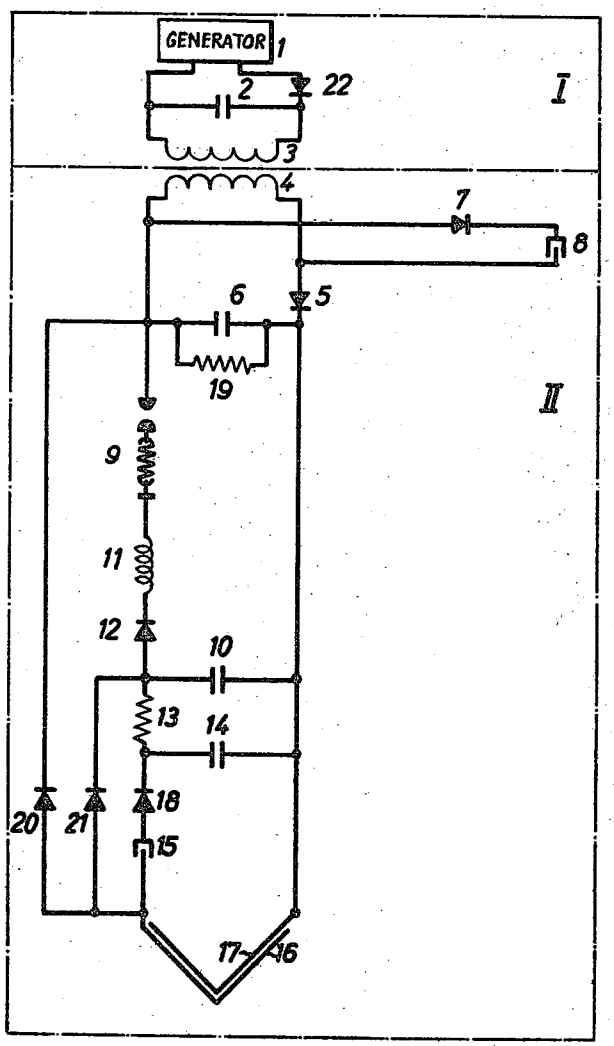
Oct. 8, 1963 HANS-DIETER HARNAU ETAL 3,106,160

ELECTRICAL PROJECTILE PRIMING DEVICE

Filed Nov. 3, 1960



Inventors
Hans-Dieter Harnau
Hermann Renner

By
Watson, Cole, Grindle & Watson
Attys.

United States Patent Office

3,106,160
Patented Oct. 8, 1963

3,106,160

ELECTRICAL PROJECTILE PRIMING DEVICE

Hans-Dieter Harnau, Gevelsberg, and Hermann Renner, Dusseldorf, Germany, assignors to Firma Rheinmetall G.m.b.H., Dusseldorf, Germany

Filed Nov. 3, 1960, Ser. No. 67,068
Claims priority, application Germany Nov. 6, 1959
11 Claims. (Cl. 102—70.2)

This invention relates to an electrical projectile priming device for several successive priming operations, in particular for projectiles with separate priming of their propellant section and their operative section. The device of the invention is distinguished from hitherto known electrical projectile priming devices mainly by an impulse generator, preferably incorporated in the firing weapon, and by a firing circuit of special design, located in the projectile and coupled to the impulse generator, for the triggering of the two half-waves which are being inductively generated in the coupling coil of the firing circuit of the projectile upon actuation of the impulse generator.

In further development of the invention, safety arrangements guarding against any faults which may occur are provided in the weapon as well as in the firing circuit of the projectile, and a possibility of checking the functioning of the device has also been provided.

The projectile priming device proposed by the present invention offers the advantage of a very high degree of safety in transit and safety against premature actuation shortly in front of the bore of the weapon.

The details of the invention will be understood from the description of an illustrated example of an electric circuit of a priming device.

The priming device comprises two section, i.e. the section I incorporated in the weapon and the firing circuit II located in the projectile. In this way, absolute safety in transit is achieved.

The section I incorporated in the weapon comprises an impulse generator 1 to which are connected a capacitor 2 and a coupling coil 3 via a rectifier 22.

The firing circuit II comprises a coupling coil 4. Both sections I and II are inductively coupled to one another after loading, by means of the coupling coils 3 and 4.

The coupling coil 3, together with the capacitor 2 forms a parallel resonant circuit coupled to the output of impulse generator 1. This resonant circuit is tuned to the characteristic frequency of the generator for the purpose of an improved transmission of energy. On actuation of the impulse generator 1, a pulse is transmitted to the coupling coil 3 whereby an oscillation with a positive and a negative half-wave is induced in the coupling coil 4.

