Jan. 7, 1964 H. E. TATEL ETAL 3,116,691

PROXIMITY FUZE

Filed Nov. 1, 1944 2 Sheets-Sheet 1

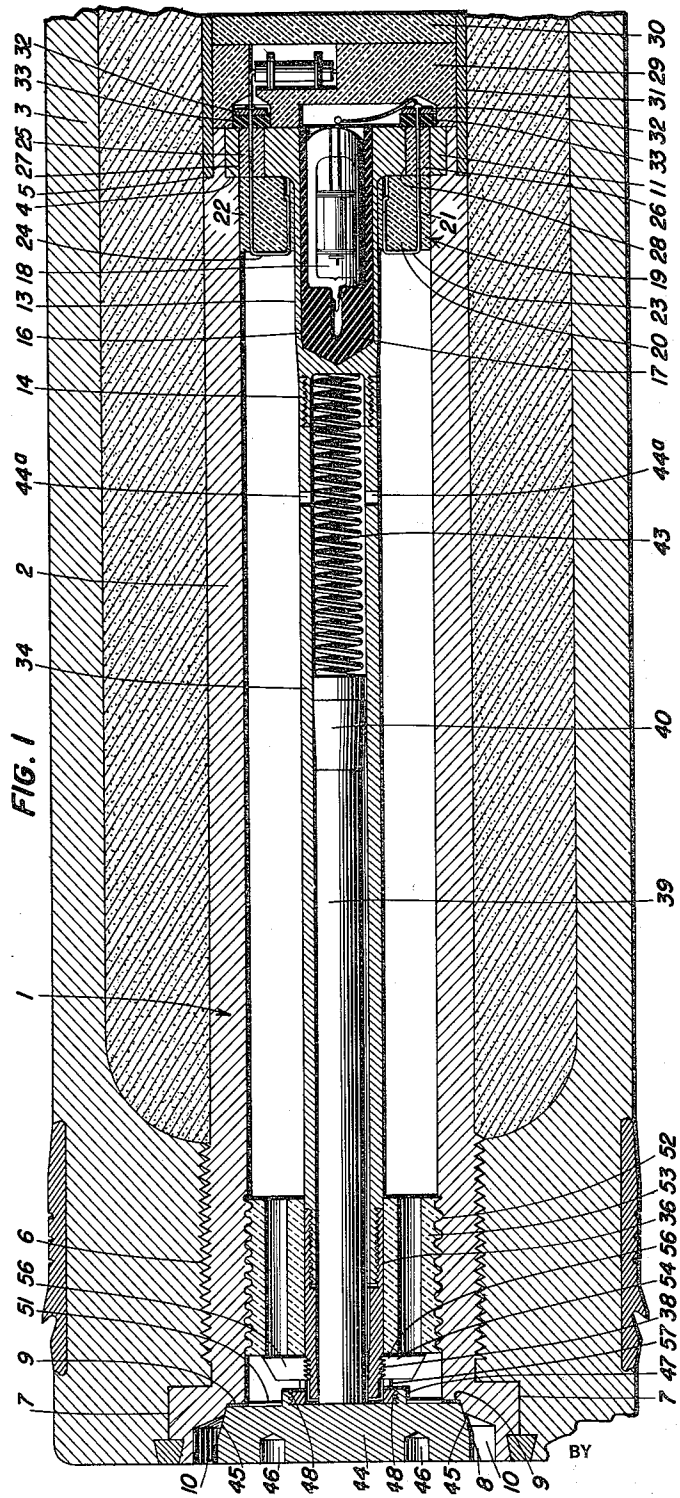



FIG. 1

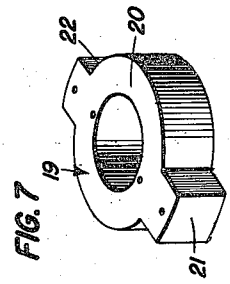



FIG. 7

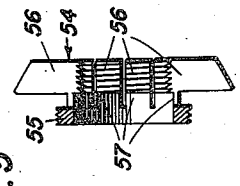



FIG. 5

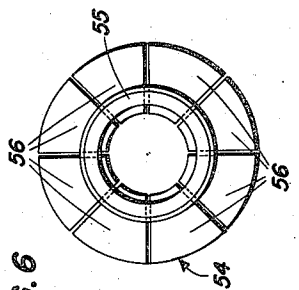



FIG. 6

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Jan. 7, 1964 H. E. TATEL ETAL 3,116,691

