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CENTRIFUGALLY ARMED FUZE FOR ROTATING PROJECTILE

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Fig. 2.

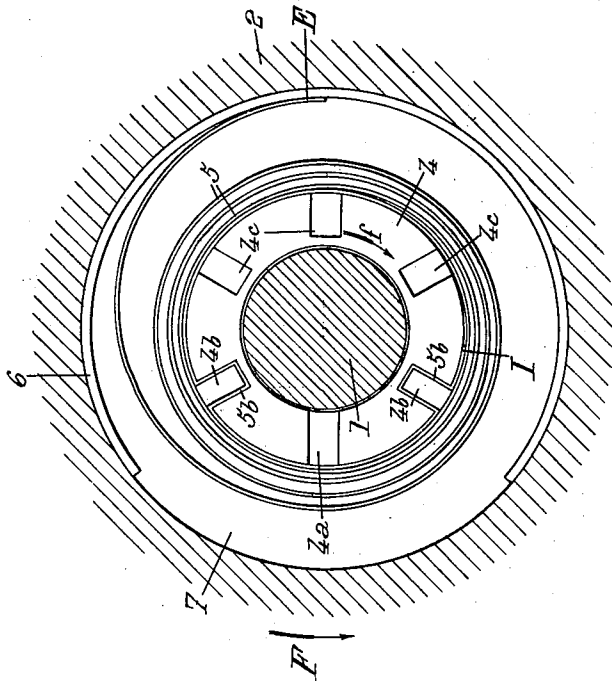
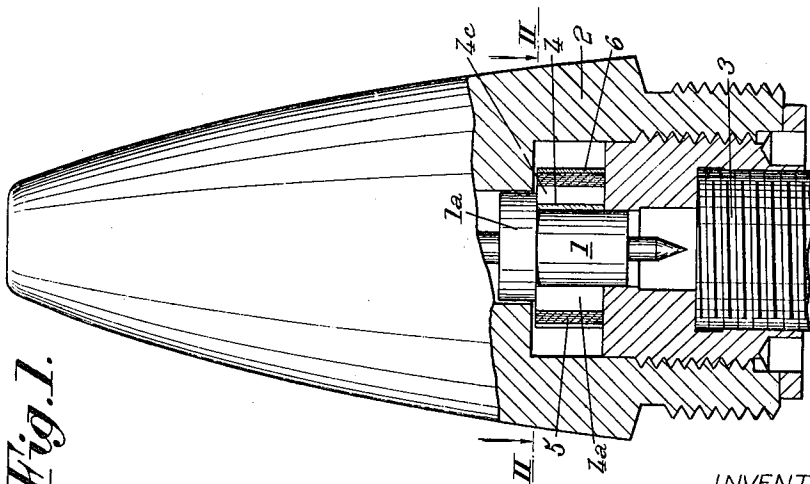


Fig. 1.



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**CENTRIFUGALLY ARMED FUZE FOR
ROTATING PROJECTILE**

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Continuation of application Ser. No. 729,921, Apr. 21,
1958. This application Nov. 25, 1960, Ser. No. 71,575
Claims priority, application Luxembourg Apr. 25, 1957
6 Claims. (Cl. 102-79)

This application is a continuation of application Serial
No. 729,921 filed April 21, 1958, and now abandoned.

This invention relates to centrifugally-armed fuzes for
rotatable or spin stabilized projectiles, i.e. to fuzes where-
in the striker or like igniting means is normally retained
at the inoperative position by a locking device and is
liberated under the action of centrifugal forces developed
by rotation of the projectile when the latter is fired, where-
by the fuze is armed, as for instance by being rendered
sensitive to impact.

In the conventional centrifugally-armed fuzes the lock-
ing device is liberated as soon as the projectile begins ro-
tating about its axis at a sufficient angular velocity. Con-
sequently the fuze is armed immediately at the outlet of
the gun or even within the latter and the projectile is
therefore liable to burst on impact against any kind of
unexpected object, such as for instance branches, wires,
etc.

The present invention has for its object to provide a
fuze wherein the arming of the fuze is delayed.

In accordance with this invention in a centrifugally-
armed fuze the locking device is rotatable with respect
to the fuze about the axis thereof and is submitted to the
temporary action of means which under the action of
centrifugal forces cause the said locking device to rotate
during a time with respect to the fuze in a direction op-
posed to the direction of rotation of the fuze itself and
at such a relative angular velocity that the absolute an-
gular velocity of the said device about the fuze axis be
temporarily lowered below the minimum value for which
the said device liberates the striker or like igniting means.

