This invention relates to the art of fuses and is primarily intended for use in rocket missiles of the non-rotating type.

More specifically, my present invention is for an improved device for arming a contact-detonated fuse of a rocket non-rotating missile.

As may be understood by those who are familiar with the art to which this invention relates, prior devices for this same general purpose have been operated either mechanically with springs that may be wound in a manner similar to a watch or clock mechanism, or electrically; but such devices are quite complicated and are open also to other objections from the standpoints of efficiency and dependability.

The general purpose of my present invention is to devise a hydraulic arming means which is characterized by marked simplicity of structure and efficiency and dependability of operation.

A more specific object is to provide such a device in which the arming is effected by the accelerating movement of the rocket with which employed and in which the timing of the arming operation may be determined by due regard to the rocket acceleration as well as the variable elements within the device.

Another object is to provide such a device that might be made compensating for outside temperature.

Another object is to provide such a device with means whereby the arming may be effected at a predetermined distance from the point where the missile is launched.

Another object is to provide such an arming device to which there may be added a conventional base type of detonator without interfering with its operation.

Another object is to provide such an improved device that will, at the same time, meet the existing military requirements.

A more specific object is to provide against premature arming that might be caused by accidental dropping, collision of the launcher, or in any way other than through the forces set up within the discharged rockets and missiles, so as to thereby increase the degree of safety with which such a device may be handled.

Other objects will appear from the following description and claims when considered together with the accompanying drawing.

Fig. 1 is a longitudinal sectional view of my present improved device, corresponding to line 1—1 of Fig. 5;

Fig. 2 is a partial longitudinal sectional view taken in the same plane as Fig. 1 but showing the parts in armed position whereas they are shown in unarmed position in Fig. 1;

Fig. 3 is a cross sectional view taken on line 3—3 of Fig. 1;

Fig. 4 is a view corresponding generally to line 4—4 of Fig. 5 and showing some parts in elevation and other parts in section;

Fig. 5 is a transverse sectional view taken on line 5—5 of Fig. 1.

Referring to the drawing in detail, cone 1 of suitable metal is secured at its rear end upon the correspondingly formed forward part of metal body 2 which is screw-threaded at 3 for attachment to rocket missile M and has screw threads 4 for connection of a booster (not shown). Secured within the forward end of cone 1 is nose portion 1a. Metal body 2 has inwardly extending transverse wall portion 5 through which extends guide member 6 with retaining nut 7 upon the rear end thereof and in engagement with the wall 5, there being provided the sealing ring 8 of suitable elastic composition.

The detonator 9 is housed within the rear end of the suitably formed portion of the enlarged part of the guide member 6 and is held in place by the inwardly extending flange 7a of the nut 7.

The enlarged part of the guide member 6 has a cavity 10 of transversely extending cylindrical-like form to accommodate the safety bar 11 whose end portions are of cylindrical form for rotatable engagement within the cavity 10, while the middle part of this safety bar 11 is cut away so as to provide a reduced full portion 11b with the squared surfaces 11c and 11d, respectively. The safety bar 11 is adapted to be rotated about a transverse axis so as to occupy either of the two positions indicated in Figs. 1 and 2, respectively. When in the position indicated in Fig. 1, the full portion 11b will extend across the path of the firing pin 12 which is capable of longitudinal movement within the guide member 6; and, in this position, the tapered rear end of the firing pin 12 will rest against the squared surface 11c of the full portion 11b of the safety bar 11, thereby withholding the firing pin 12 from entering the registering opening 6a of the guide member 6 and opening 9a of the shell of the detonator 9, as illustrated in Fig. 1 of the present drawing. Thus, with the parts in such position (Fig. 1), the firing pin 12 is prevented from engaging the detonator 9. The other squared surface 11d of the safety bar 11, that is normal to the surface 11c, is adapted for engagement with the squared end of the transversely extending lock pin 13 so as to hold the safety bar 11 in the position indicated in Fig. 1 of the present drawing.

The safety bar 11 has connected to one end thereof one end of coil spring 14 whose other end is anchored at 14a in the guide member 6; and the tendency of this spring is to turn the bar 11 about a transverse axis towards the position indicated in Fig. 2 hereof. The other end of the safety bar 11 is provided with a slot 15 adapted to receive a screwdriver or other suitable tool for turning the same to the position indicated in Fig. 1 of the drawing, that is against the spring 14. An annular washer 15a may be provided about the slotted end of the safety bar 11; and the adjacent annular portion of the guide member 6 about the end of the opening 10 may be peened over the washer 15a so as to hold the safety bar 11 in assembly.

