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RADIATION LOAD SIMULATOR

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FIG.1.

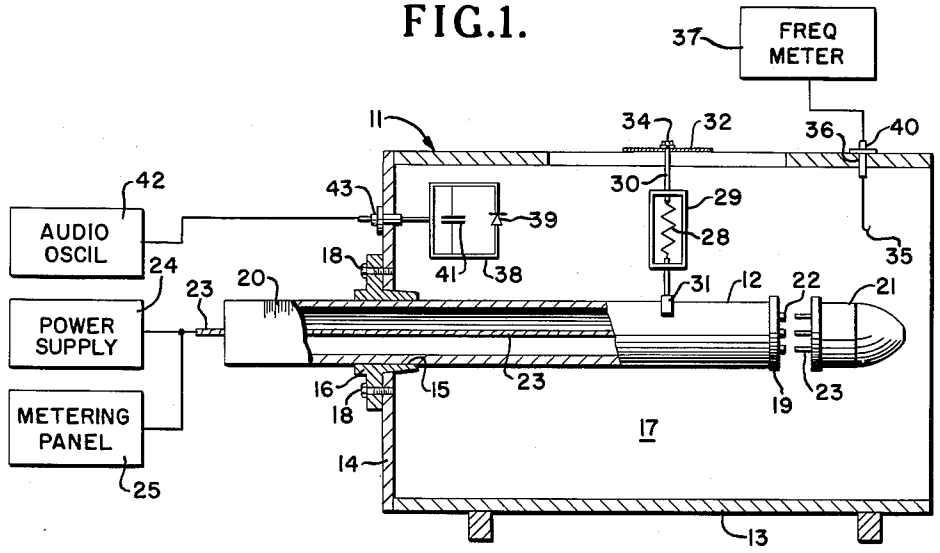
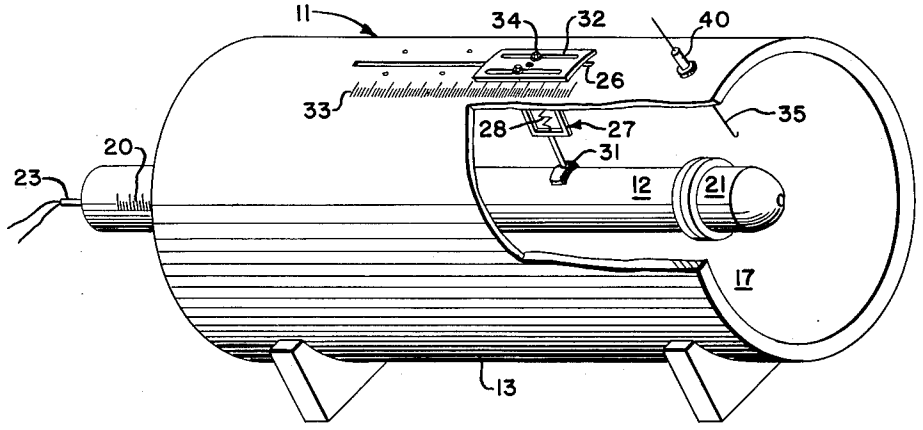


FIG.2.



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RADIATION LOAD SIMULATOR

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This invention relates generally to transmission line type apparatus and more particularly to a coaxial-transmission line test apparatus wherein the free-space, or radiation, loading conditions of a transceiver device, such, for example, as a proximity fuze are artificially simulated.

In conducting measurements on the operating characteristics of a proximity fuze under certain operational, or free-space, conditions, an elaborate free-space simulator arrangement has been heretofore devised, and referred to by those familiar with the art as a "pole test." A "pole test" consists in mounting a proximity fuze in an appropriate projectile, the axis of which, in free space, is parallel to a large, flat, perfectly reflecting surface encompassing a point on a plane approximately fifteen feet from, and parallel to the reflecting surface as the projectile is moved perpendicular to that surface, during which period of time, measurements are made upon the operating characteristics of the energized proximity fuze while the radiation, or antenna, loading conditions thereof are varied. Although the "pole test" has satisfactorily simulated the free-space operational conditions of a proximity fuze approaching a target, it has not been found to be entirely adaptable to laboratory and production line testing operations in view of its high installation and maintenance costs, its time consuming method of operation, and its enormity of size.

Accordingly, one object of the present invention is to provide a new and improved apparatus for simulating the free-space loading conditions of a transceiver device.

Another object of the present invention is to provide an improved arrangement for measuring the free-space operating characteristics of a proximity fuze.

Still another object of the present invention is to provide an improved, compact and relatively inexpensive test apparatus for simulating and measuring the effects of radiation loading and proximate environment modulation upon a proximity fuze.

