

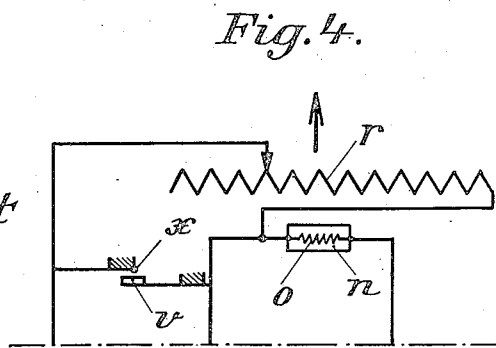
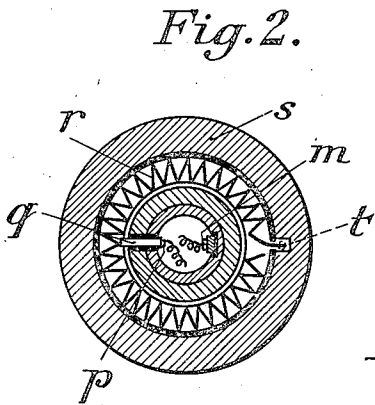
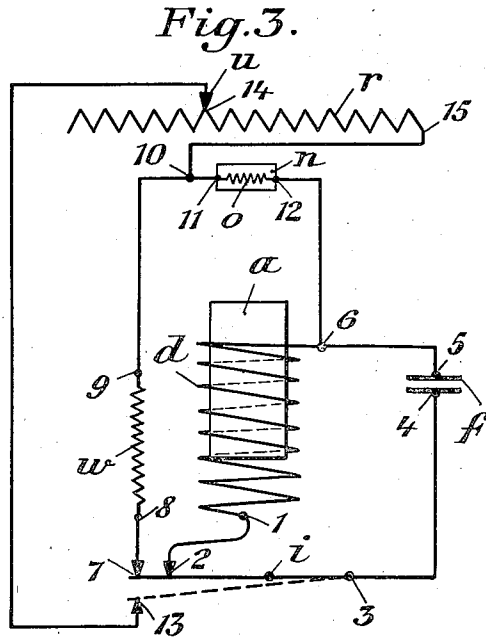
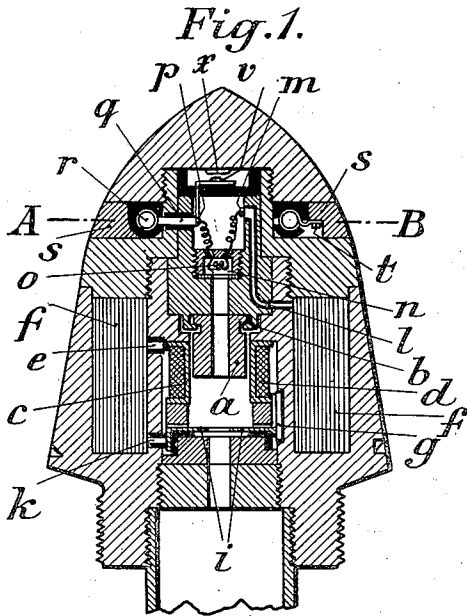
April 15, 1930.

H. RÜHLEMAN

1,755,023

ELECTRIC FUSE FOR PROJECTILES

Filed June 22, 1927



INVENTOR:
Herbert Rühlemann
BY Emil Bönnelycke
ATTORNEY.

UNITED STATES PATENT OFFICE

HERBERT RÜHLEMANN, OF SOMMERDA, GERMANY, ASSIGNOR TO RHEINISCHE METALLWAAREN- UND MASCHINENFABRIK, OF DUSSELDORF-DERENDORF, GERMANY, A CORPORATION OF GERMANY

ELECTRIC FUSE FOR PROJECTILES

Application filed June 22, 1927, Serial No. 200,683, and in Germany June 26, 1926.