PROXIMITY FUZE

Filed Nov. 1, 1944 2 Sheets-Sheet 2

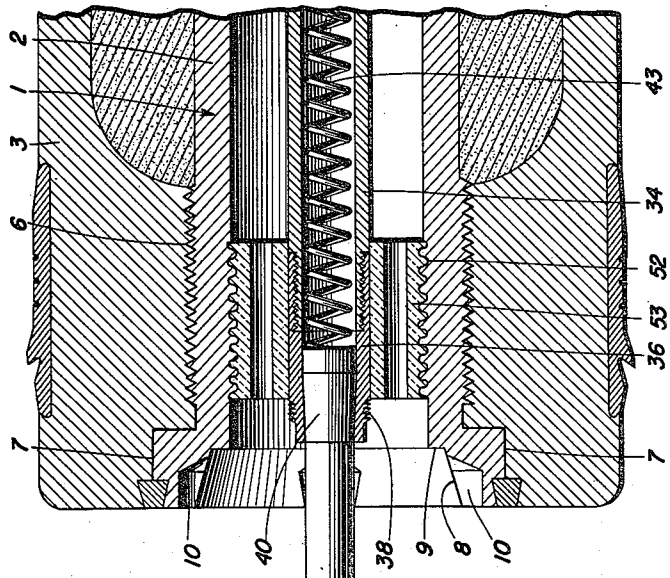



FIG. 3

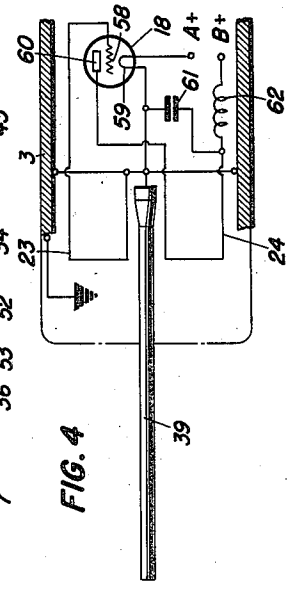



FIG. 4

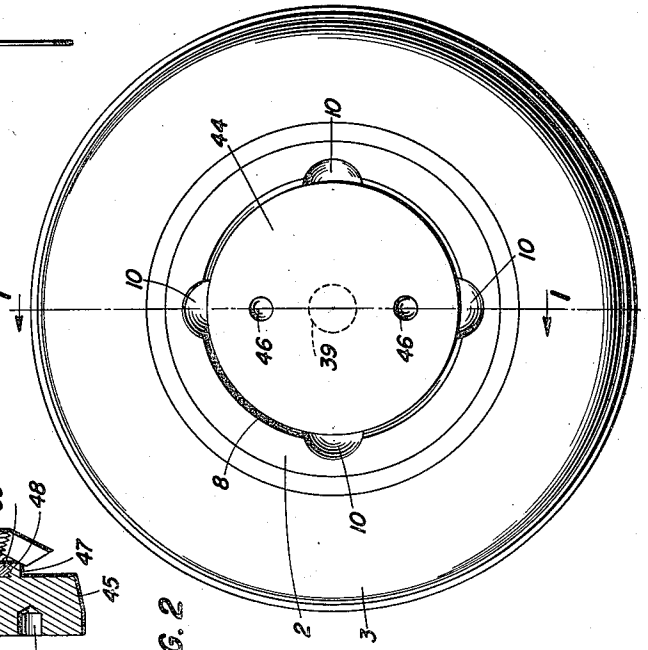
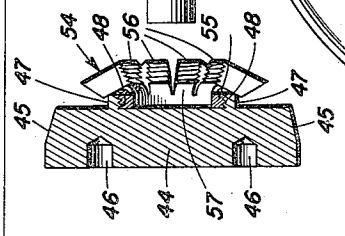



FIG. 2




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3,116,691

# PROXIMITY FUZE

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12 Claims. (Cl. 102—70.2)

This invention relates generally to electrically detonated projectiles and more particularly to an improved radio proximity fuze.

