerably increasing the destructive capacity of the mine itself, but, clearly, this can only take place to the expense of containment of the dimensions and therefore it is impossible its application in the case of mines which necessarily must be of reduced size.

It is the object of the present invention, to provide a combined influence magnetic passive-microwave active triggering device, of simple utilization, which does not need particularly complex electronics, capable of detecting through a magnetic sensor, in a completely automatic fashion, the approach of a target of particular magnetic characteristics, and its entering a zone near to the vertical of the mine; of alerting and enabling, at this point, an active microwave type (receiving/transmitting) sensor, having a directivity lobe of the same shape as the impairment cone of the mine, capable of discriminating the effective presence of a target within the cone of impairment and consequently of sending an activation signal to the firing circuits.

Clearly, said device may operate only if the transmission lobe of the microwave transmitter-receiver is directly interested by the outline of the tank, and thus, only in the presence of an effective target, it is possible to have the operation (the detonation of the mine).

Furthermore, enabling of the active sensor takes place only if there is a prior magnetic alarm and therefore the energy consumption, typical of an active element, is drastically reduced, allowing the utilization of internal batteries of low capacity for long periods of time.

Naturally, in the case of an alert which is not followed by the passage of the target within the cone of impairment of the mine, the device, after a preset period of time, resumes automatically the original status.

With the aim of better illustrating the objects and the operation of the device, a possible non-limiting embodiment applied to an anti-tank mine for dissemination is illustrated with the understanding that such an embodiment is not limitative and it is described solely by way of example.

In the drawings:

FIGURE 1 shows a sketch of the device assembled on a mine for dissemination, with indicated the directivity lobe of the microwave section and the radius of action of the alerting magnetic sensor; and .

FIGURE 2 shows a possible block diagram of the device.

With reference to Figure 1, it is indicated with M the anti-tank mine with its axis of directional detonation coiciding with the axis of B, with S the alerting magnetic sensor, with R the relative radius of alertment; with T the microwave transceiver and with B the zone irradiated by the directional transmission beam

having a width of 2d. When a target of the armored tank type approaches the mine M at a distance smaller than R, the sensor S, through the associated electronics, provides an activation signal to the supply circuits of the microwave transducer T, causing its operation.

If the target, proceeding in its way, directly enters the area B, it causes a reflection of electromagnetic power which is received by the receiving section of T and thence, properly treated, gives rise to the detonation of the mine.

If the target, on the contrary, should not enter the area covered by the transmission of T, after a preset period of time, a suitable reset circuit provides to reset the initial condition after the fall below a threshold value of the signal of magnetic alert.

The operation of the device, such as described, may be obtained by means of a circuit such as the one illustrated in Figure 2.

The magnetic transducer 1 is made of a toroidal coil designed such as to be responsive to the variations of magnetic field produced by the movement of a target, having ferromagnetic characteristics, within a radius R the value of which is dependant upon the selection of an internal threshold, chosen as to be congruent with the kinematic and dimensional characteristics of the typical target.

The signal, so detected, is conveniently amplified by amplifier 4, the output of which is brought to the input of the alerting threshold circuit 7.

When the signal at the input of such a circuit assumes a level greater than the threshold value, activation impulses are sent by the circuit 7 to the microwave

its utilization for combination with the magnetic activation signal.

The magnetic actuation signal taken from amplifier 4 and processed by the processing circuit 9 reaches the same circuit 11.

Such a circuit provides to filter suitably the magnetic signal and to evaluate its zero crossing, making available at the output an activation signal for combination, after a suitably chosen number of zero crossings, such as to cause the detonation of the mine in correspondence of a well defined point of the target. The output signal from circuit 9 is sent to the combination circuit 11 and, if at the input of said circuit a signal coming from the active section is already present, with characteristics congruent with those of the signal generated by a real target, an activation signal from the output of 11 is sent to the final circuit 12, which gives rise to the detonation of the mine.

If the target does not enter the transmission-reception lobe of the active sensor 2-3, after the disappearance of the alerting signal generated by block 7, all the circuits are reset to their initial condition.

From what disclosed above it is clear that the device, according to the invention, can function only with the physical presence of a target of suitable dimensional and reflecting characteristics and that the accidental activation by occasional magnetic disturbances or by irradiation from microwave sources in the same frequency band cannot take place.

transmitter 3 through the supply 6 and to the electronics 5 of the microwave receiver 2 which therefore begin their active phase.

