May 7, 1929. H. RÜHLEMANN 1,711,693

ELECTRIC FUSE FOR PROJECTILES

Filed Jan. 6, 1928

Fig.1.

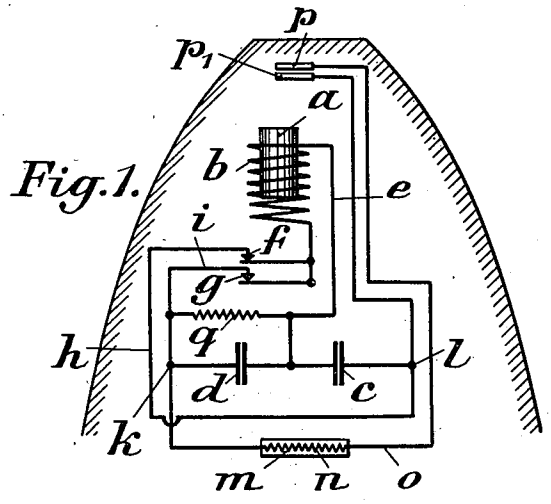


Fig.3.

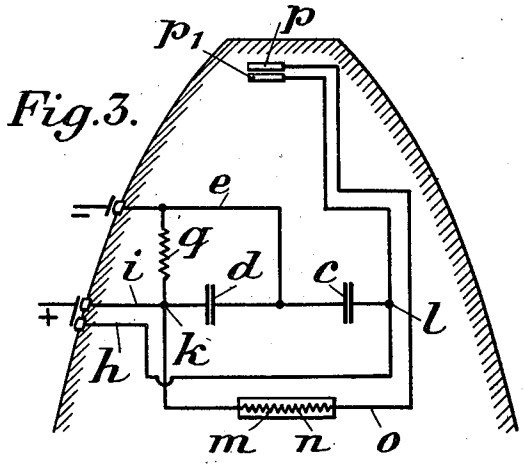
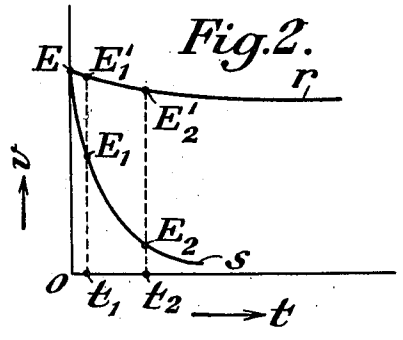


Fig.2.



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UNITED STATES PATENT OFFICE.

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ELECTRIC FUSE FOR PROJECTILES.

Application filed January 6, 1928, Serial No. 244,932, and in Germany January 14, 1927.

The invention relates to an electric fuse intended for projectiles and in which the discharging energy of an electric condenser is used to ignite the composition. The invention has for its object to make the fuse safe in the gun barrel by means of a special connection of the condenser, all mechanical safety appliances being obviated.

According to my invention the fuse comprises two condensers, the equally-loaded coatings being connected with each other and two thereof to the composition, which condensers are loaded up from a source of current to equal voltage, one of them discharging, after the projectile has been fired, through a resistance, so that only after a certain flight of the projectile a voltage arises between the two poles of the two condensers that suffices to ignite the composition.

The composition may be heated up to the degree of heat required for the ignition either by means of a heating wire embedded therein and through which the current flows, or by the spark of a spark gap formed between two poles, arranged at a distance apart from one another, of the conduit leading to the condensers. A permanent magnet arranged in known manner in the fuse may serve as source of current, which magnet, according to the fuse is a time fuse or impact fuse, generates an induction current in a coil connected with the condensers, by its movement relatively to this coil provoked due to the shot is being fired or the target being hit. The condensers may also be loaded by a source of power arranged separately from the projectile, which measure may also be adopted with all condenser fuses of other design and affords a very simple electric fuse that occupies but little space.

In order to allow of my invention to be more easily understood, two preferred embodiments of my improved fuse are diagrammatically illustrated in the drawing which accompanies and forms part of this specification. In this drawing:

Figure 1 is a diagrammatic view showing the electric connections of a fuse, the source of current is formed by a permanent magnet,

Figure 2 indicates the curves of voltage and time,

Figure 3 is a view of a fuse the condenser of which is loaded from a source of current arranged separately from the fuse.

In the embodiment shown in Figure 1, the permanent magnet a is adapted to be shifted in the longitudinal axis of the projectile in the coil b. The one end of coil b is connected to the conduit e that interconnects one coating of each of the two condensers c and d. The other end of coil b is connected to the other coatings of the condensers c and d at the points k and l by the conduits h and i through the contacts f and g. The points k and l are in connection with one another by the conduit o through an igniting wire n embedded in the composition m, a contacter p, p_1 being arranged in conduit o. The contacter p, p_1 is designed so as to be closed only when the projectile hits an aim, this being effected e. g. by the inertia of one of the contact plates or by the resistance of the air hit. The two coatings of the condenser d are further connected through a high ohm-resistance q.

When the projectile is fired, the magnet a is forwarded through the coil b due to the inertia of its mass and generates an induction current in the coil, by which current the two condensers c and d are loaded with equal voltage. At the end of its motion, magnet a opens the contact f and g whereby the loaded condensers are disconnected from coil b. As the condensers c and d are loaded in parallel to one another, no difference of potential exists at the points k and l immediately after the load. Hence, if immediately after the shot has been fired, that means when the projectile is still in the gun barrel, or close in front of it, the impact contacter p, p_1 would be closed by any reason, no current flows through the ignition wire n and no ignition takes place, as the same potential prevails at the points k and l.

