

AN ARMING MECHANISM

The invention relates to an arming mechanism having a rotor.

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Such a mechanism serves to ensure pre-barrel safety, by an ignition or detonation control being released only when a projectile equipped with such a mechanism has been in free flight for a sufficiently long time, thus when
10 the rotor has been set into rotation sufficiently often or sufficiently rapidly by the ambient flow. This incident-flow-dependent rotary movement can be utilised for heating-up a locking element which changes its geometry in a heat-dependent manner (see DE-PS 31 26
15 288), or it can be utilised for rotation-generation production of electrical energy for the switch-release of a safety circuit or for charging-up an ignition or detonation circuit store (see DE-OS 33 17 376).

20 An aim of the present invention is to provide an arming mechanism which is more especially suitable for use in a small, unmanned aircraft or projectile, hereinafter referred to as a drone. This is because, in the case of such a projectile, a type of pre-barrel
25 safety is to be ensured, namely a period of time as from launching of the drone until the reaching of free-flight factors at a safe distance from the launching mechanism.

According to the present invention there is provided
30 an arming mechanism comprising a rotor having rotary wings for the supply of an arming criterion, characterised in that the rotary wings are the blades of a driving propeller of a drone, the rotary motion of said blades being detectable from the tail region of the drone
35 on one side of a hub of the propeller, by way of a radiation coupling or detector and information on said rotary motion being suppliable via said coupling or

detector to a counting evaluation circuit for the derivation of a release signal.

Further according to the invention there is provided
5 a projectile including an arming mechanism in accordance with the immediately preceding paragraph.

The basic idea of the present invention thus lies in utilising as an arming criterion the rotary movement of
10 rotary wings in the form of propeller blades present anyway for the drive of the drone. Of course, on account of the requirement for transmitting driving energy to the propeller, in the region of the mounting of the propeller hub and of the driving unit arranged in front thereof,
15 the necessary installation space for a friction element or for an electrical generator as a supplier of arming criteria is not available, quite apart from the impairment of the power balance which would occur upon the drive of such an additional consumer by way of the
20 propeller hub. On the other hand, it would not for reasons of electromagnetic efficiency, be very promising to arrange a generator stator radially remote from the hub axis on the tail region of the drone and to equip the propeller blades with ferromagnetic components which
25 could serve as rotors relative to the stator; this is because for constructional and more especially flow-dynamic reasons, the distance between the tail of the drone and the propeller blades (thus the rotary wings) is too great in order to allow a sufficient dynamoelectric
30 effect for an arming procedure to be expected. Moreover, the electromagnetic stator-rotor coupling would again lead to a non-desirable additional loading of the propeller driving motor. Therefore, in accordance with
the present invention provision is made for detecting the
35 propeller rotation optronically and for deriving the pre-barrel arming criterion therefrom. This is because the characteristic of an optronic pick-up mounted on the tail

of the drone is sufficiently influenced - in this respect without energy-dissipating coupling phenomena - by the rotor blades rotating past the pick-up in order to modulate the irradiation (in the visible or invisible 5 spectral region) in reflected wave operation or in passive operation.

This impulsive-form modulation can be counted in order to derive the emission delivery of the arming 10 criterion from an impulse sequence of a frequency which is predetermined in flight-operation-technology respects. In this respect, the optronic transducer can, depending on spatial installation possibilities, be arranged directly on the tail of the drone or be connected thereto 15 by way of a radiation coupler.

Additional alternatives and further developments as well as further features and advantages of the invention will become apparent from the following description and 20 claims. An example of an arming mechanism, in accordance with the present invention, will now be described, by way of example only, with reference to the sole figure of the drawings which shows, in a much simplified manner, in axial longitudinal section, a propeller-driven drone with 25 an arming mechanism working as a function of the rotary movement of the propeller blades.

The drone shown in the FIGURE (see e.g. GB-OS 21 79 125 or SOLDAT UND TECHNIK 8/1988 page 457, FIGURE 7) 30 represents a small, unmanned aircraft, the propulsion of which after a, for example, catapult or rocket launching is effected by means of a propeller 12. The propeller blades or rotary wings 13 thereof are held on a hub 14, which is mounted in the tail 15 of the drone and is set 35 into rotation by a motor 16.

A time or sensor circuit controls the delivery of

submunitions; or a proximity or impact sensor 17 in the front region of the drone 11 at some future time, by way of a fuze 18, causes a charge 19 to detonate - of course only at an adequate safety distance from the launching mechanism (not shown in the drawing) of the drone, thus
 5 when propulsion of the drone 11 is no longer effected by the launching acceleration mechanism, but has been effected for a sufficiently long time by means of the propeller 12.