A further object of the present invention is to provide an improved radiation load simulator device for artificially simulating the free space impedance loading of a proximity fuze in divers operating frequency bands.

A still further object of the instant invention is to provide portable apparatus for varying the antenna impedance of a transceiver circuit.

Other objects and many of the attendant advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawing whereon:

FIG. 1 is a schematic longitudinal cross sectional view of the simulator and of the overall testing arrangement according to the present invention; and

FIG. 2 is a perspective view, partially in section of the simulator of the present invention.

Referring now to the accompanying drawing wherein like reference numerals indicate like parts throughout the several views and more particularly to FIG. 1 whereon the reference numeral **11** generally designates the radiation load simulator according to the present invention. As shown thereon, the simulator comprises a section of a closed end section of coaxial line having an inner conductor **12**, an outer conductor **13**, and an end plate **14** rigidly connected to the outer conductor. A

centrally disposed aperture **15** is provided in end plate **14** wherein the inner conductor **12** is slidably arranged. A metallic collar **16** having a plurality of wedge shaped segments formed thereon snugly encircles the conductor **12** to allow for ready adjustment of the length thereof within the high frequency field chamber **17** and for firmly positioning the inner conductor within the chamber at a desired position by the action of mounting screws **18** upon collar **16**. A graduated scale **20** is affixed to or impressed upon the conductor **12**, the purpose of which will be more fully described hereinafter.

Connected at one end of the conductor **12** is a receptacle **19** adapted for the reception of the base portion of a proximity fuze **21** and having formed therein electric contacts **22** for engaging the pin terminals **23** on the base of the proximity fuze **21** whereby suitable operating potentials are supplied to the fuze and access to the fuze parameters desired to be measured, such as, oscillator loading and sensitivity, is provided. The contacts **22** are electrically connected through cable **23** disposed within conductor **12** to a source of suitable operating potentials **24** and to a suitable measuring, or metering panel **25**. A proximity fuze adapted to be tested by the instant invention is described in an article entitled, "Proximity Fuzes for Artillery" by H. Selvidge, appearing on pages 104–109 of Electronics, February 1946.

A longitudinally slot **26** is provided in the outer conductor **13** wherein a shunting probe, generally indicated by the numerals **27**, is movably disposed. The probe **27** comprises a resistance element **28** mounted in a frame member **29** composed of insulating material, such for example, as plastic, which is supported by a vertical shaft member **30** having suitable resilient contacts **31** affixed thereto for insuring a good electrical shunting connection across the inner conductor as the probe is longitudinally moved therealong. An indexing plate **32** is secured to the upper extremity of shaft **30** for use with a calibrated scale **33** secured to, or impressed upon, the outer conductor **13** parallel to the probe slot **26** as more clearly shown on FIG. 2. Screws **34** provided for securing the probe assembly **27** at any desired position and for effecting a suitable electrical connection to the outer conductor. In order to insure a uniform and negligible resistance per unit area, all metallic surfaces bordering the chamber area **17** are silver-plated.

For the purpose of calibrating the simulator **11** to duplicate the free space loading upon a proximity fuze, the well known principle of the variation in input impedance of a shorted resonant transmission line at different electrical wavelengths from the shorted end is utilized. Consequently, the initial simulator calibration for a particular fuze operating frequency band is accomplished by adjusting the inner conductor length until the metering panel **25** indicates that the operating characteristics of an energized fuze mounted in receptacle **19** are substantially identical to the free-space operating characteristics of the fuze as determined, for example, from a pole test. To insure free-space loading simulation over the entire fuze operating frequency band, the Q of the resonant line section is lowered by empirical adjustment of the positioning and selection of the magnitude of resistor **28** of shunting probe **27**. It has been found desirable for the initial calibration to utilize a fuze having an operating frequency in the center region of the particular frequency band. A loop probe **35** extending through an aperture **36** in the outer conductor **13** is provided for enabling measurement of the operating frequency of the energized proximity fuze **21** by a suitable frequency meter **37** connected to a coaxial connector **40**.

In order to simulate the cyclical impedance, or loading, variations resulting from the raising and lowering of the fuze above the screen during a pole test, a modulating

loop 38 having a crystal rectifier 39 and a H.F. bypass capacitor 41 included therein is disposed in the closed end region of the chamber 17 wherein the current standing waves are at their maximum. Upon energization of the loop 38 by a suitable low-frequency sinusoidal voltage source 42 through the supporting coaxial connector 43, the input impedance of the closed line section 11 is modulated by the effect of the energized loop 38 upon the high frequency field surrounding the loop 38. It has been found that by a proper selection of the variable parameters; i.e., inner conductor 12 length, resistor 28, and probe 27 position during the initial calibration of the simulator 11, a satisfactory artificial loading effect is achieved for proximity fuzes in a particular operating frequency band whereby accurate and reproducible fuze measurements are obtainable. Additionally, the simulator has been found adaptable for artificial loading over divers proximity fuze operating frequencies by utilization of the hereinabove described calibration procedure and readjustment of the variable parameters of the simulator 11. Moreover if the values of the variable parameters are recorded for a particular operating frequency band after the initial calibration for that band, utilization of scales 20 and 33, as more clearly shown on FIG. 2, will eliminate the need for recalibration of the simulator apparatus for that particular frequency band, and consequently the simulator is readily adaptable for use over divers operating frequency bands.