Radio proximity fuzes as customarily constructed up to the present time make use of an antenna mounted at the forward end, or nose, of the projectile. This type of antenna has been generally satisfactory in operation, but is subject to the objectionable limitation that it is only usable at relatively low frequencies (i.e. frequencies below 200 mc. for a 5" projectile). At these lower frequencies, such an antenna will radiate a wave pattern, portions of the lobes of which extend slightly forwardly with respect to the projectile, with the result that the fuze will be triggered a fraction of a second before the projectile reaches the target area. This is desirable for the reason that the fragmentation pattern of the projectile is such that shell fragments will be projected slightly forwardly.

In order to render the fuze as versatile as possible with regard to the use of frequencies, so that the possibility of jamming by an enemy, and the effect of water waves, will be reduced to a minimum, it has been proposed to produce a fuze which will operate at frequencies much higher than those now in use. When such higher frequencies, which are of the order of 250 mc. upward, are utilized in radio proximity fuzes with nose antennae of known varieties, however, it is found that the wave pattern of the projectile is unsatisfactory. That is to say, the principal part of the radiation lobe is directed rearwardly rather than forwardly. In order to correct this unsatisfactory condition, it has been determined that the antenna should be mounted at the rear of the projectile, preferably projecting rearwardly. Two broad classes of rear-antenna projectiles may be considered. One of these entails the placement of all circuit elements, detonators, and other parts, in a can in the base of the projectile, with an antenna adapted to project rearwardly. The second class consists of an arrangement wherein the amplifier and other components are placed in the nose of the projectile and electrically connected with an oscillator and antenna mounted at the base end of said projectile. Inasmuch as all of these components have already been developed in a form suitable for nose mounting, particular consideration is herein given to the second mentioned class, the antenna and oscillator being placed in a can or container in the base of the projectile because of the losses in R.F. transmission lines. It will be recognized, however, that certain principles of this invention are equally applicable to both of the classes above defined.

One of the principal objects of the invention, therefore, is to provide a radio proximity fuze wherein at least the oscillator and antenna are mounted in the base of the projectile, in such manner that a satisfactory wave pattern may be emitted at high frequencies.

Another object of the invention is to provide a radio proximity fuze which by reason of a favorable radiation pattern (roughly coincident with the fragmentation pattern of the projectile) will produce a projectile of greater lethal effect than projectiles of this general class which have been developed up to the present time.

Another object of the invention is to provide an electrically detonated projectile of this character which may be readily adapted for use at various frequencies.

A further object of the invention is to provide such a radio proximity fuze which is compact and relatively simple in construction and which may accordingly be conveniently mounted in the base of the projectile.



Still another object of the invention is to provide a fuze of this character wherein the antenna is so arranged as to be held in a retracted position within the projectile at all times prior to firing, but which will be released and projected to operative position by the force of setback in conjunction with spring action, and/or by some other suitable means, upon firing.

Another object of the invention is to provide a radio proximity fuze of the indicated character embodying a simple and highy efficient grid and plate coil arrangement.

Other objects of the invention, not specifically mentioned hereinabove, will become apparent as the description proceeds.

In the drawings:

FIG. 1 is a longitudinal sectional view of a fuze constructed in accordance with the present invention, showing the same with the antenna in retracted position, and as the assembly appears installed in a projectile, adjacent portions of which are also illustrated;

FIG. 2 is a rear elevational view of the projectile with fuze installed;

FIG. 3 is a view similar to but less complete than FIG. 1, showing the antenna extended and the closure plate and its retaining means detached;

FIG. 4 is a schematic wiring diagram;

FIG. 5 is a diametric sectional view on a larger scale of the retaining nut for the base closure plate;

FIG. 6 is a plan view of the nut sectionally illustrated in FIG. 5; and

FIG. 7 is a perspective view of the coil supporting block which forms a part of the oscillator assembly.

