April 3, 1962 J. J. HOPKINS 3,027,842

FUZE

Filed March 4, 1946

FIG. 1

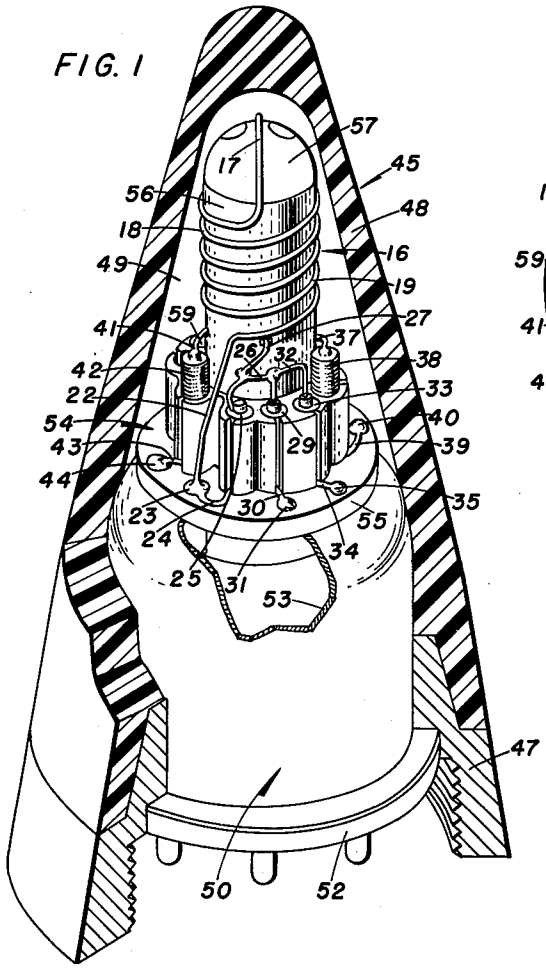


FIG. 3

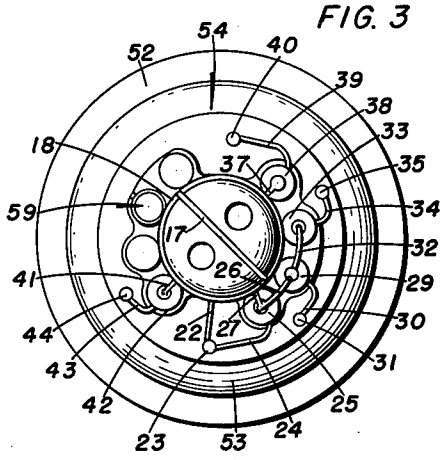


FIG. 2

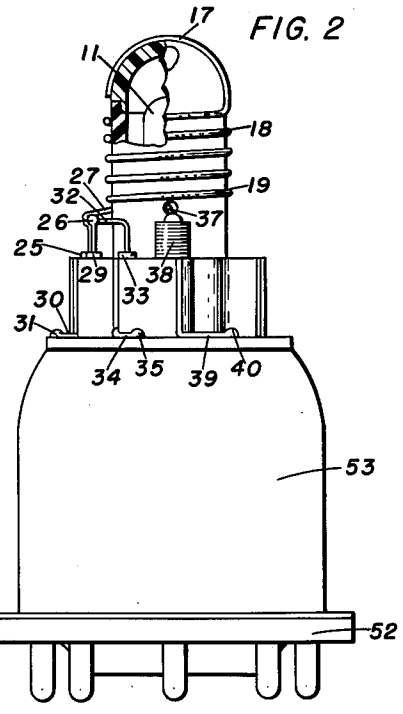
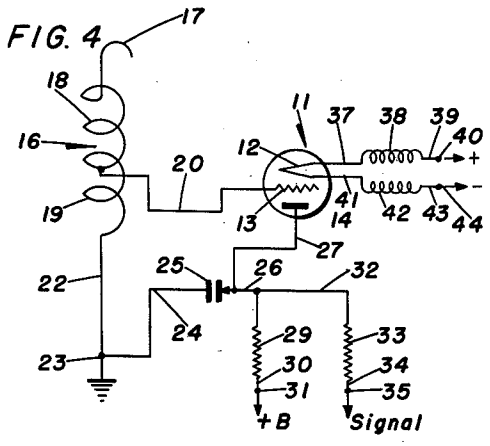


FIG. 4



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FUZE

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6 Claims. (Cl. 102—70.2)

The present invention relates generally to radio proximity fuzes and more particularly to an improved electronic fuze of the general type described in the co-pending patent application of Merle A. Tuve and Richard B. Roberts, Serial No. 471,388, filed in the United States Patent Office on January 6, 1943, entitled "Fuze," and assigned to the same assignee as the present application and invention, now abandoned.

