

PATENT SPECIFICATION

(11) 1 499 858

1 499 858

- (21) Application No. 49928/75 (22) Filed 5 Dec. 1975
 (31) Convention Application No. 16212/74
 (32) Filed 6 Dec. 1974 in
 (33) Switzerland (CH)
 (44) Complete Specification published 1 Feb. 1978
 (51) INT CL² F42C 11/04
 (52) Index at acceptance F3A 5C4 5C9D



(54) AN IMPROVED IGNITION UNIT FOR AN ELECTRICAL PROJECTILE FUSE

(71) We, WERKZEUGMASCHIN-
 ENFABRIK OERLIKON-BUHRLE AG a
 company organised and existing under the
 laws of Switzerland of Birchstrasse 155,
 CH—8050 Zurich, Switzerland, do hereby
 declare the invention for which we pray that
 a patent may be granted to us and the
 method by which it is to be performed to be
 particularly described in and by the
 following statement:—

This invention relates to an ignition unit
 for an electrically ignited projectile fuse of
 the type comprising a soft iron core
 coaxially disposed about the projectile axis,
 an induction coil embracing the soft iron
 core, and an annular permanent magnet
 which is axially slidably shiftable and in a
 first position surrounds the induction coil.

An ignition unit of this type is already
 known in the art, but for its size it generates
 little electric power.

The object contemplated by the present
 invention is to provide an ignition unit
 which combines minimum size with the
 ability to deliver the maximum possible
 amount of electrical energy, i.e. which has
 an energy/volume ratio as large as it is
 possible to achieve. For this purpose it is
 necessary to ensure that the rate of change
 of the magnetic flux through the coil is a
 maximum, since this will then induce a high
 current in the turns of the coil, which can
 then be used to charge a capacitor.

The present invention provides an
 ignition unit for an electrically ignited
 projectile fuse comprising a soft iron core,
 an induction coil embracing the soft iron
 core and an annular magnet axially slidably
 shiftable from a first position in which it
 surrounds the induction coil, in which unit a
 soft iron ring is attached to and abuts the
 rear face, (viewed in the direction of the
 projectile trajectory) of the annular
 permanent magnet, the soft iron core being
 formed with a flange which in the first
 position of the permanent magnet is abutted
 by the front face of the permanent magnet
 or by a soft iron ring carried on the front

face of the permanent magnet, the soft iron
 core being provided with a peripheral slot
 which contains the induction coil, the
 sliding shift of the permanent magnet being
 sufficient for the induction coil to be outside
 the magnetic field of the permanent magnet
 when the latter is in a second position, and
 in which the permanent magnet in its
 second position still embraces the soft iron
 core.

This arrangement achieves a high rate of
 change of the magnetic flux firstly by
 surrounding the induction coil with a closed
 magnetic circuit which is then broken and
 displaced alongside the coil causing the
 magnetic flux through the coil to drop from
 a maximum to zero.

Reference is now made to the accom-
 panying drawing which diagrammatically
 shows part of an electrically ignitable pro-
 jectile fuse in section.

Referring to the drawing the body 10 of a
 projectile contains an electronic control
 unit 11 and an energy store such as a
 capacitor 12, both accommodated inside a
 sleeve 13. The capacitor 12 can be charged
 by a generator comprising a soft iron core
 14 formed with a flange 15 secured to the
 body 10 of the projectile in a manner not
 shown in detail. In a peripheral slot 14 of
 width a the core 14 contains an induction
 coil 17. Moreover, slidably mounted on the
 core 14 are an annular permanent magnet
 18 and a soft iron ring 19. The permanent
 magnet 18 and the soft iron ring 19 which is
 attached to the magnet can slidably shift
 from a first position shown in the drawing
 through an axial distance marked h into a
 second position. This length of shift h of the
 permanent magnet 18 and of its soft iron
 ring exceeds the width a of the slot 16
 containing the induction coil 17. In
 conventional manner, not shown in the
 drawing, the induction coil is connected to
 the capacitor 12. This connection may
 include a rectifier, which prevents the
 charged capacitor 12 from discharging again
 through the coil 17. The rectifier may be

replaced by a switch adapted to break the connection between the induction coil 17 and the capacitor 12 as soon as the latter has been charged.

- 5 There is further provided a switch which enables the capacitor 12 to be connected to an electrical detonator cap 20 to initiate the detonation of the projectile. This latter switch may be operable by the impact of the
10 projectile at the target or by a time delay relay which causes the projectile to burst at the end of a preadjustable time of delay. Yet another switch, for instance in the form of a centrifugal switch, is provided to energise
15 the time delay relay when the projectile begins to spin and thus to ensure that the projectile will in fact automatically burst at the end of the preadjusted time. Finally, a safe handling device is provided which
20 ensures that the capacitor 12 cannot be charged by an accidental jolt when the projectile is being handled into the gun.

- All the component parts of the described arrangement are so designed that they can
25 withstand an acceleration of the projection in the order of 40 000 to 100 000 times the acceleration of gravity (g).

- The permanent magnet is preferably axially magnetised. A spring not shown in
30 the drawing ensures that the permanent magnet 18 abuts the flanges 15 of the soft iron core before the projectile is fired. With advantage the soft iron ring 19 is adhesively bonded to the permanent magnet 18. The
35 safe handling device preferably has the form of a so-called locking element which prevents the permanent magnet 18 from shifting until the projectile experiences both acceleration and spin.

- 40 The drawing is confined to illustrating components relevant to the present invention, the several above-mentioned switches, the control unit 11 and the safe handling device are not shown in detail.

