

The invention relates to a receiving coil for a programmable fuse of a projectile, comprising a coil core with a winding thereon. A projectile fuse of this type is known from the EP-A-0 300 255.

A programmable projectile fuse, for example according to the EP-A-0 300 255, comprises a device for setting a counter for triggering the fuse, in particular a time fuse, in the projectile after its launch, wherein the counter is set inductively by a transmitting coil placed in front of the muzzle of a gun via a receiving coil placed in the projectile, and a device for measuring the muzzle velocity of the projectile for setting the counter to trigger the time fuse in dependence on the muzzle velocity, wherein the receiving coil is wound on a coil body.

In order to permit setting the time fuse with a desired accuracy, it is necessary to transfer at least 12 Bit from the transmitting coil to the receiving coil. At a muzzle velocity of, for example, 1,200 m/sec, the receiving coil of the projectile passes through the transmitting coil on the muzzle takes a relatively short period of time, so that there is very little time available for the transfer of information from transmitting coil to receiving coil. Therefore, high frequencies are required for the transfer of information.

It has been found, that a coil core of steel permits the transfer of said information from the transmitting coil to the receiving coil, but this necessitates an undesirable increase in weight of the fuse. The coil core can be made of aluminium in order to reduce the weight of the fuse in the projectile, wherein

- a) the induced voltage is considerably lower with an aluminium core than with an iron core;
- b) the positive and negative amplitudes of the induced voltage with an iron core are asymmetric and not oppositely equal.

In order to avoid these disadvantages, an insert is placed according to the invention between coil core and coil winding, which screens the winding from eddy current fields. Preferably a thin steel band of 0.05 mm thickness is inserted between a coil winding of copper and a coil core of aluminium. This steel band attenuates the magnetic fields of the transmitting coil to such an extent that virtually no eddy currents are produced in a coil core of aluminium. There are also eddy currents in the steel band, but these are substantially smaller due to the larger eddy current resistance $R_{(Fe)}$ of the iron.

The aforementioned insert of steel band serves two different purposes:

- a) the magnetic lines of force are slightly densified due to the ferro-electrical properties of the steel band;
- b) magnetic field lines developing on the steel band cylinder induce eddy currents therein. These screen the aluminium coil carrier thereunder, so that virtually no eddy currents develop therein.

With correct dimensions of the steel band, the inventive receiving coil performs like a coil on a coil core of steel. This means that

- a) the output voltage of the receiving coil clearly increases with equal programming current of the transmitting coil;
- b) the positive and negative amplitudes are equal;

c) eddy currents can be reduced further by means of a thin, singlesidedly insulated steel foil with several windings.

An exemplary embodiment of the device comprising the inventive receiving coil will now be described in more detail, based on the attached drawing. Shown are, in

Fig. 1: a longitudinal section through a muzzle comprising a device for measuring the muzzle velocity and a transmitting coil for transferring information to a projectile which exits the muzzle;

Fig. 2: a longitudinal section through a projectile according to a second exemplary embodiment;

Fig. 3: an enlarged longitudinal section through the fuse of Fig. 2 for the purpose of improved illustration of the inventive insert.

According to Fig. 1, the muzzle 10 is surrounded by a three-section cage 11, 12, 13, which protrudes over the muzzle 10. In the middle section 12 of the cage is a first measuring coil 14, and in the front section 13 of the cage is a second measuring coil 15 as well as a transmitting coil 16. The mounting of the three-section cage 11, 12, 13 on the muzzle 10 and the interconnection of the three sections is assumed to be known and is neither illustrated nor described herein. Wires 17 and 18 serve the electrical supply of the two measuring coils 14 and 15. To screen the entire measuring system from interference by magnetic fields, a plurality of soft iron rods 19 are inserted into the three-section cage 11, 12, 13, of which only two are illustrated in Fig. 1. The transmitting coil 16 is composed of an individual winding 20 and a coil body 21. A projectile 22 flies in the direction of arrow A through the device for measuring the initial velocity and for transferring

information, i.e. through the two measuring coils 14 and 15 and through the receiving coil 16. The transmitting coil comprises an individual winding 20 and is relatively small. To determine the initial or muzzle velocity of the projectile 22, the time t required by the projectile 22 for travelling from coil 14 to coil 15 is measured. From the distance a between these two coils 14, 15 and said time t is derived the velocity $V_0 = a/t$. Taking this muzzle velocity of the projectile 22 into consideration, the time it will take the projectile to arrive at its target can be calculated. Thus, a time fuse 24 within the projectile 22 can be set or "tempered" so that the projectile is fused in the target area. The time required by the projectile to travel on exit from the muzzle 10 to the target is transmitted in digital form from the transmitting coil 16 to a receiving coil 25 in the projectile. As usual, the transfer is inductive. For setting the time fuse 24 with the required accuracy, at least twelve pulses should be transferred from transmitting coil 16 to receiving coil 25. As the projectile 22 travels through the transmitting coil 16, as mentioned earlier, at a speed of approximately 1,200 metres per second, it becomes necessary to transmit the twelve pulses at relatively high frequency at the right moment in time. The right moment in time for transmitting the pulses is determined by means of the front measuring coil 15 of the device for measuring the muzzle velocity. Information can be transferred from the transmitting coil 16 to the receiving coil 25 as soon as the projectile 22 has flown through coil 15. The pulses are fed from the receiving coil 25 via a filter 29 to a counter 32 which is connected to the time fuse 24.

According to Fig. 2, a so-called base fuse 40 at the rear end of a projectile 41 is screwed in via a thread

42. The individual elements of the fuse are located inside a fuse housing 43, which also serves as a coil core 43 and, together with a winding 23, forms the aforementioned receiving coil 25. An insulation layer 44 protects the coil from damage by hot propellant gases. The structure of the fuse is assumed known and will not be described here in detail.

According to Fig. 3, the receiving coil 25 has between copper-wire winding 23 and the aluminium coil core 43 formed by the fuse housing an insert 45, preferably of steel band, for example of ferro-electrical material of high permeability, wherein a thickness of 0.05 mm is sufficient for screening the winding 23 from an eddy current field.

A substantially thicker insert 45 of an insulating material can be used in place of the thin steel band if there is sufficient space available. A similar effect is achieved by a thus established distance between copper wire and aluminium core.



Patent Claims

- 1: Receiving coil (25) for a programmable projectile fuse (24, 40) comprising a coil core (43) with a winding (23) thereon, characterised in that the coil core (43) is of aluminium, and that an insert (45) which protects the winding (23) from eddy current fields is arranged between coil core (43) and winding (23).
- 2: Receiving coil according to claim 1, characterised in that a steel band is used as insert (45).
- 3: Receiving coil according to claim 2, characterised in that the steel band is made of ferro-electrical material of high permeability.
- 4: Receiving coil according to claim 3, characterised in that the steel band is made of a singlesidedly insulated steel foil with a plurality of windings.
- 5: Receiving coil according to claim 1, characterised in that an electrical insulating material is used as insert (45).