The locking device is conveniently in the form of a
split expansible sleeve loosely mounted on the striker or
the like and adapted to form a retaining abutment for a
shoulder thereof before the projectile is launched, means
being provided to frictionally connect the said sleeve and
the body of the fuze while permitting angular slip.

The sleeve may be retained against expansion by the
means adapted to rotate the said sleeve with respect to
the fuze itself during the operating step of the said means.

The means adapted to rotate temporarily the sleeve
within the fuze body when the projectile is fired may be
in the form of a strip, preferably made of a resilient or
non-resilient metal such as tin, the said strip being wound
about the sleeve an appropriate number of times and its
inner end being attached to the sleeve, while its outer
end is secured to the fuze body, at least when the projec-
tile is fired, the winding direction of the said strip about
the said sleeve being such that when the said strip un-
winds under the action of centrifugal forces, the sleeve
be rotated in the fuze in the reverse direction with respect
to the direction of rotation of the projectile.

Before the projectile is fired the strip is tightly wound
on the sleeve and it is conveniently surrounded by a
safety split ring, which opens under the action of centri-
fugal forces, whereby the outer end of the strip may ap-
ply against the fuze body and become frictionally se-
cured thereto by the said forces.

The inner end of the strip may be disengageably an-
chored onto the sleeve at two points situated on each side
of the slot thereof, in such a manner that the said sleeve

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is retained against expansion under the action of centri-
fugal forces until the said strip is wholly disengaged
therefrom. For this purpose the sleeve may be formed
with two anchoring notches on each side of its slot, the
strip being pressed and engaged into the said notches.

In the annexed drawings:

FIG. 1 is a sectional elevation of a fuze according to
this invention.

FIG. 2 is an enlarged transverse section thereof taken
along line II-II of FIG. 1.

In the annexed drawings reference numeral 1 desig-
nates a striker slidably disposed in the body 2 of the fuze,
the said striker being adapted to move rearwardly within
the fuze on impact to cause ignition of a pyrotechnic
composition such as for instance an initiating charge or
primer, disposed in the bottom of the fuze body 2.

Until the projectile on which the fuze is mounted is
fired, striker 1 is retained at an advanced position within
the fuze body by means of a locking device adapted to
be thereafter released by centrifugal forces developed
by rotation of the projectile about its axis when it has
been launched. In the example illustrated this locking
device is formed of a radially split and therefore expansi-
ble sleeve 4 which, until the projectile is fired, forms an
abutment for a shoulder 1a provided on striker 1. As
illustrated this split sleeve 4 is of substantial width. It
is provided with a radial slot 4a opening at both ends and
with a number of additional notches 4b, 4c which do not
extend to the inner surface of the said sleeve, these
notches increasing the flexibility of the sleeve.

With the above-described arrangement the split expan-
sible sleeve 4 would expand as soon as the angular veloc-
ity of the projectile about its own axis exceeds a pre-
determined value. In other words the fuze would be-
come armed at its outlet from the gun or even within
the latter. The projectile could therefore burst on im-
pact against branches, camouflage contrivances, etc., or
even due to a plug of grease left at the outlet of the gun.

According to the present invention this is avoided by
so mounting the expansible locking sleeve 4 that when
the projectile is fired, the said sleeve may rotate with re-
spect to the fuze about the axis of the latter and by pro-
viding centrifugal means whereby the sleeve is then
caused to rotate temporarily with respect to the fuze
in the reverse direction with respect to the direction of
rotation of the fuze itself, in such a manner that the ab-
solute angular velocity of the sleeve is then smaller than
the angular velocity of the fuze and remains below the
limit required to liberate striker 1, when the aforesaid
centrifugal means become ineffective, the angular ve-
locity of sleeve 4 tends to increase under the action of
frictional forces until it is equal to the angular velocity
of the fuze itself. The sleeve therefore expands and lib-
erates the striker, whereby the fuze is armed. In other
words the arming of the fuze is delayed, whereby the
latter is safe against untimely operation on a given length
of the projectile trajectory.

In the example illustrated the split expansible sleeve
4 is loosely mounted on the cylindrical body of striker
1 whereon it may rotate with a relatively reduced fric-
tion.

This safety of the fuze in the first part of the trajectory
may still be increased by so arranging the means which
temporarily rotate the expansible sleeve 4 that they pos-
itively retain the sleeve at its unexpanded position dur-
ing their rotating action on the latter. With such an
arrangement the fuze remains safe even, for instance, if
the absolute angular velocity of the expansible sleeve 4
after the projectile has just been fired is somewhat high-
er than provided, or if the expansible sleeve is somewhat
more flexible than expected.