As a means for holding the safety bar 11 in such set position (Fig. 1), the transversely reciprocatable lock pin 13 has a squared inner end that is adapted to engage the squared surface 11d of the safety bar 11. The lock pin 13 is adapted for such straight-line movement within an opening provided in the wall of the guide member 6, as will be understood from Figs. 1, 2 and 5 of the present drawing. The lock pin 13 may be held in locking position by the annular ring 16 which is in turn held forwardly in such position by the coil spring 17 forcing the ring 16 against the shoulder 18 on the guide member 6, the spring 17 having bearing engagement at its rear end against the seat provided in the transverse wall portion 5 of the guide member 6, as indicated in Fig. 1 of the present drawing.

As a means for disengaging the ring 16 from engagement with the lock pin 13, there is provided the plunger 19 that is positioned co-axially about the guide member.
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6 and is adapted for longitudinal movement rearwardly therealong so as to engage the ring 16 and disengage the annular shoulder 20a provided on
the guide member 6 and has bearing engagement at its one end against the annular shoulder 20a provided on
the guide member 6 and, at its other end, against the shoulder 20b within the plunger 19. The normal ten-
dency of spewing 29 is to force the plunger 19 forwardly;
as such, the forward end of the plunger 19 may be beveled
so as to better accommodate the same within the tapered
forward part of the cone 1. The forward end of the
plunger 19 may be provided with a port 21 having an
annular edge-form of valve seat for engagement by the
needle valve 22 which has screw-threaded engagement
within the port 21. By means of a screw driver or other
suitable tool engaging the slot in the end of the valve 22,
it may be adjusted so as to vary the size of the opening
and hence the amount of the fluid therethrough.

The space within the combined casing provided by
the members 1, 1a and 2, is intended to be filled with a
suitable hydraulic fluid; and sealing O rings or other
suitable sealing means of elastic composition may be
provided at the points 23, 24 and 25, as indicated in the
present arming.

The forward end of the firing pin 12 has an enlarged
portion 12a that fits snugly within the cavity in the end
of the nose portion 1a of the casing, there being a disk-
shaped frangible retainer 25 surrounding the firing pin
between its enlarged portion 12a and the bottom of the
cavity; and the closure disk 27 is seated upon an annular
shoulder and is held in place by peening the edge of the
same upon the annular edge of the nose portion 1a about
the casing just referred to. The nose portion 1a of the
casing has screw-threaded engagement with the forward
end of the guide member 6.

As will be seen from the accompanying drawing, the
sealing ring 23 is located at the joint between the nose
member 1a and the cone member 1; the sealing ring 24
is located at the joint between the nose portion 1 and
the guide member 6; and the sealing ring 25 is located at the
joint between the cone portion 1 and the body 2.

The plunger 19 is adapted to enter a cavity in the body
member 2, with suitable clearance therebetween, as indi-
cated in Fig. 1 of the present drawing; and the space
within the body member 1 is of sufficient extent to ac-
commodate the rearward movement of the plunger 19
between its engagement with the ring 16. In fact, the
plunger 19 may be within the cavity of the body member
2 at all times, as will be seen from Fig. 1 of the drawing.

Upon launching the rocket missile, the parts of my
present device will have been set in the position indicated
in Fig. 1 of the drawing and the interior of the casing
will have been filled with a hydraulic fluid of suitable
density and viscosity. It is assumed also that the springs
have been selected with respect to weight and load for
the required resistance to the movement of the plunger
19. After that, there should be proper clearances between the
plunger 19, body member 2 and guide member 6, and of
course between the firing pin 12 and the guide
member 6; and the weight of the plunger 19 should also be taken
into account. Due regard will be given to the weight
and other essential characteristics in selecting the metals
for the several constituent parts of the present device so
as to make possible the manner of operation herein
contemplated.

In order to provide for arming of the fuse within a
moderate range, the clearances provided by standard
machine tools are sufficient to control the flow area of the
hydraulic fluid; but, in case closer arming limits
should be desired, the metering screw 22 may be re-
bolted to so as to vary the rate of flow of this fluid to an
even finer point.

In the present form of device, the fuse is intended to be
point-detonating; and it is to be understood that pro-
vision may be made in my present device for operation
in either a super-quick manner or with delayed by means of standard boosters not here shown.

In actual operation, the arming of this fuse will take
place when the plunger 19 shall have been moved by the
action of the rocket acceleration through the hydraulic
fluid to the point where it engages and moves the ring
16. against the tension of the spring 17, out of the plane
of the lock pin 13 which is then automatically forced
radially outwardly under the influence of the spring 14.
At the same time, the spring 14 turns the safety bar 11
about its axis so that to move the squared surface 11c
of its full portion out of the path of the firing pin 12. That
is to say, the parts will be moved from their position of
Fig. 1 to that of Fig. 2 so that the firing pin 12 will then
have access to the detonator 9 and the fuse is thus armed
and is ready for firing upon impact of the nose or forward
end of the same so as to cause the firing pin 12 to enter
the detonator 9 which fires the booster charge not here
shown. The arming of the fuse will take place at a predeterminated distance of the surface from the point of
the launching of the missile in accordance with the resistance
to the movement of the plunger 19, which may be gov-
erned by due consideration to the several factors above
mentioned.