In electric fuses for projectiles, whether time- or impact-fuses, the ignition of the priming-composition for the explosive mixture is, as is well known, effected by a heating wire which is automatically switched into the circuit of a source of current. As current sources in time-fuses are used accumulators, dry cells or wet cells, or generators actuated by the rotating movement of the projectile. The current operates a switch gear which after a certain adjustable period of time closes the circuit of the current source across the heating wire and in this manner effects the ignition of the priming-composition. These complicate and sensitive intermediate switch gears are dispensed with in fuses according to the invention. As proposed by the invention, the ignition is effected at an exactly determined point of time after firing of the projectile by proportioning the strength of current flowing from the current source to the ignition wire which current according to the adjusted strength heats the wire after a shorter or longer action to the degree necessary for the ignition of the priming-composition.

The adjustment of the current to the strength necessary for obtaining the desired ignition time point may for instance preferably be effected by a regulating resistance connected in series with the heating wire. This manner of regulation is suitable for any current source used and permits an exact determination of the time point of ignition. The strength of the current may, however, be regulated in another manner by a regulating device particularly suitable for the special source of current used.

According to the present invention a permanent magnet is used as source of current for electrical time-fuses which magnet in the moment of firing of the projectile makes a movement relative to or in a coil and generates an induction current in this coil which serves for heating the heating wire of the

priming-composition. This current source used hitherto for impact-fuses only has, compared with the cells, accumulators or generators used with the known time-fuses, the advantage of being simple, insensible and capable of being stored for an indefinite period of time.

As the current generation by the permanent magnet is effected and continued during a short period of time, the current generated is, for the purpose of obtaining more advanced points of time of ignition, also, not passed directly through the regulating resistance to the ignition wire, but this current is used first for loading a condenser which discharges over the resistance adjusted to a certain height and over the ignition wire.

By the use of the invention in combination with a permanent magnet which in well known manner for the current generation makes a relative movement when the projectile impacts upon an aim only, a simple and effective electric impact-fuse with adjustable retardation also is provided and by a suitable arrangement and construction of the internal electric device a pure electric double-fuse is provided.

In the accompanying drawings some modifications of electric fuses according to the invention are shown by way of example in connection with a time-fuse.

Fig. 1 shows a longitudinal section of a fuse according to the invention,

Fig. 2 is a cross section on the line A—B Fig. 1,

Fig. 3 shows diagrammatically the electrical connections and

Fig. 4 is a detail of the modification shown in Fig. 3.

In the longitudinal axis of the projectile a permanent magnet *a* is arranged shiftable in the longitudinal direction. The magnet *a* is held in the head of the projectile in its front end position by means of a locking device of known construction, for instance by

the lock spring *b*. Around the magnet *a* is arranged a coil body *c* wound with several turns *d* of insulated copper-wire. The coil body *c* is fixed in the head of the projectile. The two ends of the turns *d* are connected to a condenser *f* which, for instance, may be formed as a paper condenser with two tin-foils isolated by insulating paper. The one end of the turns *d* is connected across the contact *e* to the one tin-foil of the condenser *f*, while the other end of the turns *d* is led over contact *g* to a metal strip *i* which is stretched across the path of the magnet *a* and over contact *k* to the other tin-foil of the condenser *f*. The conductors *e*, *g*, *i* and *k* are insulated from the body of the projectile.

The tin-foil of the condenser *f* connected to the contact *e* is also connected to the insulated conductor *l*. Connected to this conductor at *m* is the one end of a thin resistance wire *o* embedded in the priming-composition *n* and serving as heating or ignition wire. This wire may, in the manner of the filament of an incandescent lamp, be wound or bent in a spiral or coil or in zigzag. Instead of an ordinary resistance wire a wire of Silit or of a similar material may be used. The other end of the resistance wire is connected at *p* to the contact *q* which in turn slides upon the surface of a resistance *r* arranged in a circle. The resistance *r* is insulated and unmovably arranged in a ring *s* which is rotatably and adjustably mounted in the head of the projectile. The ring *s* has in this construction the function of the usual composition ring in burning-fuses. The one end of the resistance *r* which in the example illustrated forms an angularly bent, helically wound wire is free, whereas its other end is electrically connected to the head of the projectile by means of a screw *t*.

