Aug. 1, 1961 M. SILVER ET AL 2,994,271

FUZE ARMING DEVICE

Filed April 22, 1954

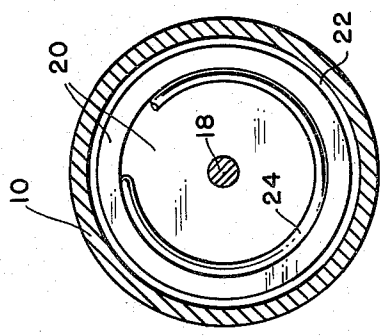

Fig. 2.

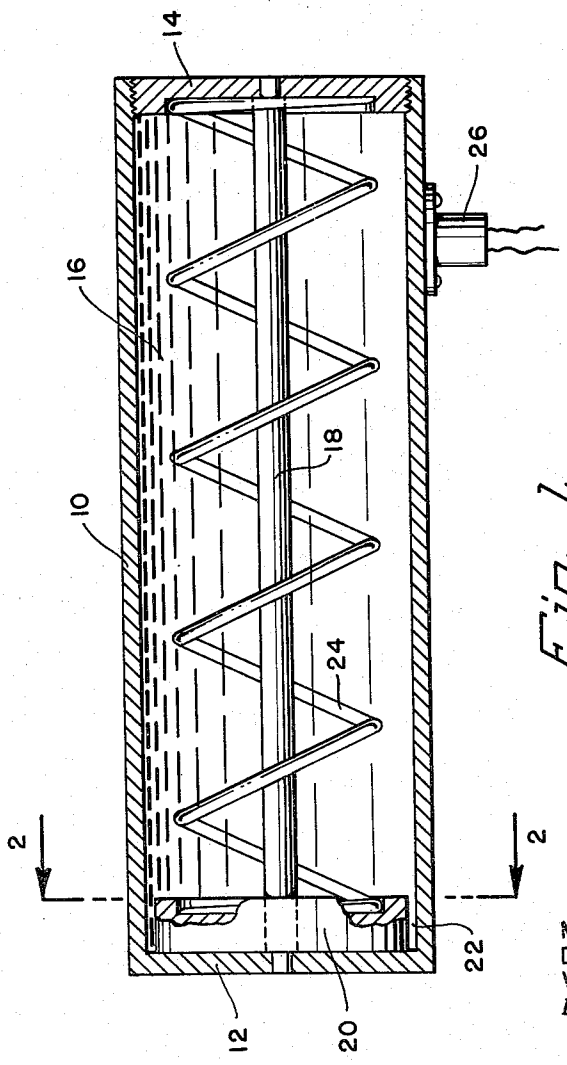

Fig. 1.

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FUZE ARMING DEVICE

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1 Claim. (Cl. 102—70.2)
(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

The present invention relates to fuze arming devices and has more particular reference to apparatus for arming a missile-carried fuze at a predetermined missile flight distance regardless of variation in missile acceleration during the arming period.

Heretofore, various missile fuze arming devices have been evolved. Such prior arming devices were, however, excessively complex, costly to manufacture, difficult to adjust, and were frequently subject to mal-operation. Moreover, many of the prior arming devices were not designed to compensate for variations in missile acceleration during the fuze arming period with the result that the arming distance of different missiles might vary over a large range. Thus, many of the previous arming devices comprised a clock work mechanism for arming the fuze after a predetermined missile flight time, and owing to variations in missile acceleration during the arming period and variations in the arming-period-accelerations of different rockets, the arming distance of a given rocket could not be fixed within reasonably close limits nor could the arming distances of a series of rockets be made the same within reasonably close tolerances.

The present invention avoids the disadvantages which have been inherent in prior fuze arming devices for missiles by providing a fluid flow, time delay fuze arming device wherein arming of the fuze is accomplished by the movement of an arming plunger through a predetermined distance in a fluid under the force arising from acceleration of the missile, the arrangement being such that the fuze will be armed at a fixed missile flight distance regardless of the value of missile acceleration during the arming period or variations in missile acceleration during the arming period.

In accordance with the foregoing, it is an object of the present invention to provide an improved missile fuze arming device.

Another object of the invention is to provide a device for arming the fuze of a missile at a fixed flight distance from the point of launching regardless of the value of, or variations in the value of missile acceleration during the arming period.

