United States Patent [19]

Kaprelian et al.

[11] **3,736,837**

[45] **June 5, 1973**

[54] **ELECTRICAL INITIATION OF PERCUSSIVE-PRIMED CARTRIDGES**

[75] Inventors: **Edward K. Kaprelian,** Mendham, N.J.; **Howard I. Carroll,** Aberdeen, Md.

[73] Assignee: **The United States of America as represented by the Secretary of the Army,** Washington, D.C.

[22] Filed: **Dec. 28, 1971**

[21] Appl. No.: **212,962**

[52] **U.S. Cl.**.....**89/28 R,** 102/70.2, 102/28

[51] **Int. Cl.**.....**F41f 9/00,** F41d 9/00

[58] **Field of Search** .....89/28 R, 28 C; 102/70.2 R, 28, 135, 1.814

[56] **References Cited**

UNITED STATES PATENTS

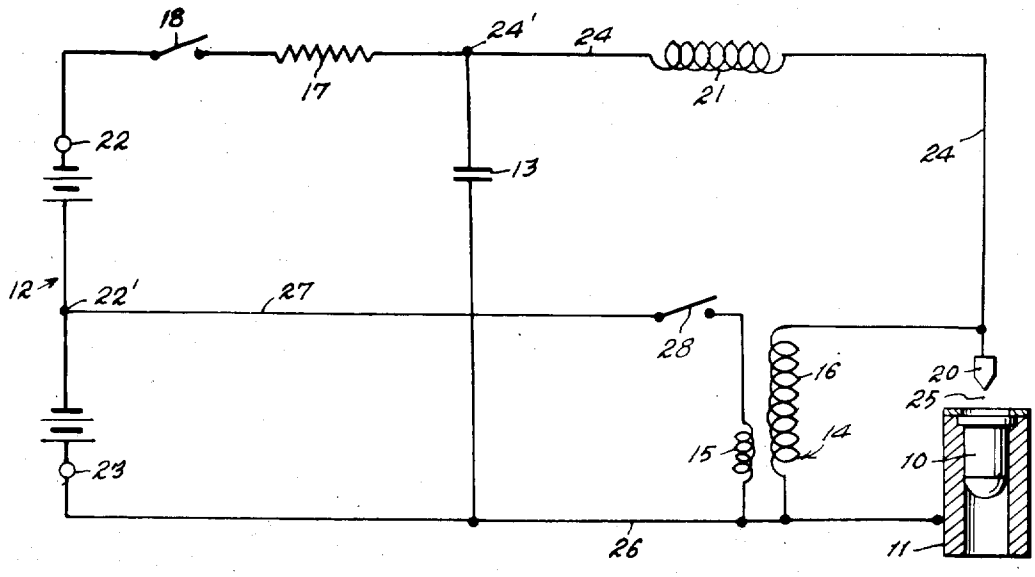
2,957,391 10/1960 Lovercheck.....89/28 R

Primary Examiner—Benjamin A. Borchelt
Assistant Examiner—J. V. Doramus
Attorney—Harry M. Saragovitz, Eward J. Kelly and Herbert Berl

[57] **ABSTRACT**

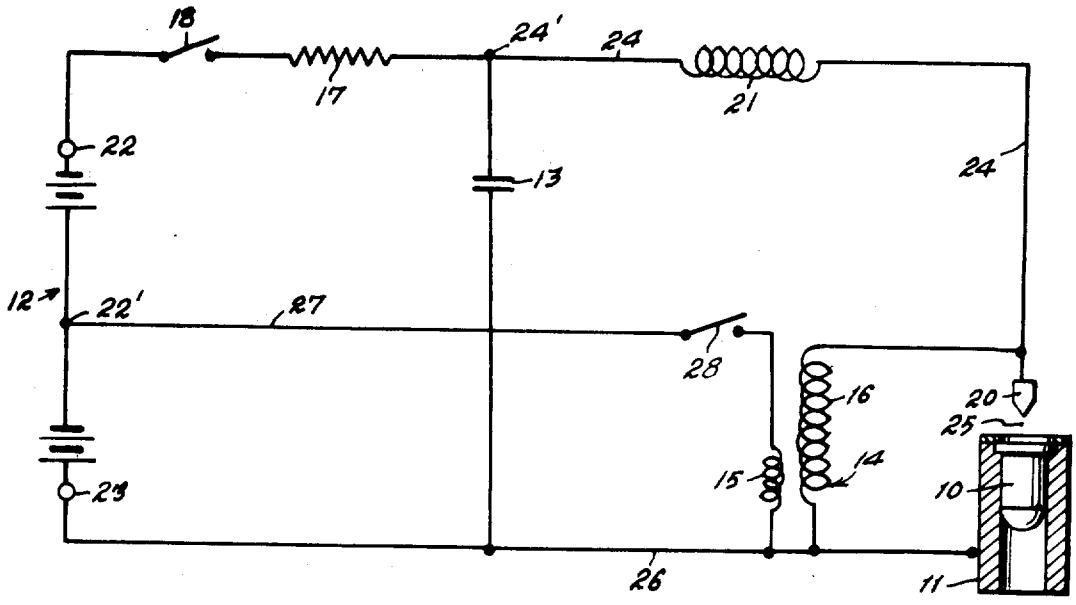
Disclosed is an electrical firing circuit for initiating percussive-primed cartridges wherein the base of the cartridge forms one electrode of a spark gap which has connected thereacross an RF pulse generating means and a charged capacitor. When energized, the pulse means ionizes the air in the spark gap whereupon the capacitor discharges thereacross causing heating of the cartridge base containing the primer mix whereby the primer mix is initiated and hence the cartridge.