10 For this detonation, an arming mechanism 20 is provided which releases the control of the fuze 18 by way of the ignition detonation sensor 17 only when, and not until, the propeller 12 has rotated for a sufficient long
 15 time and sufficiently rapidly. This rotation is detected by means of an e.g. optronic pick-up 21, which is directed from the tail 15 of the drone approximately axially-parallel therewith across the rotary path of the propeller rotary wings 13. If the pick-up 21 works as an
 20 active light barrier or photo-electric cell, it is designed as a transmitter/receiver, and the rotary swings 13 act as reflectors which periodically cross the beam path. With some designs of pick-up 21, the rotary wings 13 serve as diaphragms or shutters for periodic shading
 25 (modulation) of the ambient radiation striking the receiver. With a pick-up 21 responding to the thermal radiation spectrum the propeller (knife-) edges heated in flight operation serve as rotating IR radiators. For reasons of space it can be advantageous to design the
 30 pick-up 21 arranged on the tail 15 as the irradiation (Einstrahl) or radiation (Ausstrahl) cross-sectional area of a radiation conductor 22 and to realise the actual e.g. optoelectrical transducer 23 in the interior of the drone 11, for instance in the region of the energy supply
 35 and drive control.

The arming mechanism 20 has an evaluation circuit

24, which arms the fuze 18 only when the propeller 12 has rotated for a sufficiently long time; i.e., the evaluation circuit 24 can substantially be designed as a counting circuit for the impulses supplied by the rotating rotary wings 13 and converted e.g. optronically, which upon reaching of a predetermined counting end position supplies a release signal 25 to the fuze 18.

To increase the pre-barrel safety ensured by this arming mechanism, the control of the impulse-counting evaluation circuit 24 can be effected by way of a filter circuit 26, which for example allows only impulse-sequence frequencies above a limiting frequency to pass through to the evaluation circuit 24. In this way it is ensured that impulses are only added-up for the arming which result from the working rotational speed of the propeller 12, whilst possible impulse phenomena in the period of time when the propeller 12 is still stationary or is respectively only running up, remain shut out.

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To summarise, there is provided, an arming mechanism (20) having rotary wings (13), the rotary motion of which gives rise to an arming criterion, designed for constructionally simple and functionally reliable use in a small, unmanned aircraft (drone 11). For this, arranged in the region of the projection of the rotary-motion path of the driving propeller (12) onto the tail (21) of the drone and offset radially relative to the propeller hub (13) is a radiation pick-up (21) which is stimulated in impulse-shaped manner actively or passively (in the visible or thermal radiation spectrum) by the propeller blades (rotary wings 13) sweeping past. An arming release signal (25) is issued only when and not until the driving propeller (12) has worked for a sufficiently long time at nominal rotational speed (in order) to have flown the drone (11) out of a safety region in the vicinity of the launching sight and over

the target area.

5 Still further according to the present invention
there is provided an unmanned aircraft or projectile
comprising a driving rotor, said aircraft or projectile
having a radiation detector arranged to detect variations
in radiation from the rotor and having a counting
evaluation circuit for arming the projectile on a
10 predetermined radiation criterion being detected from the
rotor.

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CLAIMS

1. An arming mechanism comprising a rotor having rotary wings for the supply of an arming criterion,
5 characterised in that the rotary wings are the blades of a driving propeller of a drone, the rotary motion of said blades being detectable from the tail region of the drone on one side of a hub of the propeller, by way of a radiation coupling or radiation detector and information
10 on said rotary motion being suppliable via said coupling or detector to a counting evaluation circuit for the derivation of a release signal.
2. An arming mechanism according to Claim 1 in which an
15 evaluation of rotation duration is effected therein.
3. An arming mechanism according to Claim 1 or Claim 2, in which a rotation frequency evaluation is effected therein.
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4. An arming mechanism according to any one of the preceding claims, in which a transmission conductor or lead is provided between a pick-up or receiver arranged on the tail region of the drone and a transducer arranged
25 in the interior of the drone.
5. An arming mechanism according to any one of the preceding claims in which the propeller rotary wings are designed as reflectors for a light-barrier or photo-
30 electric pick-up or receiver.
6. An arming mechanism according to any one of Claims 1 to 4, in which the propeller rotary wings are designed as diaphragms or shutters for a pick-up or receiver
35 stimulated by ambient radiation.
7. An arming mechanism according to any one of Claims 1



to 4, characterised in that a, or the, pick-up of
receiver responds to radiation in the invisible spectral
region, e.g. to the heating-up of the propeller rotary-
wing edges.

8. An arming mechanism substantially as herein
described with reference to the single figure of the
accompanying drawings.

9. A projectile including an arming mechanism as
claimed in any one of the preceding claims.

10. An unmanned aircraft or projectile comprising a
driving rotor, said aircraft or projectile having a
radiation detector arranged to detect variations in
radiation from the rotor and having a counting evaluation
circuit for arming the projectile on a predetermined
radiation criterion being detected from the rotor.

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