The numeral 1 indicates generally the housing or can of our improved fuze. The can 1 includes a tubular body 2 which is formed of steel or other suitable material and is reduced and counterbored at its forward or inner end to form internal and external shoulders 4, 5. Near its rear end, the outer surface of the can is provided with a threaded course 6 by which it is adapted to be supported in the base of a projectile as 3, a relatively thick radial flange 7 being formed at the rear end of the can to seat in a suitable counterbored portion of the base, as shown. The can 1 is hollow throughout its length and is formed at its outer end with a generally frusto-conical countersunk recess 8, which defines a shoulder 9. As best seen in FIGURE 3 the recess 8 is provided with an annularly disposed series of generally semi-circular notches 10.

Closing the inner end of the can 1 is a peripherally flanged sleeve 13, the inwardly projecting central portion of which is hollow as indicated at 16 to house the oscillator vacuum tube 18, while such central portion also cooperates in supporting the antenna housing tube 34, threadedly attached thereto at 14. The front flange 11 is mounted in the counterbored front extremity 4 of the can.

The vacuum tube 18 is preferably of the rugged type disclosed in the copending application of H. H. Porter et al., Serial No. 519,518, filed January 24, 1944; a rubber cushioning sock 17 being interposed between the tube and sleeve and extending over the rear end of the tube to effectively cushion it against setback.

Fitted about the sleeve portion 13 and abutting the flange 11 is a coil supporting block 19 formed of polystyrene or other suitable insulating material and seen in perspective in FIGURE 7. It will be observed that said block is formed with a hub 20 and oppositely presented diametrically opposed wings 21 and 22. The wings 21 and 22 are apertured to receive, respectively, the grid and plate coils of the oscillator, which coils are shown at 23 and 24 in FIGURE 1. Terminal portions of the coils are projected through insulating bushings 25 and 26 which are carried in openings 27 and 28 in the flange 11. The re-

maining components of the oscillator are contained in a polystyrene block 29 which abuts the forward face of the flange 11. An end wall 30 closes the outer end of and retains the block 29, these parts being held in place by a sleeve 31 fitted there-about and mounted on the shouldered reduced portion 5 of the can. The terminals of the grid and plate coils are held under tension by washers as 32 soldered to their corresponding outer ends, an insulating disc 33 of semi-resilient material being retained and somewhat compressed beneath each washer 32 to stress and rigidly position the parts.

The antenna housing sleeve 34 is screwed onto the threaded portion 14 of the sleeve 11 and extends axially throughout the major portion of the can 1. The sleeve 34 is externally threaded at its rear end for reception of the coupling sleeve 36 which forms an extension thereof. The bore of the coupling sleeve tapers to decreased diameter toward its rear end, the outer surface of the sleeve being reduced near its rear end and formed with buttress threads 38, for a purpose which will presently appear.

The antenna rod 39 is normally contained within the sleeve 34, although during operation it is projected rearwardly as shown in FIG. 3. A slightly enlarged generally frusto-conic rear end portion 40 limits extension of the antenna by coming up against the tapered bore of sleeve 36 when the rod 39 is fully projected. Compression spring 43, trapped in the sleeve 34, serves to project the antenna, which is normally held in the retracted position, with the spring under compression, by a closure plate 44. Vents 44*a* in sleeve 34 permit entry of air as the antenna element is projected to operative position.

Closure plate 44 is tapered from its mid-point toward its inner end to provide a frusto-conic wall portion 45 adapted to seat in the conformably tapered recess 8 of the can 1 while allowing the closure plate to be forced out of the recess without possibility of jamming due to cocking of the plate. Its flat outer surface is provided with spanner openings 46, to permit easy installation of the plate. Concentrically formed on the inner wall of the plate 44 is a boss 47, tapped to define a socket 48. A copper gasket 51 is arranged under the plate to seal the rear opening of the can.