5 Claims, 1 Drawing Figure



PATENTED JUN 5 1973

3,736,837



INVENTORS,
Edward K. Kaprelian
Howard I. Carroll

BY: Harry M. Saragovitz
Edward J. Kelly & Herbert Berl
ATTORNEYS.

ELECTRICAL INITIATION OF PERCUSSIVE-PRIMED CARTRIDGES

The invention described herein may be manufactured, used, and licensed by or for the Government for governmental purposes without the payment to us of any royalty thereon.

The invention relates to electrical firing means for munitions and more particularly to electrical firing means and apparatus for electrical initiation of small arms cartridges, particularly percussive-primed cartridges.

In one instance small arms cartridges are each provided with an electrical primer which is electrically coupled through firing pin means, breech mechanism in cooperation with switching means to a primer source such as a charge capacitor or an induction circuit means for activating the electrical primer. Such an arrangement not only involves complicated mechanical firing mechanism and erosion of the firing pin, but also the susceptibility of the electrical primer to radio frequency fields with probable ignition of the primer and subsequent premature firing of the cartridge. In another known means, a cartridge is fired by means of an electric spark which jumps a gap disposed in the proximity to an ignitable fuse. However, such means is not only impractical from military use, but also involves the use of a special cartridge, not standard in civilian or military use.

Percussive-primed cartridges are normally initiated by the action of a firing pin, but can also be initiated by "cook-off" of the primer mix by virtue of external heating. Caliber .22 percussive-primed cartridges have been fired in a modular firing device, but module firing once started was generally unpredictable in action and could not be controlled or stopped. One such moduler firing device consists of 360 aluminum tubes or barrels to accommodate caliber .22 cartridges bound together by epoxy resin in a box-like configuration having the approximate dimension of 7½ × 5 × 2 inches. A sheet of pyrotechnic material was caused to burn across the basis of the caliber .22 percussion primed cartridges assembled in the tubes of the modular firing device whereby the heat thus generated caused the primers of the cartridges to "cook-off". While this means does cause ignition of the primers of percussive primed cartridges, its use is highly undesirable particularly since it has been found that it is not only unreliable and uncontrollable but also highly hazardous from a safety standpoint. Percussive primed cartridges may also be fired in a direct contact circuit. For example, a caliber .22 percussive prime cartridge connected directly across a 40 volt source required a current of 300 amperes over a period of 10 seconds for firing. Obviously, the inadequacy of employing such a firing means is apparent. Also, it has been found possible to fire percussive primed cartridges utilizing the spark plug principle wherein the cartridge comprises the electrodes of the spark gap. This system requires 2000–2500 volts for high-frequency ionization of the gap while at the same time providing sufficient electrical energy to fire the cartridge in the order of 10 joules for a caliber .22 percussive primer cartridge. Thus the energy requirements of this system are high, limiting the practicality thereof for military requirements.

An object of the invention is a new and novel electrical firing circuitry for electrical initiation of percussive primers.

Another object of the invention is a new and novel means for electrical initiation of percussive primed cartridges.

A further object of the invention is an electrical firing system for ignition of percussive prime cartridges which permits operation of weapons systems at a high rate of fire without employment of complex mechanical movement and complex electrical circuitry and switches.

A still further object of the invention is a new and novel electrical ignition means for ignition of percussive primed cartridges of extreme simplicity wherein the energy requirement thereof is relatively low.