In this phase the transmitter 3 emits an e.m. power at very high frequency, such as to determine the required directivity of transmission.

A portion of such a radiation directly hits the receiver 2 in such a way that a Doppler beat takes place in the receiver upon the reception of the echo signal reflected by the target.

If the target moves as to enter the transmission lobe of the transmitter 3, the echo power received by the receiver 2 is sufficient to provide a Doppler signal of sufficient amplitude for successive processing. The Doppler signal, detected by sensor 2, filtered for the removal of the high frequency carrier, is sent to the reception amplifier 5 where it is conveniently amplified and filtered in such a band which accounts for the kinematic characteristics of the target, thence it is sent to the processing circuits 8 which provide a properly calibrated integration and comparison with a threshold resulting by the reflectivity characteristics of the target.

If the signal, thus processed, is congruent with the typical signal of a certain target, an activation signal outputs from the processing circuit 8, which signal is sent to the combination and retention circuit 11.

Such a circuit provides for the retention of the activation signal coming from circuit 8 for a minimum period of time corresponding to the time of passage of a typical target at its minimum speed, and for evaluating a minimum permanence time of the signal before allowing

CLAIMS

1. A combined influence magnetic passive-microwave active triggering device for the activation of anti-tank mines and the like, characterized in that it comprises a passive magnetic receiving transducer, non-directional in the azimuthal plane, capable of detecting a moving ferromagnetic target within a certain zone of radius R and of generating, consequently, an alerting signal; and a microwave receiving/transmitting transducer having a reception/transmission lobe of a conical shape, with the axis of the lobe coinciding with the longitudinal axis of the cylindrical body of the mine, capable of being activated in consequence of the reception by the first transducer of the said alerting signal, such as to detect the effective presence of a target in the impairment zone of the mine.

2. A device according to claim 1, characterized in that it comprises an amplifier and a filter circuit, associated with the passive magnetic sensor, capable of suitably discriminating and amplifying the detected magnetic signal until it reaches a pre-selected threshold level, and a comparison processing circuit capable of supplying a signal useful to ascertain whether the value of said threshold is being overcome for a given period of time.

3. A device according to the preceding claims, wherein said alerting signal is sent to a supply circuit electronically activable and capable of energizing the microwave transmitter and to an amplifying filter associated with the microwave receiver, to cause their operation.

4. A device according to the preceding claims characterized in that the signal at the output of the magnetic amplifier is sent to a processing circuit capable of counting the zero crossings of said signal and of supplying to a combination circuit a signal enabling operation only when a preset number of zero crossingshas been reached, corresponding to a well defined cross-section shape of the moving target.

5. A device according to the preceding claims characterized in that the microwave transmitter is energized for transmission by a supply circuit activable by a suitable alerting signal, and the microwave receiving transducer is connected to an amplifying and filtering circuit also activable by the same alerting signal.

6. A device according to the preceding claims characterized in that a Doppler signal detected by the microwave receiving transducer and amplified and filtered by the reception amplifier, is further processed by an integration and threshold comparator circuit which provides to select only signals congruent with the dimensional and reflecting characteristics of a real target.

7. A device according to the preceding claims characterized in that said signal selected by the integration and threshold comparator circuit is sent to a combination circuit which, if a suitable magnetic signal of consent is present, outputs an activation signal for a final circuit.

8. A device according to the preceding claims, characterized in that the active section having a relatively high energy consumption is activated only for brief periods of time in correspondence with the reception of

an alerting signal and returns to the off condition as soon as such a signal is no longer present, thus ensuring the best utilization and thence the maximum reduction of the capacity of the internal supply batteries.

9. A device according to the preceding claims characterized in that the microwave transmitting transducer and the microwave receiving transducer may be unified in a single receiving/transmitting transducer.