In the illustrated embodiment this is obtained by winding on the expansible sleeve 4 a strip 5 preferably made of a resilient or non-resilient metal, such as tin, for instance. This winding may comprise a pre-determined number of turns, as for instance about twelve. The inner end I of strip 5 is anchored onto sleeve 4, while its outer end E is adapted to be secured to the fuze body 2, either in a permanent manner, or under the action of centrifugal forces when the projectile is launched, as hereinafter explained. The direction of winding of strip 5 about striker 1 is such that when the projectile rotates, the unwinding of the successive turns of the said strip under the action of centrifugal forces should rotate the expansible sleeve 4 about striker 1 with respect to the fuze in a direction opposite to the direction of rotation of the fuze about its own axis. In FIG. 2 arrow F indicates the direction of rotation of the fuze, while arrow f indicates the direction of the relative rotation of the sleeve within the fuze.

The strip 5 wound on the striker 1 is preferably normally retained in position by an outer split ring 6 which opens under the action of centrifugal forces as soon as the projectile begins rotating, as shown in FIG. 2. The outer end of strip 5 is then liberated and it is applied by centrifugal forces against the outer wall of an annular recess 7 provided in the fuze body around the cylindrical portion of striker 1 on which the expansible sleeve 4 is disposed.

The inner end I of strip 5 is preferably anchored onto the split expansible sleeve 4 at two points disposed on each side of the slot 4a thereof in such a manner that the portion of the strip extending between these points and which bridges the said slot 4a may retain the sleeve in the unexpanded state until the strip is wholly unwound therefrom. In the example illustrated this is obtained by means of the above mentioned notches 4b which are disposed on each side of the slot 4a of the sleeve, strip 5 being pressed into the said notches by means of an appropriate tool which forms thereon depressions 5b which fit into the said notches 4b. As above explained notches 4b cooperate with notches 4c for increasing the flexibility and therefore the expansibility of sleeve 4.

It will be appreciated that the safety delay between the launching of the projectile and the arming of the fuze is dependent of a number of factors, such as the thickness of strip 5, the length thereof, the mass of sleeve 4, etc. The thickness of strip is preferably as reduced as possible in order that the said strip may easily break, should the depressed portions thereof become jammed within notches 4b at the end of the unwinding step. It is besides of interest to have the said strip relatively as long as the radial dimension of the annular housing 7 will permit in order to increase the safety delay. When the strip is fully unwound, the sleeve 4 is progressively brought to rotate at the same absolute angular velocity as the fuze by the frictional forces and of course the time required therefore is more or less proportional to the mass of the sleeve or, more exactly, to its moment of inertia about the axis of the fuze.

The general operation of the fuze is now clearly understandable:

As soon as the projectile is fired, it rotates at a high speed about its axis in the direction indicated by the arrow F in FIG. 2. During the accelerating step within the gun, the safety ring 6 is strongly applied against the inner or front side of the plug which forms the rear part of the fuze and it therefore rotates substantially at the same angular velocity as the projectile. It is consequently almost at once expanded and applied against the outer wall of the annular housing 7 under the action of centrifugal forces. The outer end of strip 5 is consequently liberated and it is urged outwardly by centrifugal forces and also applied against the outer wall

of housing 7, or against the inner side of the expanded ring 6, as illustrated in FIG. 2. The successive portions of the strip are in turn urged outwardly and the said strip thus tends to unwind from striker 1 for becoming wound internally against the outer wall of housing 7.

But owing to the difference in diameter between sleeve 4 and the outer wall of housing 7, this kind of transfer of strip 5 from the sleeve to the said outer wall involves a relative rotation between the ends I and E of the strip. Now the outer end E is already strongly applied against the aforesaid outer wall by centrifugal forces and it is frictionally retained or secured thereon. As to the inner end I, it is anchored onto sleeve 4 as above explained, and the said sleeve is strongly pressed against the plug or rear end of the fuze by the inertia forces which result from the acceleration of the projectile within the gun, the said forces also acting on the striker 1 itself, the shoulder 1a of which is therefore strongly applied against the front end of the sleeve. Strip 5 is therefore prevented from unwinding until the projectile has left the gun. Sleeve 4 is then free to rotate on striker 1 and strip 5 may unwind from the said sleeve, the latter rotating in the direction of arrow f of FIG. 2, i.e. in the reverse direction with respect to the rotation of the projectile. The absolute angular velocity of the sleeve is therefore equal to the difference between the angular velocity of the projectile and the relative angular velocity of the said sleeve with respect to the fuze. Since the unwinding of the strip is a rather rapid process, this absolute angular velocity of sleeve 4 is relatively low and it may even be quite nil. In any case, it is insufficient for causing expansion of the sleeve. When the strip is wholly unwound from the sleeve, its depressed portions 5b which had been driven into notches 4b are disengaged, thus leaving sleeve 4 quite free. Under the action of frictional forces the latter tends to assume progressively the same angular velocity as the fuze itself, whereby it is expanded by centrifugal forces. Striker 1 is then free to act on impact or in other words the fuze is armed.