In the above-mentioned co-pending application there is disclosed an electronic fuze adapted to cause detonation of a projectile upon attainment of proximity to a target. A fuze of this class comprises an oscillator for generating radio frequency signals, an antenna system including an "exciter" antenna and a projectile casing for radiating the signals, an amplifier coupled to the oscillator for selectively amplifying a modulated signal in the oscillator plate or work circuit, the last-mentioned signal having a predetermined amplitude indicative of target proximity, and a gaseous grid-controlled discharge tube responsive to the amplified modulated signal for producing a detonating current. The fuze is associated with an electrical detonator controlled by this detonating current and, of course, suitable bursting charges for causing explosion of the projectile when it comes close to the target.

It has been found that where the antenna system included an "exciter" antenna comprising a cap mounted exteriorly of the projectile nose or largely embedded therein, the soldered connection between the conductor leading from said cap to the oscillator coil became loosened, when the projectile was discharged from the gun, with resultant failure of the fuze to operate. This condition was brought about because the adiabatic temperature increase due to stagnation pressure on the apex of the projectile nose caused the temperature at said apex to rise to approximately 700° F., which temperature was, of course, sufficient to cause melting of the soldered connection.

One of the principal objects of the present invention, therefore, is to provide an improved radio proximity fuze wherein the "exciter" antenna is contained completely within the recess of the projectile nose with the result that there will be no soldered connections to be subjected to high temperatures.

Another object of the invention resides in the provision of an improved fuze of this character which will be of relatively light weight and compact construction and capable of easy assembly, such considerations being of paramount importance in fuzes for use in small missiles.

For a better understanding of the present invention, reference is made to the following specification, taken in connection with the accompanying drawings, wherein:

FIGURE 1 is an elevational perspective view of a preferred embodiment of fuze in accordance with my invention, illustrating its relationship to broken away portions of a projectile in which it is installed;

FIGURE 2 is a side elevation of the device, as seen from a substantially diametrically opposed reference position of view, and also partly broken away;

FIGURE 3 is a top plan view of the fuze; and

FIGURE 4 is a circuit schematic of the oscillator, antenna and associated electrical circuits employed in the fuze.

Referring first to FIG. 4 in a brief description of the electrical elements of the embodiment shown in FIG. 1,

included in the fuze is an electronic tube **11** of the triode type, having an electron-emitting filamentary cathode **12**, a control electrode, or grid, **13**, and an anode, or plate, **14**. A single coil of conductive material **16** having an antenna extension portion **17**, an impedance matching transformer section **18** and an inductance section **19**, serving as the oscillator tank coil, forms a part of the oscillator. Specifically, a conductor **20** connects a tap of coil **16** to the grid of the tube **11** and a conductor **22** connects one terminal of the coil to ground terminal **23**. The tank circuit of the oscillator also includes a capacitor **25**, connected between the ground terminal **23** and the plate or anode **14** by conductors **24** and **27**. Anode **14** is coupled to a suitable source B+ of space current (not shown) through a plate resistor **29**, conductor **30** and terminal **31**. The signal output circuit from plate **14** comprises conductor **32**, resistor **33**, conductor **34** and the terminal **35**, which terminal is adapted to be coupled to an amplifier input circuit. The amplifier is of the same general type as that described and illustrated in the co-pending patent application mentioned in the first paragraph of this specification and, therefore, need not be described herein. The filament heating circuit is completed from a source A (not shown) through chokes **38** and **42**, conductors **37**, **41**, **39** and **43**, and terminals **40** and **44**. The circuit components and conductors illustrated in FIGS. 1, 2 and 3 have the same reference numerals as their respective assemblies shown in FIG. 4.

Referring now specifically to FIG. 1, the numeral **45** indicates generally a converging projectile nose of plastic material and preferably of two-piece construction. The nose includes a base portion **47** and an ogive portion **48**, and said nose has a hollow interior defining a chamber **49**.

The fuze unit including the above described electrical components is shown generally at **50**, and includes a base **52** on which is mounted an amplifier unit including the above-mentioned amplifier (not shown in detail). The amplifier unit is surrounded by a metal shield **53**, and an oscillator support **54** is rigidly secured to the top of the shield. The oscillator support is of circular shape and includes a base portion **55** and a mid-portion having annularly disposed circular recesses adapted to receive the resistors, chokes and capacitor. The oscillator support includes a coil form **56**, of suitable insulating material, and said coil form surrounds the electronic tube **11** to provide a measure of protection therefor. The coil form is closed at its upper end by a hemispherical cap **57**, which cap may be fabricated integrally with the form and which form can be made integrally with the oscillator support **54**, thus providing a central well in which the tube **11** is received.