According to the invention these two half-waves are utilized for two successive priming operations. The first positive half-wave charges the pre-storage condenser 6 by way of the rectifier 5. The second negative half-wave ignites the propellant section of the projectile by way of the rectifier 7 and the primer 8.

During the subsequent period of acceleration for the projectile, the acceleration switch 9 closes the resonant circuit comprising the condensers 6, 10 and the inductance 11 which leads to an oscillating discharge of the condenser 6, said discharge being already interrupted, however, after a quarter cycle by means of the rectifier 12, so that the intermediate storage condenser 10 retains

maximum charge potential. By including the inductance 11 and the rectifier 12 (transfer intensifier) in the circuit, almost the entire energy is transferred from the condenser 6 to the condenser 10, with the exception of small losses in the inductance 11, and only a very short-duration contact in the acceleration switch 9 is required to effect this transfer, since the resonant circuit may be tuned for high-frequency operation. The upper limit of the frequency is defined by the switching capacity of the rectifier 12. It is chosen in such a way, however, that upon closing of the switch 9 the pre-storage circuit 4, 6 which is tuned to the frequency of the initial resonant circuit 2, 3, is being de-tuned such that the priming capacitor 14 can under no circumstances receive a potential sufficiently high to effect priming.

Thereafter the condenser 10 discharges with delay into the condenser 14 via the resistance 13. In this way the barrel safety which is required according to the type of the projectile and its employment, is guaranteed because the primer 15 will only have been prepared when the condenser 14 has attained its full priming potential. In the priming circuit is also included a rectifier 18 which only passes current through the primer 15 when the condenser 14 begins to act as a potential source (ignition by impacting on target). The device is safeguarded against any faults which may occur in the following way:

If the transfer of the charge of condenser 6 is not effected within the very short time provided for the dispatch of the projectile (propellant failure), then, if the switch 9 is closed later on by mechanical impact (unloading etc.), said condenser whose potential will have dissipated through the leak resistance 19, will no longer have the potential necessary to initiate the priming of the operative section.

If the two nose halves 16, 17 constituting the nose contactor have been damaged prior to firing so that both nose halves 16, 17 have connected so as to conduct current, the condenser 6 is short-circuited via the two nose halves 16, 17 and the rectifier 20. In this case the projectile leaves the barrel as a dud.

If the contactor nose 16, 17 is damaged during the barrel safety interval, ignition of the operative section can still not take place because the condenser 10 is then discharged via the nose halves 16, 17 and the rectifier 21, i.e. the transfer of the charge from condenser 10 to condenser 14 is terminated before the requisite priming voltage is attained. The energy with which the capacitor 14 has been charged up to then is compensated via the two nose-halves 16, 17, the rectifier 21 and the resistance 13.

Since the timing operation can only be triggered by the inductive transmission of a potential impulse originating in the impulse generator 1, which is located in the weapon, the transport safety of the projectile is guaranteed in any case.

Prior to being assembled in the projectile, every priming device can be accurately tested for functioning in a simple manner, since the circuit points required for testing have been made accessible from without to enable the operational elements (contact hoods and primer connections) to be connected.

To carry out a test, it is possible for example to transmit the potential impulse in the usual manner to the coupling coil 4 and to connect the condenser 14 to the input of an oscillograph via the screw fitting for the

primer 15 and the primer thread (connection for 17), so that the charge characteristic for condenser 14 is rendered visible, which characteristic should be confined within predetermined limit curves.

In this operation, the second half-wave (connections made at 8) prompts a short mechanical impact which actuates the acceleration switch 9.

The behaviour of the primers in the case of premature contacting of the hoods may for example be ascertained by means of a timed switch, not shown in the drawing, which is connected to the leads of the contacting hoods 16, 17.

What we claim is:

1. An electrical priming device for a projectile having a propellant section connected to an operative section, comprising means for receiving a signal having an alternating waveform, a signal storage and transfer circuit and a firing circuit for the operative section, said storage and transfer circuit including a first capacitor and means for transferring charge from the first capacitor to said firing circuit, a priming device for said propellant section, means for routing the positive half-wave of said signal to charge said first capacitor, and means for routing the negative half-wave of said signal to actuate said propellant section priming device.

2. An electrical priming device for a projectile according to claim 1, in which the operative section storage and transfer circuit includes a second capacitor and acceleration responsive means for connecting said first and second capacitors for transfer of charge from the first capacitor to said second capacitor.

3. An electrical projectile priming device according to claim 2 in which the operative section storage and transfer circuit includes a third capacitor and a resistor, said third capacitor and said resistor being connected in series across the second capacitor.

4. An electrical projectile priming device according to claim 1, in which said firing circuit includes a priming means and an impact contactor, first and second contacts for said contactor closable in response to an impact, said contactor and priming means connected to said storage and transfer circuit for the receipt of an actuating signal therefrom upon closure of said first and second contacts.

