

March 10, 1964

A. S. KHOURI ET AL

3,124,073

PROXIMITY FUSE

Filed March 14, 1951

Fig. 1.

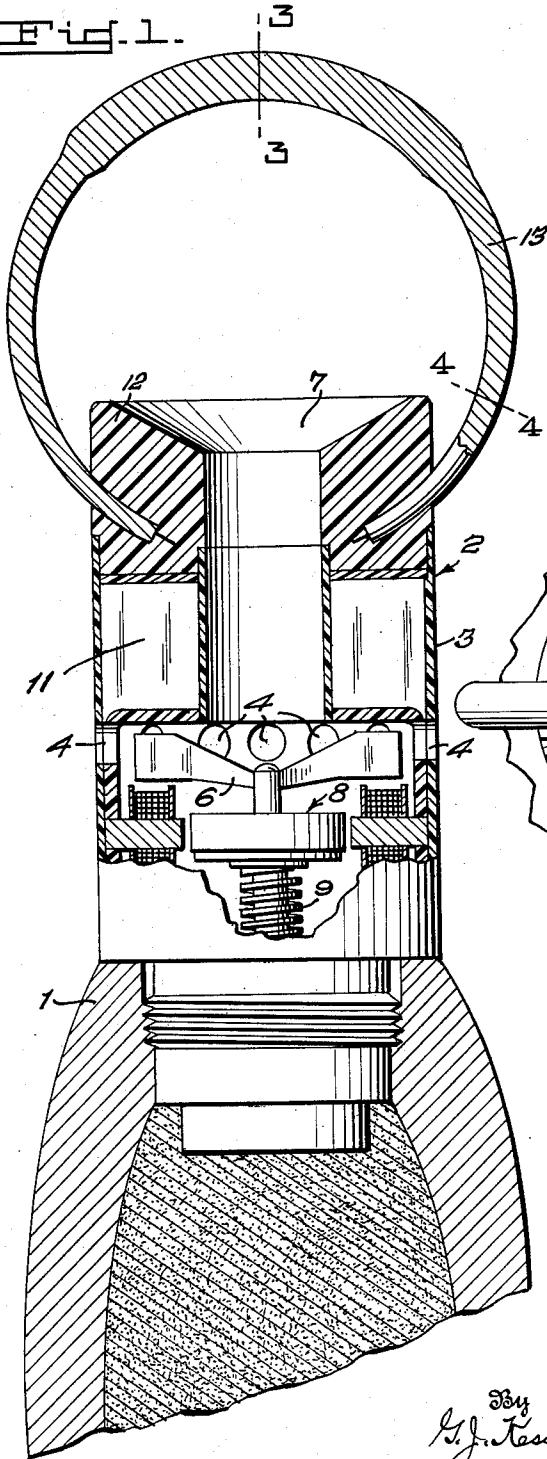


Fig. 4.

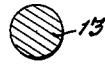


Fig. 2.

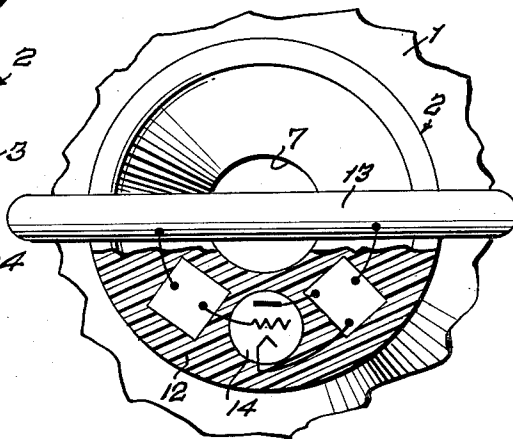


Fig. 3.



Inventors,

Alfred S. Khouri  
R. E. Carroll  
Paul M. Tedder  
Palmer H. Craig

By  
G. J. Tessenich, J. H. Church & M. L. Libman  
Attorneys

1

3,124,073

## PROXIMITY FUSE

Alfred S. Khouri, Milwaukee, Wis., and Ralph E. Carroll, Gainesville, Fla., assignors to the United States of America as represented by the Secretary of the Army

Filed Mar. 14, 1951, Ser. No. 215,441

3 Claims. (Cl. 102-70.2)

This invention relates to a proximity fuse for relatively small slow-speed, non-rotated ordnance projectiles such as mortar shells.

In providing an electronic proximity fuse for a mortar shell, a number of problems appear which are not present in other types of projectiles. The electronic and mechanical elements must be incorporated into a structure sufficiently strong to withstand the force of setback, which will be several thousand times that of gravity. The extremely small diameter of the mortar barrel prevents the use of a transverse antenna such as can be used with bombs, yet it is desirable to have a high forward sensitivity, while in the case of antiaircraft projectiles and low-angle shells, a high sideways sensitivity is preferable or satisfactory. Therefore, an antenna must be provided having features not heretofore found in proximity fuses, of high forward sensitivity combined with small dimensions, particularly transverse to the projectile axis. The whole structure must be housed in a very small space, and be rugged and yet readily assembled and simple in construction.

All of the above factors presented a very difficult problem, which was not satisfactorily solved until some time after the satisfactory solutions of the radio proximity fuse problem had been found for other types of projectiles. It is the primary object of this invention to disclose a solution to this problem.

The specific nature of the invention, as well as other objects and advantages thereof, will clearly appear from a description of a preferred embodiment as shown in the accompanying drawing in which,

FIG. 1 is a schematic side view, partly in section, of the nose of a mortar shell equipped with a fuse of the present invention.