To recapitulate, the movement of the plunger 19 in
my present device may be determined by the force of the
rocket acceleration, the selection of the metals for the
several parts and with due regard to the weight of the
plunger 19, the clearances between the several parts as
above pointed out, the weight and load of the springs,
and the density and viscosity of the hydraulic fluid.

Also, the effects of temperature change may be com-
penated for by the use of a body material that has a
lower coefficient of thermal expansion than the material
of the plunger, the outer clearance being more readily
affected by the temperature changes than the inner clear-
ance. Also, it is possible to select a hydraulic fluid
which has a viscosity-temperature slope approximating
the change in volume slope of two dissimilar materials due
to temperature.

Notable among the practical advantages that are ob-
tained with the present invention are those of compara-
tive simplicity of structure and dependability of operation.

It should be pointed out that this device also meets
the several rigid requirements of the Government ordниl-
ary establishment, as will be now briefly noted. (1) This
fuse will fit existing projectiles in the manner required.
(2) This fuse is capable of withstanding long storage
conditions at high and low temperatures and is capable of
operating under such conditions. (3) This fuse does not
alter the ballistic characteristic of the projectile. (4) This
fuse also meets the standard requirements with re-
spect to the time of actuation, performance and safety.

And it might be added that this fuse possesses the neces-
sary rigidity against the vibrations due to speed of flight
of the missile of the type herein contemplated.

Also, it is possible to add to the present device a
canonical base type of detonator so that a firing pin
can rupture the cap by striking the reverse or rear side of
the same, as well as the forward side of the cap as
here disclosed.

Another important advantage of my present device
resides in the safety with which a shell or rocket can be
transported, handled or dropped without creating a
safety hazard, since the arming of the present device
depends upon the terrific inertia through a time interval incident to the firing of the shell.

Other practical advantages will no doubt suggest themselves to those who are familiar with the particular art to which the present invention relates.

It is to be understood that the present disclosure is merely for the purpose of illustration and that there might be devised various modifications thereof without departing from the spirit of my invention as herein set forth and claimed.

What I claim is:

1. A fuse for a missile of the non-rotating type, comprising a body open at its forward and rear ends and provided with means for attaching the open rear end thereof in operative relation to the missile, a hollow open-end guide means extending co-axially within and along said body, a detonator within the rear open end portion of said guide means, a firing pin extending co-axially within said guide means and having its rear end in registry with said detonator and with its forward end exposed for impact, a spring-actuated holding means normally tending towards inactive position so as to release said firing pin, means for restraining said spring-actuated holding means so as to prevent release of said firing pin, said body having a chamber adapted to contain a hydraulic fluid about said guide means, and a plunger surrounding said guide means and movable along the longitudinal axis of said body by force of acceleration of the missile against the resistance of the movement of the hydraulic fluid for releasing said restraining means so as to thereby permit access of said firing pin to said detonator, said plunger having a passage therethrough from the forward to the rearward ends thereof, and adjustable means for varying the flow of the hydraulic fluid through said passage so as to thereby vary the rate of travel of said plunger through the hydraulic fluid.

2. A fuse for a missile of the non-rotating type, comprising a hollow open-end body having a centrally apertured transverse wall across the rear part thereof so as to provide forward and rearward chambers within said body, the rear end of said body having means for attaching the open end thereof in operative relation to the missile, a hollow open-end guide means extending co-axially within and along said body and having its rear end portion extending through said central opening in said transverse wall of said body, means for securing said guide means in sealed condition within said wall, means for closing the forward end of said body in sealed condition about the forward end portion of said guide means, a detonator within the rear open end of said guide means, a firing pin extending co-axially within said guide means and having its rear end in adjacent registry with said detonator and with its forward end extending through said guide means so as to be exposed for impact, a spring-actuated holding means normally tending radially outward towards inactive position so as to release said firing pin, an annular member surrounding said guide means and adapted to occupy position in the plane of said holding means for restraining the same against being forced radially outward, spring means for holding said annular member in such restraining position, said hollow body being adapted to contain a hydraulic fluid therewithin and about said guide means, and a plunger surrounding said guide means and movable along the longitudinal axis of said body by force of acceleration of the missile against the resistance of the movement of the hydraulic fluid, said annular member extending radially outwardly into the path of said plunger so as to be released from restraining position and to thereby permit access of said firing pin to said detonator, said spring means for said annular member being in the form of a coil spring surrounding said guide means with bearing engagement at its ends with said annular member and with said transverse wall of said body, said guide means being provided with a shoulder, a coil spring surrounding said guide means and having abutment at its rear end against said shoulder and at its other end against the rear end of said plunger, said plunger having a passage therethrough from the forward end to the rearward end thereof, and adjustable means for varying the flow of the hydraulic fluid therethrough so as to thereby vary the rate of travel of said plunger through the hydraulic fluid.

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