After being loaded, the one condenser, d, discharges rather quickly through the resistance q, whilst the condenser c loses only quite successively some of its voltage due to the incompleteness of its dielectrics. These phenomena are illustrated in Figure 2 for the condenser c by the voltage-time curve r, and by the curve s for the condenser d. Upon the shot being fired (t=zero), both condensers have the voltage E, at the moment t_1

a voltage E_1'—E_1 prevails between the points k and l of the two condensers, which voltage, upon the contactor p, p_1 at this moment being closed unintentionally, would not be high enough yet, to send from condenser c to condenser d a current through the heating wire n, that would be sufficient to immediately ignite the composition m. Only when a further equalization of the two condensers takes place, also through the resistance q, the wire n would be heated in this case up to the temperature required to ignite the composition, which heating would take place only gradually. After the moment t_2 the potential difference E_2'—E_2 of the condensers c, d has become so great, that when the contacter p, p_1 would now be closed, an immediate ignition of the composition takes place by the current equalizing through the latter. The resistance q and therewith the discharge of condenser d is so tuned, that at the moment t_2, that is when a sufficient potential difference already prevails between the condensers c and d, the projectile is already at a sufficient distance from the gun barrel, so that an eventual premature closure of the contacter p, p_1 and the subsequent immediate ignition of the composition affords no danger for the crew and the gun.

As it will be seen from the foregoing, my improved purely electrically operated impact fuse is not only safe during transport, as only after the shot electric ignition power is supplied to it, but is also safe within the gun barrel, as only after the projectile has left the gun barrel a current of a voltage required to immediately ignite the composition is generated and sent through the latter, and finally, my fuse is of a very high sensibility, as the impact contacter may be closed already by a very slight force and as the delay arising in the electric equipment, after the contacter has been closed, is extremely small.

Instead of by the igniting wire n, the composition m may also be ignited by means of a spark gap formed in the conduit o. To this end the conduit o including the composition m is interrupted. However, a spark can be produced in the composition after the contacter p, p_1 has been closed, only after a determined potential difference has arisen between the points k and l after the discharge of condenser d through the resistance q.

The resistance q through which the condenser d is discharged, may further be designed so as to be regulated. In this manner the discharge time of condenser d is made adjustable and a barrel-safe fuse is obtained, as thus the voltage required to ignite the composition arises after a shorter or longer lapse of time according to the amount of resistance, adjusted on the resistance q between the poles k and l interconnected through the composition m. A spark gap is advantageously arranged in this case in the composition m in the conduit o leading to the condensers. The impact contacter p, p_1 arranged in conduit o is then dispensed with, but the wiring $k\ o\ l$ is closed from the first, except said spark gap.

When the ignition of the composition m is effected by means of a spark gap, then in order to differently adjust the ignition moments, the two poles located in the composition and leading to the condensers c and d, of the conduit o may be arranged adjustable as to their mutual distance. According to whether a greater or smaller spark gap is adjusted, the potential difference between the condensers c and d required to produce the spark and formed by the gradual discharge of the condenser d through resistance q will arise after a shorter or longer lapse of time.

The impact fuse the wiring diagram of which is illustrated in Figure 3, is loaded from a source of current arranged separately from the projectile, the other electric equipment and mode of operation of the fuse corresponding to that of the first embodiment. A separate generator or a cell may serve as source of current. To load the fuse, e. g. the conduit e that immediately connects one coating of each of the two condensers c and d, is connected to the minus pole, and the wires h and i^2 leading to the other coatings of the condensers are connected to the plus pole of the source of current. With a time fuse, the source of current may be combined with the fuse setting machine, so that the load is effected together with the setting operation. Furthermore, two contact pieces connected to the poles of the source of current may be provided for in the gun barrel, so that the loading of the condensers may take place upon the projectile being introduced in the gun barrel, or, with a suitable connection of said contact pieces with the trigger mechanism, only when the projectile is fired.

If the source of current is separated from the projectile, a switch is arranged in the conduit connecting the condenser d of the fuse through the resistance q, which switch connects the condenser automatically only upon the shot being fired, in order to obviate that the condenser d, eventually loaded before the shot, already discharges likewise before the shot.

What I claim, is:—

1. In an electric ignition device for projectiles, a source of electric current, an igniting composition, two electric condensers adapted to be loaded by said source of current and the equally-loaded coatings being connected with each other and two thereof to the composition, and means for unequally discharging one condenser relative to the other.

2. In an electric ignition device for projectiles, a source of electric current, an igniting composition, two electric condensers adapted to be loaded by said source of current and the equally-loaded coatings being

connected with each other and two thereof to the composition, and a high-ohm resistance interconnecting the two coatings of one of said condensers.

3. In an electric ignition device for projectiles, a source of electric current, an igniting composition, two electric condensers adapted to be loaded by said source of current and the equally loaded coatings being connected with each other and two thereof to the composition, and a high ohm regulating resistance interconnecting the two coatings of one of said condensers.

In testimony whereof I have affixed my signature.

HERBERT RÜHLEMANN.