In summary, it should be apparent to one skilled in the art to which the invention relates, after an understanding of the invention, that a novel arrangement has been disclosed for simulating the in flight operational loading conditions on a proximity fuze whereby the operational characteristics of the proximity fuze may be readily and conveniently measured. Inasmuch as the disclosed arrangement is especially adaptable to proximity fuzes, it has been described with particularity with reference thereto. It is to be understood however, that the disclosed arrangement is not limited to use with proximity fuzes, but that it is also applicable to other transceiver type devices.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is to be understood therefore that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. High frequency apparatus for simulating the free-space loading of a proximity fuze comprising a closed end section of coaxial transmission line having an outer conductor and an inner conductor, means connected to said inner conductor for energizing a proximity fuze connected thereto, and means bridging said inner and outer conductors for effecting the load impedance presented by said line to the proximity fuze.

2. High frequency apparatus for simulating the radiation loading on a proximity fuze, comprising a closed end section of coaxial transmission line having an inner conductor and an outer conductor, means connected to said iner conductor for the reception and energization of a proximity fuze connected thereto, means operatively connected to said inner conductor for effecting the adjustment of said inner conductor within said outer conductor, and means adjustably bridging said inner and said outer conductors for selectively effecting the load impedance presented by said line to the proximity fuze.

3. High frequency apparatus for simulating the free-space loading of a proximity fuze, comprising a closed end section of coaxial transmission line having an inner conductor, an outer conductor and an end plate member, means connected to said inner conductor for the reception and energization of a proximity fuze, means engaging said inner conductor and said end plate member for enabling the adjustment of the length of said inner conductor within said outer conductor thereby to effect the loading of said closed end line on the proximity fuze, means electrically shunting said inner and said outer conductors for selectively effecting the load impedance presented by said line to the proximity fuze, and means operatively connected to said line for varying the load impedance presented by said line to the proximity fuze.

4. High frequency apparatus for simulating the free-space loading of a proximity fuze, comprising a closed end section of coaxial transmission line having an inner conductor, an outer conductor and an apertured end plate member, electrical means connected to said inner conductor for the reception and energization of a proximity fuze, mechanical means for enabling the adjustment of the length of said inner conductor within said outer conductor, means bridging said inner and outer conductors for discretely affecting the load impedance presented by said line to the proximity fuze, and modulating means for cyclically varying the load impedance presented by said line to the proximity fuze.

5. In an apparatus according to claim 4 wherein said electrical means includes a receptacle affixed to one end of said inner conductor, said receptacle having a plurality of electrical contacts disposed therein, and an electrical cable arranged within said inner conductor for electrically connecting said contacts to a suitable energizing source.

6. In an apparatus according to claim 4 wherein said mechanical means includes an annular collar snugly encircling said inner conductor, said collar having a wedge shaped portion formed thereon slideably disposed within said aperture of said end plate member and a plurality of additional apertures formed therein, a plurality of taps formed in said end plate member, and threaded members disposed in said apertures adaptable for threadedly engaging said taps for effecting a firm encirclement of said collar around said inner conductor as said threaded members engage said taps.

7. In an appartus according to claim 4 wherein said bridging means includes an electrical resistance element of a predetermined magnitude, finger contacts electrically connected at either end of said element for engaging the inner surface of said outer conductor and the outer surface of said inner conductor, and means for securing said bridging means at a predetermined position in said apparatus.

8. In combination with the apparatus as claimed in claim 4, a potential energy source electrically connected to said apparatus for energizing the proximity fuze, an audio oscillator electrically connected to said apparatus for energizing said modulating means, frequency measuring means electrically connected to said apparatus for measuring the operating frequency of the energized proximity fuze, and suitable metering means electrically connected to the energized proximity fuze for indicating the operating characteristics thereof.

9. In an apparatus according to claim 4 wherein said modulating means includes an electrical network disposed in said section of transmission line, and a source of electrical potential for energizing said electrical network.

10. In an apparatus according to claim 9 wherein said electrical network includes an inductive loop of wire and a rectifier element serially connected in said loop.

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