Still a further object of the invention is to provide a fuze arming device as in the foregoing wherein a plunger is, under the force of acceleration of rocket during the arming period, caused to move through a fluid for a predetermined distance whereby to cause the fuze to arm at a fixed predetermined missile flight distance from the point of launching regardless of the value of, or variations in the value of the missile acceleration during the arming period.

Other objects and many of the attendant advantages of the present invention will become apparent as the same becomes better understood from the following detailed description had in conjunction with the annexed drawings wherein:

FIG. 1 is a longitudinal sectional view of the present fuze arming device; and

FIG. 2 is a transverse sectional view taken substantially along line 2—2 of FIG. 1.

Referring now to the drawing and more particularly to FIG. 1, the fuze arming device of the present invention comprises a housing or shell **10**, which may be cylindrical in cross-section as shown, closed at one end wall portion **12** and at the other end by closure member **14** which may be removably secured within the shell **10** by a threaded connection, as shown, or other suitable means. Shell **10** and its end closures **12** and **14** form a fluid-tight container which is filled with a temperature stable fluid **16**, such as a silicone oil. Secured at opposite ends to the closure members **12** and **14** and disposed on the axis of shell **10** is a longitudinally extending rod **18** having slidably mounted thereon a plunger **20** of desired cross-sectional configuration. The transverse dimensions of plunger **20** are substantially less than those of shell **10** whereby to define a clearance space or orifice **22**, as shown more clearly in FIG. 2, between the plunger **20** and the inner wall of shell **10**. A spring member **24** which abuts the closure member **14** and the plunger **20** serves to bias the latter to one end of the shell **10**, as shown. Affixed to shell **10**, adjacent one end of, is some suitable type of electrical switching means for completing an electrical circuit to arm the fuze (not shown). Thus, switch **26** may comprise a magnetic arrangement which will be actuated to its closed position owing to a change in the magnetic field when the plunger **20**, which may be of a magnetically permeable material, is moved adjacent switch **26**.

In the operation of the present invention, a force proportional to the product of plunger mass and missile acceleration will act on the plunger **20** during the period of missile acceleration following launching of the latter. Plunger **20** will, under the action of this force, be caused to accelerate along rod **18** and through the fluid **16** with a resultant flow of the latter around the plunger and through the space **22**. During such plunger movement, fluid **16** will exert force on plunger **20** which opposes that due to missile acceleration and whose instantaneous value is proportional to the square of instantaneous plunger velocity. As the plunger continues to accelerate, its velocity reaches first a critical value, whereat the fluid flow rate around the plunger attains a critical value and laminar flow changes to turbulent flow, and finally a limit value at which the acceleration force acting on the plunger is exactly balanced by the restraining force of the fluid. Upon the plunger attaining the limit velocity, acceleration thereof ceases, owing to the balance of the forces acting thereon, and it will continue to move along rod **18** at a uniform fixed velocity, namely the limit velocity, whose value is proportional to the missile acceleration. If the latter remains constant the limit velocity will remain constant. If, however, missile acceleration should vary, owing to a change in thrust, for example, the limit velocity of the system will change until the restraining force of the fluid on the plunger equals that due to the new value of missile acceleration. The physical characteristics of the system, such as the mass and shape of the plunger and viscosity of fluid **16**, are made such that the plunger will be accelerated to its limit velocity within a relatively small movement along rod **18** whereby the plunger will move at the limit velocity along substantially the entire length of the rod and, therefore, a given total plunger movement will correspond to a given missile flight distance. Thus, by locating the switch means **26**, a predetermined distance from the normal or at rest position of the plunger, the fuze may be armed at any desired missile flight distance. Because of the above described characteristics of the system, the fuze will be armed at the same flight distance regardless

of variations in missile acceleration. Spring 24 serves to retain plunger in its rest position illustrated and prevent arming of the fuze under impact loads such as might be occasioned if the missile is dropped.

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

What is claimed is:

In a missile subjected to forward acceleration in the direction of its trajectory, the improvements in combination, comprising: a fuze arming device carried by the missile having an element adapted to move in a substantially rearward direction relative to said forward direction, and electrical switching means adapted to be actuated in response to a predetermined rearward movement of said element, said device including a cylinder, and said element comprising a piston adapted to move in said cylinder, said cylinder containing a fluid adapted to bypass from one side of said piston to the opposite side of same as the piston moves rearwardly within the cylinder, said piston being constructed of magnetically permeable material, and said switching means comprising a magnetic switching device positioned externally of said cylinder adapted to be actuated when said piston moves adjacent thereto.

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