The can 1 is also internally theraded at 52 near its rear end to support the guide sleeve 53, of polystyrene or other suitable insulating material. The guide sleeve supports and positions the antenna tube and coupling sleeve assembly. The end cover plate 44 is held to the coupling sleeve 36 by a displaceable split nut 54 which includes a threaded base or ring portion 55 screwed into the socket 48, the remainder of the nut being constituted of a plurality of segments 56 arranged as shown in FIGURES 5 and 6. Each segment includes a relatively massive radially projecting section and a threaded inner surface coacting with the buttress threads 38 on the coupling sleeve 36. The buttress threads are capable of supporting large tensile loads without translating any appreciable fraction of such loads into radial thrust, which would tend to cause the split nut to expand and become disengaged from the coupling sleeve 36. Each segment 56 is connected to the base or ring portion 55 by a web 57.

When the projectile is fired, the force of set back causes the nut 54 to spread, bending the segments 56 on their webs 57 as shown in FIG. 3, due to the fact that said segments overhang the web to a considerable degree. The plate and nut assembly are thus freed. After the projectile has emerged from the gun, the spring displaces the plate and nut assembly from the recess 8, and projects the antenna to operative position as shown in FIG. 3.

Referring more particularly to the oscillator circuit, shown in FIGURE 4, it will be noted that the antenna element 39 is grounded to the can and projectile through the housing 34. Vaccum tube 18 includes a grid 58, a filament or cathode 59 and a plate or anode 60. The grid coil or inductance 23 has one terminal connected to the grid and the other grounded to the can 1. The plate coil 24



has one terminal connected to the plate 60 and the other connected to the junction of a bypass condenser 61 and a radio frequency choke 62. The opposite terminal of the choke is connected to the positive B battery terminal. The negative B battery terminal and the negative A battery terminal are also grounded. The positive A battery terminal is connected to the filament 59 by a suitable conductor.

It will be understood that this circuit arrangement may be varied as desired, and that, when installed, the output terminals of the oscillator are connected to suitable amplifier and firing means (forming no part of our present invention and accordingly not shown) which may, as previously indicated, be mounted in the nose or other portion of the projectile.

The electrical circuits, when rendered effective by suitable arming means (not shown) are adapted to fire the projectile when it approaches a target. The operation and arrangement of the other electrical circuits and components are preferably similar to those of the radio proximity fuze forming the subject matter of copending application of M. A. Tuve et al., Serial No. 471,388, filed January 6, 1943.

Our invention provides a radio proximity fuze which is adapted to operate on a wide range of frequencies. As a result, the possibility of jamming is reduced to a minimum. The mechanism is nevertheless of simple construction and capable of withstanding the stresses present in a projectile during acceleration.

The can 1 defines a cavity which permits the oscillator to be coupled to the antenna most efficiently. The cavity also reduces losses with the result that the oscillator has higher Q (ratio of stored energy to dissipated energy). As will be observed, one side of the filament is connected to the ground, thus eliminating the need for chokes in the filament circuit and, accordingly, reducing losses due to their use. In view of the fact that separate plate and grid coils, inductively coupled, are employed, the circuit components may be connected at points of low R.F. voltage.

We claim:

1. In a radio proximity fuze for projectiles, means for generating electro-magnetic waves including a can defining an oscillator cavity, and an antenna mounted within the can and movable to a position extending therefrom when the projectile is fired, said oscillator and said antenna being electrically connected so that said antenna emits said electro-magnetic waves for reflection by a target.

2. A radio proximity fuze for projectiles including a can adapted to be mounted in the base of a projectile, an oscillator mounted in the can at one end thereof, an antenna mounted within the can and electrically connected with the oscillator, means for urging the antenna toward an operative position extending from the can, and means for normally retaining the antenna in an inoperative position within the can and against the compression of said last mentioned means, said retaining means being releasable by the force of set back upon firing of the projectile for releasing the antenna whereby said antenna will be projected to operative position for emitting radiation generated by the oscillator.