FIG. 2 is a front view of the fuse of FIG. 1 partly broken away to show some of the elements schematically.

FIG. 3 is a sectional view taken on line 3-3 of FIG. 1.

FIG. 4 is a sectional view taken on line 4-4 of FIG. 1.

The nose of a conventional mortar shell is shown at 1. Inserted in the customary fuse well is a proximity fuse 2. The fuse has a casing 3 provided with apertures 4. Turbine 6 drives a generator rotor generally indicated at 8 and also, through worm 9, drives suitable safety arming mechanism of known construction, which is not shown in detail because the specific arming mechanism is not part of the present invention, and also because various types and functions of arming mechanism are well known in the fuse art. An annular space 11 is provided between air duct 7 and casing 3, which is used to house amplifier and firing circuit components for the fuse. The electric circuits are not shown in detail because they are not part of the present invention. It is understood and well known that the radio proximity fuse consists of an antenna, an oscillator-detector circuit associated therewith and with an amplifier and thyatron circuit, and a generator and safety arming system, substantially as shown in FIG. 2 of Research Paper RP 1723, Vol. 37, July 1946, part of Journal of Research of the National Bureau of Standards, and entitled "Radio Proximity Fuse Design" by Hinman and Brunetti.

Above the annular space 11 is a molded plastic nose piece 12 of a suitable insulating material. Apertures are

2

provided in this insulating material for reception of the circuit components of the oscillator-detector stage, as schematically represented in FIG. 2. A loop antenna 13, of maximum outside dimensions substantially equal to, and not larger than, the diameter of mortar shell 1, is also supported by nose piece 12, the ends of the loop being suitably connected to a vacuum tube 14 of the oscillator-detector stage as indicated in FIG. 2, which is a schematic showing and is not intended to represent any particular circuit, it being well-known in the art to properly connect any antenna to its associated circuit. The diameter of the loop is of great importance in the present invention. An external loop antenna would not ordinarily be expected to withstand the forces of setback. But, by using a loop antenna having a diameter substantially equal to, but not larger than, the diameter of the mortar shell, as in the present invention, the walls of the mortar tube, from which the mortar shell is launched, may be used to provide the necessary bracing to prevent the loop from failing upon setback. Since the forces to setback are present only while the mortar shell is in the mortar tube, the bracing provided by the walls of the mortar tube is available as long as is necessary to prevent failure of the loop antenna.

Upon setback the loop tends to bend outward from the axis of the projectile causing the loop to ride against the walls of the mortar tube. If the walls of the mortar tube were not present the loop would continue to bend outward until buckling occurred, or until the ends of the loop broke out of their supports. A loop having a diameter larger than the diameter of the mortar shell could not be used because it would not fit into the mortar tube. A loop having a diameter significantly smaller than the diameter of the mortar shell would experience considerably more bending before the bracing effect of the walls of the mortar tube became available, and the likelihood of failure would be correspondingly greater.

The advantages of the loop circuit cannot be fully realized unless precaution is taken to prevent the loop from axially exciting the vehicle. If the loop is electrically asymmetrical with respect to the vehicle, the vehicle (or projectile) will be excited by the loop and will act as a longitudinal radiator. It is known that the sensitivity due to the field of the loop alone will be reduced by an amount which is a function of such longitudinal radiation, which should therefore be kept as low as possible.

The asymmetry of the circuit results from electrostatic shielding of the grid of the oscillator tube from ground potential, by the plate. This added capacity from plate end of the loop to ground can be compensated for by the proper location of components, and the use of a small balancing condenser of about 2 or 3 mmf. from the grid end of the loop to ground. When the loop is electrically balanced, the current maximum in the loop is at the intersection of the vehicle axis and the loop. Under these conditions, there is no excitation of the vehicle.

In order to minimize air disturbance due to the presence of part of the ring antenna in front of the air duct, and to reduce air drag of the antenna generally, the improved antenna design as shown in FIG. 3 provides a streamlined contour for that portion of the antenna which is in front of the air duct.

It will be apparent that the embodiments shown are only exemplary and that various modifications can be made in construction and arrangement within the scope of my invention as defined in the appended claims.

We claim:

1. In combination with a projectile, a proximity fuse comprising: a cylindrical metal casing; a nose piece of insulating material mounted on the front end of said casing; radio proximity fuse circuitry located in said nose piece and said casing; and an external open-ring

3

loop antenna supported at its ends by said nose piece and located in a plane passing through the axis of said projectile, the radial distance from the axis of said projectile to the outer surface of said projectile being substantially equal to, and at least as large as, the maximum radial distance from said axis to the outer extremities of said open-ring loop antenna, the ends of said open-ring antenna extending into said nose piece and connected to operate in conjunction with said radio proximity fuse circuitry.

2. The invention according to claim 1 wherein said projectile is a mortar shell and said casing is adapted to be screwed into a standard mortar fuse well.

4

3. The invention according to claim 1 wherein said open-ring loop antenna is streamlined to have a minimum effect on the trajectory of said projectile.

**References Cited in the file of this patent**

**UNITED STATES PATENTS**

1,757,288      Bleecker ----- May 6, 1930

**OTHER REFERENCES**

10 "Properties of Loop Aerials," Horner, Wireless Engineer (British), August 1948, pp. 254-259.

Hinman et al.: National Bureau of Standards Research Paper 1723, vol. 37, July 1946, 18 pages.