Our invention relates to means for operating electric fuses for projectiles.

In electric projectile fuses the electric energy required for the ignition of the primer is already present in the projectile before the discharge, in an electric storage device, such as an accumulator or a condenser, or the projectile contains a current producing plant, such as a generator or a cell, which enters into action on or after the shot during the flight of the projectile or only on its impact on the aim, and produces the required electric energy. The projectile thus carries with it already before the shot and in any condition, the entire energy required to cause the explosion of the bursting charge. If this energy is not present there from the first in the condition required for the ignition, that means as electric energy, the latent energy is transferred electrically automatically after the shot into electric one, without that the operations further enacted and the effects resulting therefrom would permit any further human influence.

Now the method and the means forming the subject-matter of our invention provide the possibility of imparting to these operations an intentional and determined direction even after the projectile has been fired. According to our invention the electric energy required for initiating the ignition of the primer or for immediately igniting the latter, is transmitted only after the shot and during the flight of the projectile from a source of current separate from the projectile, or only a portion of this required electric energy is transmitted to the igniting device during the flight of the projectile after the shot, whilst the projectile itself carries with it, already before being fired, the remaining portion of the required energy in a latent state in a storage device, and transforms it into active power by means of a generator only during its further flight.

Furthermore, a very reliable guard for the projectile, when still in the gun-barrel or on transport, is thus created, as before the shot till the moment the projectile leaves the muzzle of the barrel it possesses no energy that would cause the explosion of the bursting charge, or only so little energy, that a premature or unintentional ignition is excluded.

Finally, electric time fuses or delay action fuses may be set, according to our invention, so as to act at a determined moment, by the aid of the means the invention affords, without special operations being required as hitherto, which take up much time and disturb the desired succession of the shots.

To carry out the method forming the subject-matter of our invention, an electric conductor is arranged beside the path of the projectile, which conductor is conductively connected to a source of current and from which the electric igniting device of the projectile receives the required electric energy by a contact action, when passing past said conductor during the flight of the projectile. Or a field of lines of force is arranged beside the path of the projectile, which field produces an induction current in the electric igniting device of the projectile passing through said field after being fired. According to whether a projectile fitted with an electric fuse is fired that possesses only an electric accumulator or besides the latter a power producing plant, the whole electric energy required for initiating the ignition of the primer or for immediately igniting the latter, is transmitted to the projectile, on only the remainder of energy still wanting.

Preferably that portion of the electric power producing plant serving to charge the electric fuse and arranged outside the projectile and causing a current to flow in the fuse or producing an induction current therein, that is, the contact points or an exciting coil, are arranged in front of the muzzle of the gun-barrel. The charging of the electric fuse thus takes place only after the projectile has already left the gun-barrel. This affords a very great safety of the fuse when still within the barrel. It is further obtained by this arrangement, that the charging of the fuse and the mechanical motions eventually tripped therein take place only after the projectile is no longer accelerated or is accelerated still in such a little degree only, that these motions of mechanical fuse members are not interfered with or prevented at all.
by forces of inertia. The contact points or the members producing a field of lines of force, of the plant and arranged beside the path of the projectile are preferably rigidly connected with a part of the gun that partakes of the pointing motions of the latter, as for instance with the cradles or with the gun-barrel itself. These members then assume always the correct position relatively to the projectile passing past them and to its electric fuse.

Furthermore, our invention affords suitable means for varying and differently regulating the current flowing in the conductor arranged near the path of the projectile, or the strength of the lines of force, in order to vary the energy to be supplied to the fuse or to be generated therein. This result may be obtained in a simple manner by inserting a regulating resistance in the circuit comprising said contact points or said induction coil. This arrangement enables the gun to fire projectiles having electric fuses that require different quantities of electric energy for the ignition of the primer of the bursting charge, as it permits of the current plant to be adapted to the different conditions and nature of the fuses. Besides, when projectiles are used the setting to different ignition moments of the fuses of which is effected by varying the quantity of the electric energy supplied to them, the possibility is afforded of the fuses being set to different ignition moments by simply varying said current or the strength of said field of the electric plant arranged outside the projectile.

In order to allow of our invention to be more easily understood, a preferred embodiment of the means for carrying out our method is diagrammatically illustrated in Fig. 1 of the accompanying drawing in combination with a gun, whilst Fig. 2 diagrammatically shows the interior of an apparatus for projectile equipped with an electric time fuse.

In the arrangement shown in Fig. 1, the charging and setting of the electric fuse takes place by means of separate excitation by an exciting coil surrounding a section of the path of the projectile. In order to secure this coil against the direct action of the propulsive gases, the latter are preferably deflected laterally between the muzzle and the exciting coil, this being obtained by mounting a muzzle brake on the gun-barrel, which arrangement is of advantage still to obtain other purposes.

The exciting coil is mounted on the cylindrical portion located in front of the baffle wall of the muzzle brake, and is connected through a regulating resistance and an amperometer to a source of current. The regulating resistance serves to vary the electromotive force supplied to coil and thus to vary the strength of the field of lines of force generated by said coil. The resistance may be installed directly at the gun or separately from it at a special stand. A second regulating device may further be provided, as indicated in the embodiment shown, so that the regulation of the strength of the field produced by coil may be effected both at the gun and at a station located at a distance therefrom.

The projectile shown in Fig. 2 and intended to be fired by the described gun, possesses a coil arranged on its shell surface closely behind the guide bunch. The ends of this coil are connected to a second coil and to a condenser. An iron core is always mounted in the coil, which core is partly outside the latter under the action of a spring. The iron core has pivotally connected to it a lever which is mounted on one end for rocking motion in the body of the projectile by means of a pivot. This lever is further pivotally connected on its free end with a shiftable rack and abuts in position of rest on a fixed lug, under the action of spring acting on the iron core. The rack has fixed on it a tilting contact piece adapted to interconnect the wires which connect the condenser with the contact pieces embedded in the primer.