3. A radio proximity fuze including a can to be mounted in a projectile, an oscillator mounted within the can, an antenna element housing sleeve mounted spacedly within and substantially coaxial with respect to the can and an antenna element in the housing sleeve, said antenna element being movable from an inoperative position in the sleeve to an operative position extending from said sleeve for emitting radiation generated by the oscillator.

4. A radio proximity fuze including a substantially tubular can, an oscillator supporting sleeve spacedly mounted within and substantially axially of the can, a coil supporting block carried by the sleeve, oscillator means including a vacuum tube carried within the sleeve, grid

and plate coils carried by the block, means carried by the oscillator supporting sleeve for mounting other oscillator components, said can defining an oscillator cavity, and an antenna normally carried within the can and movable to an operative position extending from the can for radiating energy generated by the oscillator.

5. A radio proximity fuze including a can, a socketed oscillator mounting sleeve therein, an antenna housing sleeve connected with the oscillator mounting sleeve and extending longitudinally and terminating near one end of the can, a coupling sleeve connected with and forming a continuation of the antenna housing sleeve at said end of the can and having a tapered internal wall forming a reduced portion at said end, an antenna element slidably mounted in the housing sleeve and coupling sleeve and having a generally frusto-conical portion near one end adapted to coact with said reduced portion, and a spring confined within the housing sleeve between the socket and the inner end of the antenna element, said antenna element being movable by said spring from an inoperative position within the housing sleeve to operative position extending from said sleeve, the frusto-conical portion being engageable with the reduced portion of the coupling sleeve to limit outward movement of the antenna element and assure positive electrical connection between the housing sleeve and said antenna element.

6. In a radio proximity fuze as recited in claim 5, means normally retaining the antenna element within the housing sleeve and against the compression of the spring.

7. In a radio proximity fuze as recited in claim 5, means for normally retaining the antenna element within the housing sleeve and against the compression of the spring, said means including a retaining closure portion mounted in the outer end of the can, and a split nut operatively connecting the closure plate with the coupling sleeve, said split nut having holding portions displaceable by setback upon firing of the projectile for releasing the closure plate from the coupling sleeve.

8. In a fuzed projectile assembly, a can mounted in the projectile, means within the can for generating radio frequency energy, an antenna carried by the can and projectable therefrom, said antenna being operatively connected with said means when in the projected position, means normally retaining said antenna within said can, and means responsive to forces resulting from firing said projectile for freeing and projecting said antenna.

9. In a fuzed projectile assembly, a cylindrical can coaxially mounted within the projectile, means for generating electro-magnetic waves, an antenna element axially mounted in said can and movable from an inoperative position within said can to an operative position extending therefrom.



10. An arrangement as set forth in claim 9, in which said generating means comprises an oscillator arranged in and near one end of said can.

11. A radio proximity fuze including a can to be mounted in a projectile, an oscillator mounted within the can, an antenna element housing sleeve mounted spacedly within and substantially coaxial with respect to the can and an antenna element in the housing sleeve, means for normally retaining the antenna within the housing sleeve in an inoperative position, including a retaining element, a releasable connecting element tying said retaining element to said sleeve, said connecting element including a portion releasable by the force of setback to free said retaining means, whereby said antenna element may move from said inoperative position to an operative position of the antenna element projecting from said can.

12. A radio proximity fuze including a can to be mounted in a projectile, an oscillator mounted within the can, an antenna element housing sleeve mounted spacedly within and substantially coaxial with respect to the can and an antenna element in the housing sleeve, means for normally retaining the antenna within the housing sleeve in an inoperative position, including a retaining element, a releasable connecting element tying said retaining element to said sleeve, said connecting element including portions shiftable by the force of set back to release said retaining means whereby said antenna element may move from said inoperative position to an operative position of the antenna element projecting from said can, said connecting element further including a split nut having a base portion, a plurality of segments, and a web for connecting each of said segments with said base portion.


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