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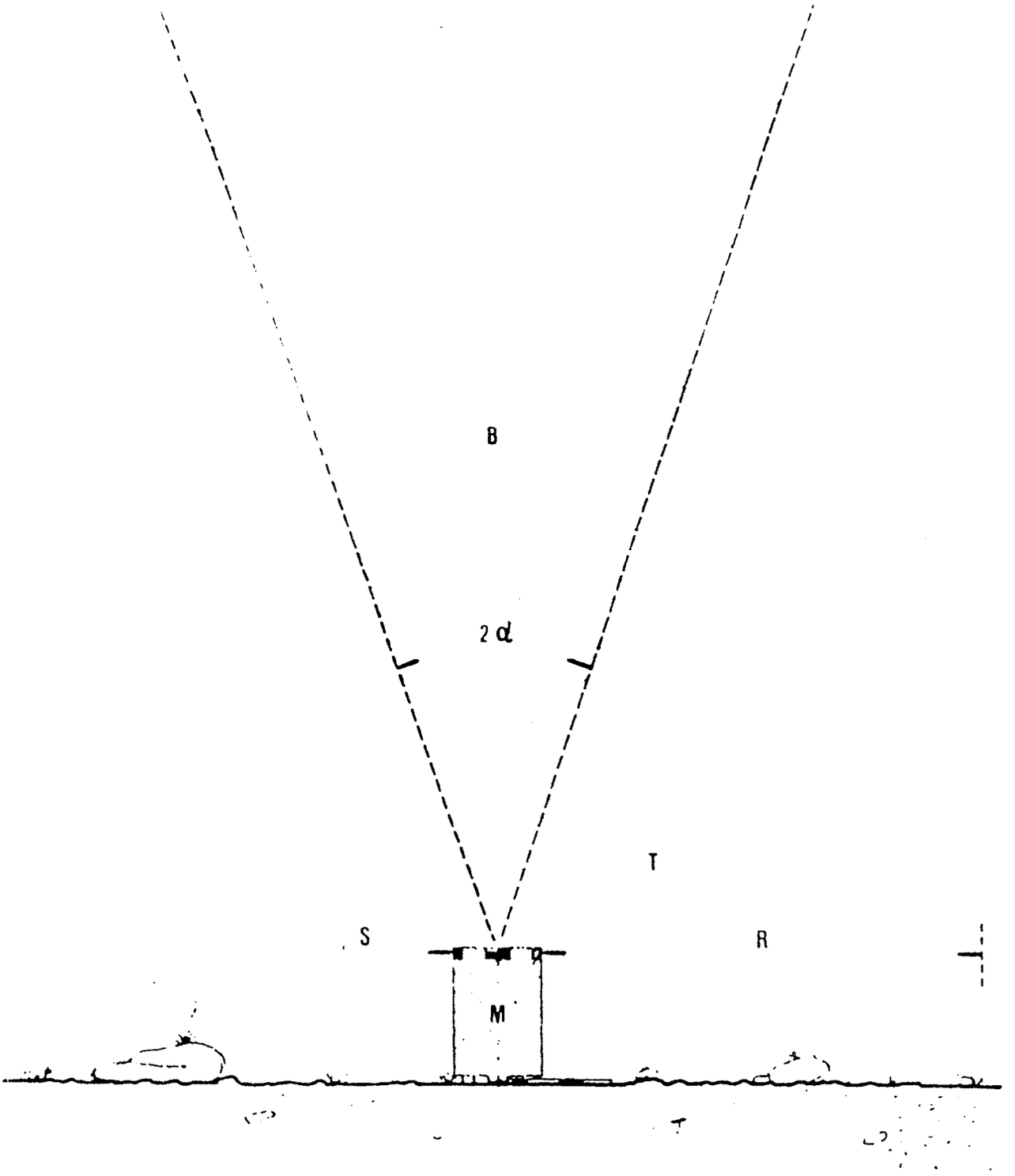