It will be noted that even if for any reason sleeve 4 had some tendency to expand before the final unwinding of the strip, it would be positively prevented from doing so by the portion of the said strip which bridges the slot 4a of the sleeve and which is anchored onto the said sleeve at both ends in notches 4b.

What I claim is:

1. A centrifugally-armed fuze for a rotatable projectile comprising a fuze body formed with an axial bore and with an axially substantially cylindrical inner housing having a lateral wall, a transverse front wall and a transverse rear wall, a charge to be ignited disposed substantially at the rear end of said axial bore, a striker slidably disposed within said bore to cause ignition of said charge by moving rearwardly of said fuze from an advanced position to a rear position, said striker being formed with a shoulder situated in front of the rear wall of said housing when said striker is at its advanced position, and with a cylindrical portion disposed at the rear of said shoulder, a centrifugally expansible split sleeve freely and rotatably mounted on said cylindrical portion between said shoulder and the rear wall of said housing to retain said striker at its advanced position, a flexible strip spiral wound on said sleeve in the reverse direction with respect to the rotation of said projectile when fired, said strip having its inner end attached to said sleeve, and a centrifugally expansible ring disposed on said flexible strip to retain same on said sleeve until the projectile is fired, rotation of the latter then causing expansion of said ring which liberates said flexible strip, and the outer end of said strip then being applied by centrifugal force against the outer wall of said housing whereon it is frictionally secured to cause said strip to rotate said split sleeve within said fuze body in the reverse direction with respect to the rotation of said fuze.

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2. In a fuze as claimed in claim 1 the inner end of said flexible strip bridging the split portion of said sleeve and being disengageably anchored onto said sleeve each side of said split portion to retain said sleeve at the unexpanded position on said cylindrical portion of said striker until said strip is fully unwound and disengaged from said sleeve.

3. In a fuze as claimed in claim 1, said split sleeve being formed with a peripheral notch on each side of the split portion thereof and the inner turn of said flexible strip being formed with depressions forced into said notches to cause the portion of said inner turn which extends between said notches to retain said sleeve at the unexpanded position on said cylindrical portion of said striker until said depressions are disengaged from said notches at the end of the centrifugal unwinding of said strip from said sleeve.

4. In a projectile fuze armed by rotation of the projectile to unwind centrifugally a flexible strip wound spirally about a centrifugally releasable split sleeve interposed between a shoulder portion of ignition means and an explosive charge toward which the ignition means is relatively movable, means for releasably securing the flexible strip to the split sleeve including at least one notch disposed in the outer peripheral portion of the split sleeve adjacent each side of the split, the flexible strip being indented into each of the notches and so wound about the split sleeve as to rotate the split sleeve temporarily in the opposite direction from that of the projectile, such that centrifugal release of the split sleeve is delayed.

5. A projectile fuze according to claim 4 further comprising a centrifugally releaseable safety ring wound about the flexible strip.

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6. A centrifugally armed fuze for a rotatable projectile comprising a fuze body formed with an axial bore and with an axially disposed inner housing having a transverse wall fixed in the axial direction, igniting means comprising two elements, one fixed with respect to said fuze body and the other movable axially in said bore in response to impact of the projectile on an obstacle to cause ignition by moving in the axial direction of said fuze from a first position where it is at a distance from said fixed element to a second position where it is in contact with said fixed element, said movable element being formed with a shoulder portion capable of moving in said housing and the axial distance of which from said housing transverse wall decreases when said movable element moves from said first position to said second position, an expansible split sleeve freely and rotatably interposed around said movable element between the shoulder portion thereof and said housing transverse wall to retain said fixed element in its first position, and a flexible strip having an inner end attached to said split sleeve and spiral wound about it in a direction such as to rotate it initially in the opposite direction from that of the projectile, whereby centrifugal release of the split sleeve is delayed.

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