Portion **19** of the coil **16**, which is, of course, wound about the form **56**, constitutes a part of the oscillator tank or radio frequency determining circuit and is in an inductance parameter therein and portion **18**, above the top of conductor **20** on coil **16**, cooperates with portion **19** to form one magnetically linked circuit of an impedance matching transformer coupling the antenna to the tube. Portion **19** serves as the other magnetically linked transformer circuit. The antenna of the improved fuze is shown at **17** and is formed by bending an extension of coil **16** upwardly and transversely of cap **57** and medially thereof, so that the antenna conforms closely to the arcuate surface of the cap. The antenna is curvalinear in side elevation and terminates with its free end directly above the uppermost turn of coil **16** and in spaced relation thereto. In this connection it should be understood that the size of the antenna materially affects the coupling and thus the loading of the oscillator. More specifically, by employing a cap **57** of relatively great height and training the antenna thereover, much greater cou-

pling will result than if a relatively small cap with a correspondingly small antenna is used.

After the improved fuse has been mounted in a projectile nose during assembly, as illustrated in FIG. 1, a suitable potting compound is poured into the nose through openings in base **52** and base portion **55**, one of these openings being shown generally at **59**. Other openings may be provided to permit free flow of the compound, so that there are no air pockets, to the end that the parts may be rigidly secured in place.

In operation the fuze is installed in a projectile as shown in FIG. 1. The oscillator generates radiant-energy carrier signals. Target proximity changes the radiation resistance of the radiating system comprising antenna **17** and the projectile casing and this change causes a modulated signal to appear at terminal **35**. The remaining phases of operation are like the corresponding phases of operation of the fuze described in the co-pending application referred to hereinabove.

It will be particularly noted that the base **52**, the amplifier-containing shielding member **53**, the oscillator support **54**, the coil form **56**, and cap **57** comprise a unitary assembly for positioning the oscillator and antenna sections of the fuze in the projectile nose with optimum space utilization. Considerable space is saved by housing tube **11** within coil form **56**. Another space-saving expedient is the disposition of resistors **29** and **33**, capacitor **25** and chokes **38** and **42** in the space between phase portion **55** and the tip of the projectile.

It is desired particularly to point out that, in view of the fact that the antenna element **17** is contained entirely within the chamber **49**, there will be no need for soldered connections to be exposed to the high temperatures present at the apex of the projectile during flight. Therefore, fuze failure due to breaking down of soldered antenna connections will be eliminated.

It will also be understood that, by substituting an antenna contained wholly within the chamber **49** for the type formerly employed, i.e., one mounted on the outer surface of the ogive of the projectile nose, or embedded therein, fuze failure due to leakage of water vapor about said antenna and into the fuze is prevented.

While there has been shown what is at present considered to be a preferred embodiment of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the true spirit and scope of the invention. For example, oscillator circuits such as the grid coupled and well-known Colpitts can be used, if desired.

I claim:

1. In a fuze for electrically detonated projectiles having a chambered ogive, a signal generator in the ogive and comprising an oscillator having at least one electron tube, a protective casing surrounding said tube throughout its length, a cap closing said casing and having an arcuate surface, and a coil wound on said casing and having an extended portion projecting over said cap, said coil constituting an oscillator coil and matching transformer and said extension constituting an antenna.

2. In a fuze for electrically detonated projectiles having a chambered ogive, a signal generator in the chambered ogive and comprising an oscillator having at least one electron tube, a protective casing for said tube, a cap closing said casing and having an arcuate surface, and a coil wound on said casing and having an extended portion projecting over said cap, said coil constituting an oscillator coil and matching transformer and said said extension constituting an antenna.

3. The combination with a radio proximity fuze having a projectile nose formed with a hollow interior defining a chamber, of an oscillator for generating electromagnetic waves, said oscillator having a coil form with a coil wound thereon and a cap closing said form at one end, said cap having an arcuate surface, and an antenna electrically connected with the coil and trained over said arcuate surface, said antenna being contained wholly within the chamber and being of such electrical length that optimum electrical coupling to the projectile with consequent optimum preloading of the oscillator will take place.

4. In a radio proximity fuze, a projectile having a hollow nose defining a chamber, an electro-magnetic wave generator in the chamber, an antenna for said generator,, said antenna comprising an arcuately disposed strand of wire contained entirely within said chamber, and a hemispherical support for rigidly mounting the antenna in the chamber.

5. In a radio proximity fuze, a hollow projectile nose open at its base, a closure for the base, said closure and said nose defining a closed chamber, an oscillator housed in said chamber and having a plurality of components including an electron tube, and an oscillator support including a coil form providing a central well and a plurality of annularly arranged recesses, said electron tube being mounted in said central well, and the components of said oscillator being disposed in said annularly arranged recesses.

6. In a radio proximity fuze, a hollow projectile nose open at its base, a closure for the base, said closure and said nose defining a closed chamber, an oscillator housed in said chamber, said oscillator having a plurality of components including an electron tube, an oscillator support including a coil form providing a central well and a plurality of annularly arranged recesses, said electron tube being mounted in said central well, the components of said oscillator being received in said annularly arranged recesses, a hemispherical cap closing said coil form, an oscillator coil and an impedance matching transformer wound on said form, and an antenna comprising a continuation of the conductor composing said transformer, said antenna extending transversely over said cap and terminating in closely spaced relation to the topmost turn of said transformer.

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