During transportation and until the projectile is fired, the various parts of the electric projectile fuse assume the positions shown in Fig. 2. When fired the contact which hitherto has been held in open position by means of a spring, not shown, will be moved into the circuit of the condenser coil against the operation of a spring. At the moment the coil enters the fields of force produced by the exciting coil in the end of the gun-barrel, an induction current is produced in coil. This flows in part through the ignition coil and the other part through the closing contact to the condenser coil and places this condenser in a charged condition. Due to the current flowing in the ignition coil the iron core will be pulled into the coil and thereby presses the spring together and at the same time swings the lever in the direction of the arrow. Thereby the contact piece or member which is secured to the toothed rod strikes an abutment on the projectile body and thereby is rocked out of its heretofore safe position, that is, open position, into a position whereby the lower portion, which is constructed as a rigid member, moves into the position above the projectile open contacts from the condenser coil to the primer and in the circuits of the member. So that upon the return of the toothed rod the circuit will be closed by the bridging of the member. As soon as the ignition coil is wound, the further flight of the projectile, is through and past the field of the exciting coil, the induction circuit and therewith the magnetic operation of the coil on the core will cease. At the same time, the firing...
speed has been lowered to such an extent that
the contact $t$ will be opened again under the
action of its spring and the condenser $k$ will
maintain its charge since it is now discon-
nected from the coils $s$ and $t$. The core $l$
will thereby be moved again as heretofore.
Under the action of spring $m$ the core $l$ moves
outwardly beyond coil $s$, takes with it the rack
$p$ and shifts the contact piece $q$ toward the
contact points of the wires $s'$ leading from
the condenser $k$ to the primer $r$. This mo-
tion of the rack $p$ and of contact piece $q$ is
retarded by the fact, that now a pair of wings
$v$ is rotated by rack $p$ through the inter-
mediary of a gear $u$. Upon the wiring $s'$ be-
ing closed thereafter by contact piece $q$, the
condenser $k$ is discharged and a spark is pro-
duced between the poles embedded in the
primer $r$ which is thereby ignited.

The strength of the electromotive force pro-
duced in the coil $k$ and acting in the coil $i$ de-
deps on the strength of the field produced
by the exciting coil $c$ mounted on the gun-
barrel. The greater this strength in the ex-
citing coil $c$ is, the more the iron core $l$ of the
fuse is attracted into the magnet coil $i$ and
the more time passes until the circuit com-
prising the condenser $k$ and the initial igni-
tion $r$ is closed after the projectile has passed
through the exciting coil $c$. The regulating resistance $d$ enclosed in the
circuit leading to the exciting coil $c$ has a
scale which permits to read off the moments of
ignition for each adjusted strength of re-
istance $d$ and for each fuse used. This scale
may conveniently be arranged on the amper-
emeter $e$ interposed in the circuit leading to
the exciting coil $c$, so that variations of the
current supplied from the source $f$ and there-
with variations of the moments of ignition
may be seen at once and may be compensated
for by inserting more or less resistance, to
obtain the desired moment of ignition.

What we claim and desire to secure by Let-
ters Patent, is:

1. The method of supplying electric energy
to electric projectile fuses carrying with them in an electric storage device a portion
of the electric energy required for igniting the
primer, consisting in transmitting to the
electric igniting device of the projectile the
remainder of electric energy required for pro-
voking said action, from a source of current
separate from the projectile and after the
projectile has been fired.

2. The method of supplying electric energy
to electric projectile fuses equipped with an
electric generator adapted to produce a part
of the electric energy required for igniting the
primer consisting in transmitting to the elec-
tric igniting device of the projectile the re-
mainder of electric energy required for pro-
voking said action, from a source of current
separate from the projectile and after the
projectile has been fired.

3. A gun-barrel and a projectile adapted
to be fired thereby and having an electric igni-
ting device, and an electric conductor ar-
ranged near the path of the projectile and
adapted to actuate by induction the igniting
device of the projectile passing past it during
flight.

4. A gun-barrel and a projectile adapted
to be fired thereby and having an electric igni-
ting device, and means for producing near
the path of the projectile a field of electric
lines of force to be crossed by the projectile
during its flight, to actuate by induction the
igniting device of the projectile.

5. A gun-barrel and a projectile adapted
to be fired thereby and having an electric igni-
ting device, and means for producing be-
fore the muzzle of said gun-barrel a field of
electric lines of force adapted to be crossed
by said projectile during flight, to actuate by
induction the igniting device of the projec-
tile.

6. A gun-barrel and a projectile adapted
to be fired thereby and having an electric igni-
ting device, and means connected to the
muzzle of said gun-barrel and adapted to pro-
duce before the muzzle of said gun-bar-
rel a field of electric lines of force adapted to
be crossed by said projectile during flight, to
actuate by induction the igniting device of the
projectile.

7. A gun-barrel and a projectile adapted
to be fired thereby and having an electric igni-
ting device, an electric conductor arranged
near the path of the projectile and adapted
to actuate by induction the igniting
device of the projectile passing past it during
flight, and means for varying the electric energy
produced by said conductor, to vary the ac-
tion of said igniting device.

8. A gun-barrel and a projectile adapted
to be fired thereby and having an electric time
fuse adapted to be actuated differently by
electric energy of different strength, means,
for producing in the path of the projectile a
field of electric lines of force adapted to be
crossed by the projectile during flight, to
actuate by induction said time fuse, and
means for varying the electric energy pro-
duced by said field, to vary the timing ac-
tion of said time fuse.

In testimony whereof, we have signed our
signatures.

HERMANN SCHULER.
ANTON GIETMANN.