When firing the projectile the magnet *a* by the inertia of its mass comes free from the locking springs *b* and moves to the rear in the head of the projectile. During this movement the lines of force of the magnet intersect the turns of the coil *d* and generate in the latter an induction current by which the condenser *f* is loaded, as this coil *d*, as stated above, is connected to both coatings of the condenser *f*. Shortly before reaching its rear end position the magnet *a* impacts upon the metal strip *i* and bends same in the middle. Hereby the one end of the metal strip is withdrawn from the contact *g*. The circuit of the coil *d* across the condenser *f* is opened and the loaded condenser *f* is disconnected from the coil *d*.

At the same time the circuit of the condenser *f* across the heating wire *o* of the priming-composition *n* is closed by the metal strip *i* bent in its middle by the magnet to such an extent as to make contact with the rear closing nut of the head of the projectile. Thereby the current flows from the one tin-

foil of the condenser *f* through the conductor *l* and the screw *m* to the heating wire *o* from which the current passes through the screw *p* and the contact *q* to the resistance *r*. According to the angular position of the ring *s* in the head of the projectile, the current flows there through a greater or smaller number of wire turns, i. e. a greater or smaller length of the resistance wire itself until it passes at the end at *t* into the body of the projectile and returns through the latter to the metal strip *i* and from there to the contact *k* and the other tin-foil of the condenser *f*. According to the height of the resistance in form of the wire windings adjusted in the resistance *r* more or less current will flow in the circuit and therefore also through the heating wire *o* of the priming-composition *n*.

The heating wire *o* furnishes an amount of heat according to the Joule-law of

$$Q = 0,24.I^2.r.tg - \text{cal.}$$

that is to say the amount of heat generated depends upon the strength of the current.

As a quite definite degree of heat is required for igniting the priming-composition, the ignition will be effected with a current of low strength after a longer period of action only, whereas with a high strength of current ignition takes place after a short period of time already. By means of the regulating resistance *r* the strength of the current and thereby the desired time necessary for causing ignition may be adjusted. The ring *s* is for this purpose, as the priming-composition of burning-fuses, provided with a scale indicating the ignition time points after firing which together with a mark at the head of the projectile permits to read off the ignition time adjusted.

In the modification shown in Fig. 3 the magnet *a*, as in the construction above described, on firing of the projectile moves through the coil *d* and generates in the latter an induction current which loads the condenser *f*. The current in this case flows from the one end *l* of the coil *d* through the points 2, 3, 4, 5 to the other end 6 of the coil *d*. During loading of the condenser *f*, however, a part of the induction current flows in a second circuit 1, 2, 7, 8, 9, 10, 11, 12, 6 through the priming-composition *n* and an exactly adjusted constant resistance *w*.

This second circuit causes a preheating of the ignition wire *o*. If, for instance, the detonation point is at 400° C. the ignition wire is preheated by this circuit to a temperature of about 350° C. At the end of the movement of the magnet *a* with regard to the coil *d*, the latter is disconnected from the condenser *f* and moreover the circuit for preheating the ignition wire is opened. The metal strip *i* then comes into the position shown in dotted lines and hereby closes the condenser *f* over the ignition wire *o* and the

resistance r adjustable by the moving contact u . The discharge of the condenser f then takes place from the one tinfoil 4 through the points 3, 13, 14, 15, 10, 11, 12, 6 to its second coating 5. This current furnished by the condenser f during the flight of the projectile is proportioned by the resistance r in such a manner that it effects the remaining heating of the ignition wire from 350° C. to the temperature of 450° C. which corresponds to the detonation point of the priming-composition and therefore the ignition of the latter after the lapse of the time adjusted at the indicating device of the resistance r .