FIG. 1

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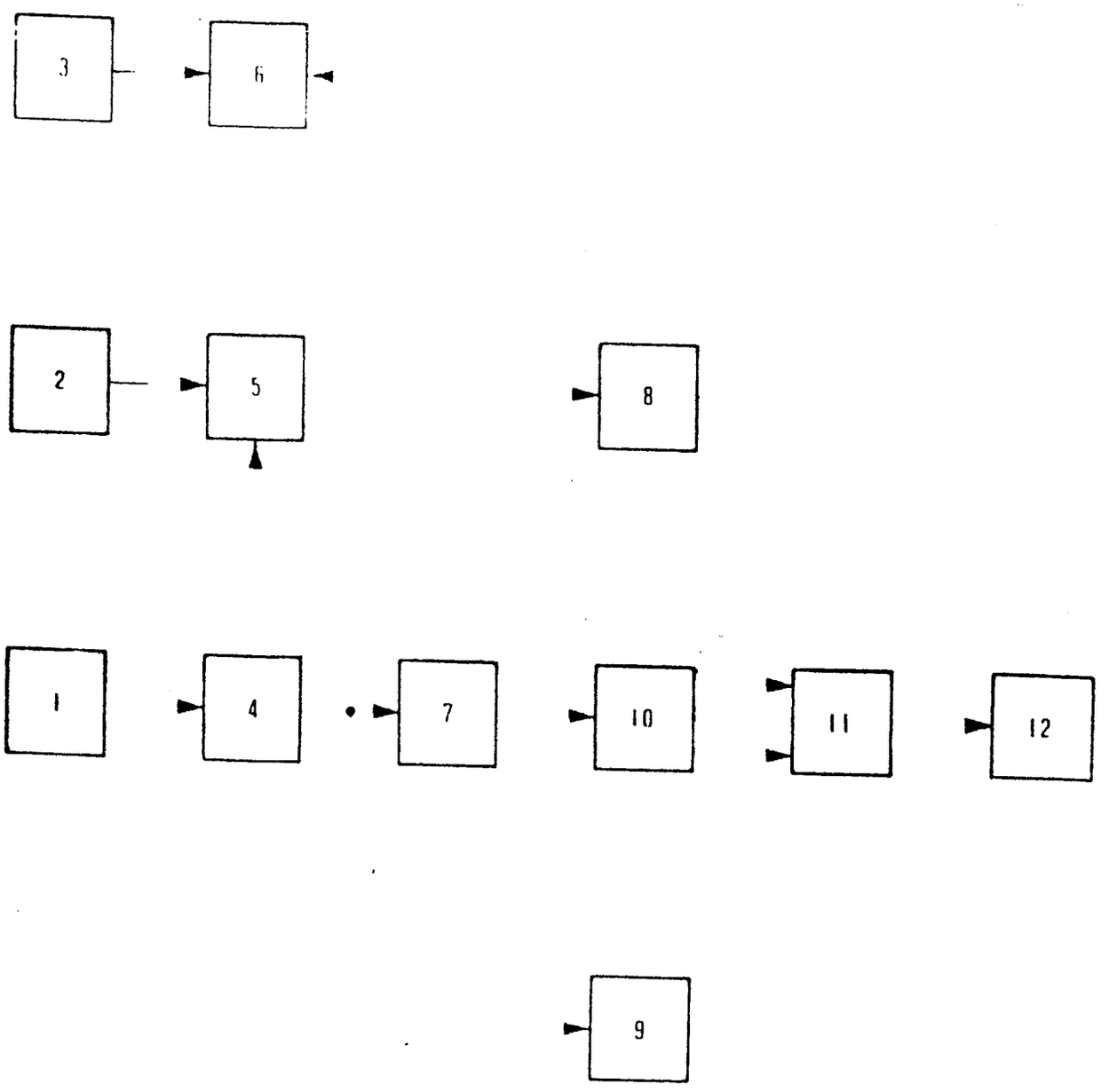

FIG. 2

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EUROPEAN SEARCH REPORT

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Application number

EP 85 83 0249

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	FR-A-2 199 863 (DELEGATION MINISTERIELLE POUR L'ARMEMENT-DIRECTION TECHNIQUE DES ARMEMENTS TERRESTRES) * Page 1, line 25 - page 4, line 25; figure 1 * ---	1-9	F 42 C 13/08 F 42 C 13/04 F 42 C 13/00
X	DE-A-2 318 869 (PHILIP PATENTVERWALTUNG) * Page 5, line 4 - page 13, line 21; figures 1-3 * ---	1-9	
A	FR-A-2 342 626 (DIEHL) * Page 1, lines 21-37; page 3, lines 15-33 * ---	1,4	
A	DE-A-3 200 918 (B.R.D.) * Page 3, line 11 - page 4, line 13 * -----	1,2,4	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

F 42 C
F 42 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	08-01-1986	MARCHAU M.F.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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