- 45 The described ignition unit functions as follows: When upon being fired the projectile experiences axial and rotary accelerations the time delay relay is acti-
50 vated and the safe handling device becomes ineffective permitting the permanent magnet 18 and its associated soft iron ring 19 axially to shift by virtue of their inertia a distance h from the position shown in the drawing. This movement of the permanent magnet 18
55 and of the soft iron ring 19 affects the magnetic flux acting on the induction coil 17 and induces a current in the coil 17 which

charges the capacitor 12. However, the charged capacitor is not connected to the electrical detonator cap until the interposed
60 contacts are closed either by the time delay relay or by impact of the projectile.

However, the control unit 11 may be so designed that the projectile cannot be
65 detonated until the projectile has hit the target and the delay time has elapsed.

Preferably the end face of the permanent magnet 18 remote from the soft iron ring 19 may carry a second soft iron ring. If this is
70 done a relatively short shift h will result in the induction coil 17 being outside the range of action of the magnetic field of the permanent magnet 18, since this is short circuited by the soft iron ring.

WHAT WE CLAIM IS:—

75 1. An ignition unit for an electrically ignited projectile fuse comprising a soft iron core, an induction coil embracing the soft iron core and an annular permanent magnet axially slidably shiftable from a first position
80 in which unit a soft iron ring is attached to and abuts the rear face, (viewed in the direction of the projectile trajectory) of the annular permanent magnet, the soft iron core being formed with a flange, which in the
85 first position of the permanent magnet is abutted by the front face of the permanent magnet or by a soft iron ring carried on the front face of the permanent magnet, the soft iron core being provided with a peripheral
90 slot which contains the induction coil, the sliding shift of the permanent magnet being sufficient for the induction coil to be outside the magnetic field of the permanent magnet when the latter is in a second
95 position, and in which the permanent magnet in its second position still embraces the soft iron core.

2. An ignition unit according to Claim 1 in which the permanent magnet and the
100 rearward soft iron ring are adhesively bonded together.

3. An ignition unit according to Claim 1 and 2, in which a detonating means is
105 located inside the core.

4. An ignition unit for an electrically ignited projectile fuse substantially as described herein with reference to the drawing.

ERIC POTTER & CLARKSON,
Chartered Patent Agents.

replaced by a switch adapted to break the connection between the induction coil 17 and the capacitor 12 as soon as the latter has been charged.

- 5 There is further provided a switch which enables the capacitor 12 to be connected to an electrical detonator cap 20 to initiate the detonation of the projectile. This latter switch may be operable by the impact of the
10 projectile at the target or by a time delay relay which causes the projectile to burst at the end of a preadjustable time of delay. Yet another switch, for instance in the form of a centrifugal switch, is provided to energise
15 the time delay relay when the projectile begins to spin and thus to ensure that the projectile will in fact automatically burst at the end of the preadjusted time. Finally, a safe handling device is provided which
20 ensures that the capacitor 12 cannot be charged by an accidental jolt when the projectile is being handled into the gun.

- All the component parts of the described arrangement are so designed that they can
25 withstand an acceleration of the projection in the order of 40 000 to 100 000 times the acceleration of gravity (g).

- The permanent magnet is preferably axially magnetised. A spring not shown in
30 the drawing ensures that the permanent magnet 18 abuts the flanges 15 of the soft iron core before the projectile is fired. With advantage the soft iron ring 19 is adhesively bonded to the permanent magnet 18. The
35 safe handling device preferably has the form of a so-called locking element which prevents the permanent magnet 18 from shifting until the projectile experiences both acceleration and spin.

- 40 The drawing is confined to illustrating components relevant to the present invention, the several above-mentioned switches, the control unit 11 and the safe handling device are not shown in detail.

- 45 The described ignition unit functions as follows: When upon being fired the projectile experiences axial and rotary accelerations the time delay relay is activated and the safe handling device becomes
50 ineffective permitting the permanent magnet 18 and its associated soft iron ring 19 axially to shift by virtue of their inertia a distance h from the position shown in the drawing. This movement of the permanent magnet 18
55 and of the soft iron ring 19 affects the magnetic flux acting on the induction coil 17 and induces a current in the coil 17 which

charges the capacitor 12. However, the charged capacitor is not connected to the electrical detonator cap until the interposed contacts are closed either by the time delay relay or by impact of the projectile.

However, the control unit 11 may be so designed that the projectile cannot be detonated until the projectile has hit the target and the delay time has elapsed.

Preferably the end face of the permanent magnet 18 remote from the soft iron ring 19 may carry a second soft iron ring. If this is done a relatively short shift h will result in the induction coil 17 being outside the range of action of the magnetic field of the permanent magnet 18, since this is short circuited by the soft iron ring.

WHAT WE CLAIM IS:—

1. An ignition unit for an electrically ignited projectile fuse comprising a soft iron core, an induction coil embracing the soft iron core and an annular permanent magnet axially slidably shiftable from a first position in which unit a soft iron ring is attached to and abuts the rear face, (viewed in the direction of the projectile trajectory) of the annular permanent magnet, the soft iron core being formed with a flange, which in the first position of the permanent magnet is abutted by the front face of the permanent magnet or by a soft iron ring carried on the front face of the permanent magnet, the soft iron core being provided with a peripheral slot which contains the induction coil, the sliding shift of the permanent magnet being sufficient for the induction coil to be outside the magnetic field of the permanent magnet when the latter is in a second position, and in which the permanent magnet in its second position still embraces the soft iron core.

2. An ignition unit according to Claim 1 in which the permanent magnet and the rearward soft iron ring are adhesively bonded together.

3. An ignition unit according to Claim 1 and 2, in which a detonating means is located inside the core.

4. An ignition unit for an electrically ignited projectile fuse substantially as described herein with reference to the drawing.

ERIC POTTER & CLARKSON,
Chartered Patent Agents.