Referring to the drawing wherein the electrical ignition means and system of the invention for firing percussive primed cartridges is illustrated in conjunction with a single percussive primed caliber .22 cartridge **10** in the breech of a single barrel firearm **11** for the purpose of simplicity, it being understood that application of the invention is not limited to single barrel firearms and further, that it has been used in conjunction with weapon systems whereby a rate of fire of 10,000 rounds per minute has been attained without a single moving mechanical part and without complex circuitry and switching. An electrical energy source **12** which may consist of two series connect lead-acid type batteries provides means for charging a capacitor **13** and energizing the RF pulse producing means **14** which may consist of an automotive type ignition coil having a primary winding **15** and a secondary winding **16.** A resistor **17** has one terminal coupled through a switch **18** to terminal **22** of the electrical energy source on battery **12** and and another terminal by means of conductor **24** to an electrode **20** through an inductor **21.** The electrode **20** is aligned with cartridge **10** along its longitudinal axis and spaced from the base thereof to form a spark gap **25** therewith across which electrical energy is discharged. Capacitor **13** has one plate connected to a junction **24'** formed on conductor **24** intermediate resistor **17** and inductor **21** whereby it is coupled through resistor **17** and switch **18** to terminal **22** of battery **12** and through inductor **21** to electrode **20.** The opposite plate of capacitor **13** is connected to common **26** and thereby to terminal **23** of battery **12** and firearm **11** and hence to cartridge **10.** Primary winding **15** of ignition coil **14** has one terminal connected through switch **28** via conductor **27** to an intermediate top **22'** of battery **12** and its other terminal connected to terminal **23** of battery **12** by means of common conductor **26.** The secondary winding **16** of ignition coil **14** is coupled across spark gap **25,** one terminal thereof being connected to electrode **20** and the other terminal thereof to common circuit **26** and hence through firearm **11** to cartridge **10.** In operation, switch **18** is closed and capacitor **13** is charged through resistor **17** to the potential of battery **12.** The size of capacitor **13** is selected in view of the priming mix of the percussive primed cartridge **10** to provide sufficient arc heat to cause cook-off of the priming mix. After capacitor **13** has been charged by battery **12** switch **28** is closed and a current build up in primary winding **15** inducing a high voltage in the secondary winding **14** thereof it being understood that the voltage induced in the secondary winding may be created by either opening or closing of switch **28,** whereby a RF pulse is created and discharges across spark gap **25** causing ionization of the air in said gap thereby producing a highly conductive

path across which capacitor **13** then discharges. The energy of capacitor **13** discharge creates sufficient heat in the base of cartridge **10** to cause cook-off of the primer mix in the percussive primed cartridge **10.** Resistor **17** functions to prevent battery **12** from maintaining the arc or capacitor discharge across spark gap **25** and indicator **21** prevents the RF pulse of the RF pulse producing means **14** from shorting to ground, common conductor **26,** through capacitor **13.**

Although a specific embodiment of the invention has been illustrated and described, it will be understood that this is but illustrative and that various modifications may be made therein without departing from the spirit of the invention and the scope of the claims.

We claim:

1. An low voltage electrical firing circuit for initiating percussive-primed cartridges comprising in combination:

a percussive-primed cartridge affixed in a firearm and having the base thereof serving as one electrode of a spark gap,

a terminal spaced from the base of said cartridge and exterior thereof and in alignment therewith forming the other electrode of said spark gap,

radio-frequency pulse generating means coupled across said electrodes for ionizing said spark gap,

high intensity electrical energy storage means coupled across said spark gap and operable to discharge across said spark gap when it is ionized by the said pulse generating means and heat said base whereby the primer of the percussive-primed cartridge is initiated.

2. The invention in accordance with claim **1** wherein said radio-frequency pulse generating means comprises a high tension induction coil having a primary and secondary winding, said primary winding coupled across a potential source through switching means for connecting and disconnecting said primary winding to or from said potential source, and said secondary winding having one terminal connected to said other electrode and another terminal connected to said one electrode through said firearm.

3. The invention in accordance with claim **2** wherein said high intensity electrical storage means comprises a capacitor coupled in parallel with said potential source and said spark gap.

4. The invention in accordance with claim **3** and means for preventing the potential source from creating an electrical arc across said spark gap when ionized comprising a resistor connected in series with potential source and said other electrode.

5. The invention in accordance with claim **4** and means for preventing the RF pulse generated by said pulse generating means from shorting to ground through said capacitor comprising a blocking impedance coupled between said other electrode and said capacitor.

* * * * *