5. A firing device according to claim 1, including an impulse generator and an input oscillator circuit coupled to said impulse generator, said generator and oscillator circuit being located in said operative section.

6. An electrical priming device for a projectile having a propellant section and an operative section, said device including means for receiving a signal having an alternating waveform, an electrical charge storage and transfer circuit and a firing circuit for said operative section, said charge storage and transfer circuit having first, second and third charge storage means, acceleration responsive means for transferring charge from said first to said second charge storage means, said second and third charge storage means being connected via charge transfer delay means, said firing circuit including a priming means connected in series with an impact contactor, first and second contacts for said contactor closable in response to an impact, said series connected contactor and priming means connected to said third charge storage means for discharging said discharge storage means to actuate said firing device upon closure of said first and second contacts, and means for routing the positive half-cycle of the received signal to charge said first charge storage means, a propellant section priming means and means for routing the negative half-cycle of the received signal to actuate said propellant section priming means.

7. An electrical projectile priming device according to claim 6, and including first means connected between said impact contactor and said first charge storage means to permit discharge thereof upon closure of said first and second contacts prior to operation of said acceleration responsive means, and second means connected between said impact contactor and second storage means and providing a discharge path therefor upon closure of said first and second contacts.

8. An electrical priming device for a projectile having a propellant section coupled to an operative section, including a coil for receiving a signal having an alternating waveform, an electrical charge storage and transfer circuit and a firing circuit for said operative section, said charge storage and transfer circuit including first, second and third capacitors, acceleration responsive means for connecting said first and second capacitors to permit transfer of charge from said first capacitor to said second capacitor, a delay resistor connected in series with said third capacitor, said series connected delay resistor and third capacitor connected across the second capacitor, said firing circuit including a primer, a rectifier and an impact contactor having first and second contacts, said primer being connected in series with said first and second contacts and with said rectifier, the third capacitor being connected to said rectifier, said rectifier being poled to permit discharge of said third capacitor through said primer upon closure of said first and second contacts, said primer being actuable only if said third capacitor is charged above a predetermined level, a second primer connected in said propellant section, first and second routing rectifiers, said coil connected in series with said first routing rectifier and across said first capacitor, said coil further being connected in series with said second routing rectifier and across said second primer, said first and second routing devices being poled so that the positive half-cycle of the received signal is routed via said first routing rectifier to charge said first capacitor, and said negative half-cycle of said received signal is routed via said second routing rectifier to actuate said second primer.

9. An electrical projectile priming device according to claim 8, and including an acceleration responsive switch, an inductance and a rectifier all connected in series and between one side of said first capacitor and one side of said second capacitor, so that closure of said switch allows charge to be transferred from said first to said second capacitor.

10. An electrical projectile priming device according to claim 8 and including a resistor connected in parallel with said first capacitor, a first capacitor discharging rectifier connected in series with said first and second contacts across said first capacitor and poled to permit discharge of said first capacitor on closure of said first and second contacts prior to operation of said acceleration responsive means to transfer charge from said first to said second capacitor, a second capacitor discharge rectifier connected in series with said first and second contacts across said second capacitor and poled to permit discharge of said second capacitor on closure of said first and second contacts.

11. An electrical projectile priming apparatus comprising an impulse generator, a resonant circuit including a capacitor and an inductor connected in parallel, a rectifier, said impulse generator connected in series with the rectifier to said parallel resonant circuit to supply unidirectional impulses thereto, the resonant circuit forming an alternating signal having a frequency equal to the frequency of the impulse generator in response to a pulse from said generator, a receiving coil coupled to said parallel resonant circuit inductor, a second capacitor connected in parallel with said receiving coil to define a signal receiving parallel tuned circuit having a resonant frequency equal to that of the signal generating resonant circuit and an acceleration responsive switch coupled to said receiving coil, said resonant circuit comprising a first and a second charge storing capacitor and having a resonant frequency such that it is strongly detuned relative to the signal receiving tuned circuit upon closure

of said acceleration responsive switch, the combination further including a rectifier connected in series between said first and said second charge storing capacitors whereby closure of said acceleration responsive switch allows charge to be transferred from said first to said second storing capacitor.

References Cited in the file of this patent

UNITED STATES PATENTS

2,514,359 Allison ---------- July 11, 1950
2,737,890 Brode ---------- Mar. 13, 1956
2,900,910 Small ---------- Aug. 25, 1959
2,903,534 Bleakney ---------- Sept. 8, 1959
2,921,981 Kidd ---------- Jan. 19, 1960
2,926,610 Ruehlemann ---------- Mar. 1, 1960
2,998,773 Ruehlemann ---------- Sept. 5, 1961

FOREIGN PATENTS

1,056,970 Germany ---------- May 6, 1959