Fig. 4 illustrates a device which makes the electric time-fuse described above also suitable as an impact-fuse. If during the flight of the projectile the priming-composition will not be caused to ignite at the adjusted ignition time point, the resiliently mounted contact piece v will, when the projectile impacts upon an aim, be thrown forward by the inertia of its mass. Hereby the contact piece v is pressed against a fixed contact x and short-circuits resistance r . The rest of the condenser load may hereby at once discharge without resistance through the priming-composition which effects the ignition of the latter.

According to another arrangement not shown an automatically acting contact device may be used by means of which, when the projectile impacts upon an aim, the electric energy generated by the movement of the magnet a in the induction coil is passed through the ignition wire o , so that the ignition of the priming-composition is caused.

What I claim is:

1. In an electric time-fuse for projectiles, in combination an explosive mixture, a priming-composition, a heating wire for igniting said priming-composition, an induction coil, a permanent magnet loosely mounted in said coil, said magnet being shifted in said coil and generating electric energy when the projectile is fired, a circuit connecting said energy generator to said heating wire, a condenser in said circuit loaded by said energy generator, a regulating resistance in the circuit of the heating wire, a movable contact in said circuit in the path of said movable magnet, said contact being at the end of the movement of said magnet shifted by the latter to cut the said coil off said condenser and to close the circuit through said regulating resistance and said heating wire, for the purpose of permitting the condenser to discharge, and a contact device for automatically short-circuiting the regulating resistance in the circuit from said condenser to said heating wire, said contact device acting when the projectile impacts upon an aim earlier than the time-fuse has come to action.

2. In an electric time-fuse for projectiles, in combination an explosive mixture, a prim-

ing-composition, a heating wire for igniting the priming-composition, a source of current in a circuit containing the said heating wire, means for regulating the strength of the current flowing to the heating wire for the purpose of heating said wire to the degree required for igniting the priming-composition after a shorter or longer duration of the action of the current, and a contact device for automatically short-circuiting the regulating resistance in the circuit from said condenser to said heating wire, said contact device acting when the projectile impacts upon an aim earlier than the time-fuse has come to action.

3. In an electric time-fuse for projectiles, in combination an explosive mixture, a priming composition, a heating wire for igniting said priming composition, an induction coil, a permanent magnet movably mounted in said coil, said magnet being shifted in said coil and generates electric energy when the projectile is fired, a circuit connecting said energy generator with the heating wire, a condenser in said circuit loaded by said energy generator, and a regulating resistance in the circuit of the heating wire.

4. In an electric time-fuse for projectiles, in combination an explosive mixture, a priming composition, a heating wire for igniting said priming composition, an induction coil, a permanent magnet movably mounted in said coil, said magnet being shifted in said coil and generates electric energy when the projectile is fired, a circuit connecting said energy generator with the heating wire, a condenser in said circuit loaded by said energy generator, a regulating resistance in the circuit of the heating wire, and a movable contact in said circuit in the path of said movable magnet, said contact being, at the end of the movement of said magnet, shifted by said magnet to cut the said coil from said condenser and to close the circuit through said regulating resistance and said heating wire, for the purpose of permitting the condenser to discharge.

5. In an electric time-fuse for projectiles, in combination an explosive mixture, a priming composition, a heating wire for igniting said priming composition, an induction coil, a permanent magnet movably mounted in said coil, said magnet being shifted in said coil and generates electric energy when the projectile is fired, a circuit connecting said energy generator with the heating wire, a condenser in said circuit loaded by said energy generator, a regulating resistance in the circuit of the heating wire, a movable contact in said circuit in the path of said movable magnet, said contact being, at the end of the movement of said magnet, shifted by said magnet to cut the said coil from said condenser and to close the circuit through said regulating resistance and said heating

wire, for the purpose of permitting the condenser to discharge, and means for preheating the heating wire by the current generated in said coil during the loading of the condenser.

- 5 6. An electric igniter for projectiles comprising a source of current, a regulating resistance, a priming composition, a resistance wire for the composition, and a condenser for
10 storing the current from the source of current necessary for heating the wire to fire the composition.

In testimony whereof I have affixed my signature.

15

HERBERT RÜHLEMANN.

20

25

30

35

40

45

50

55

60

65