

Oct. 5, 1943.

T. B. DOE ET AL

2,330,873

FUSE

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2 Sheets-Sheet 1

Fig. 1

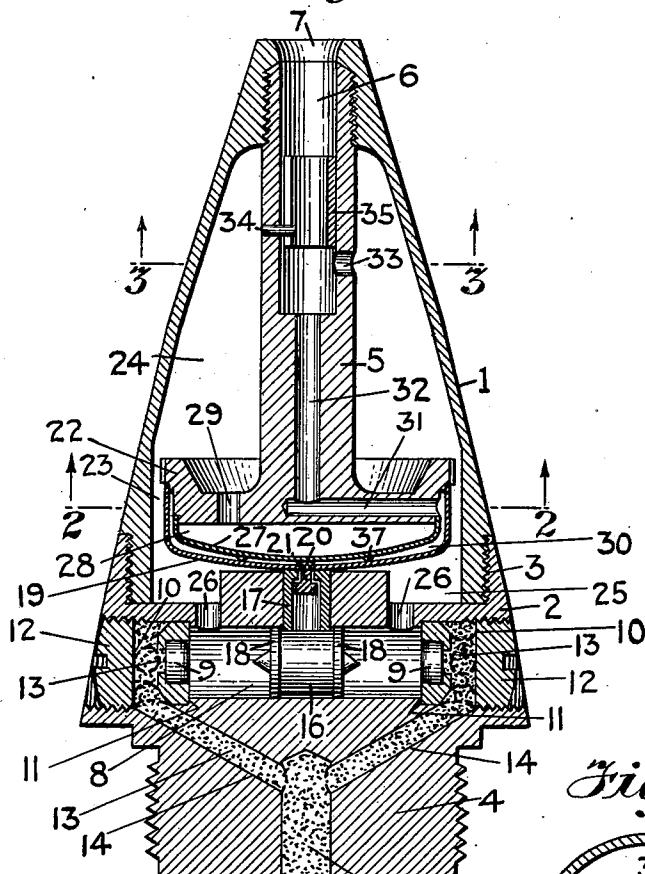


Fig. 2

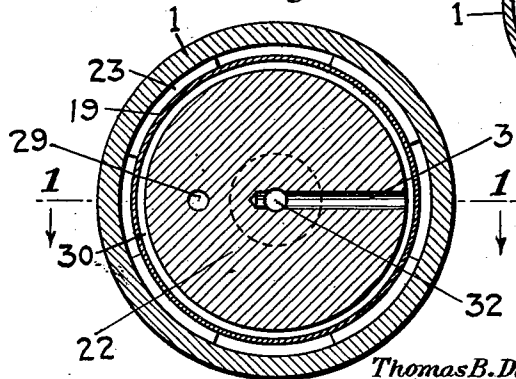
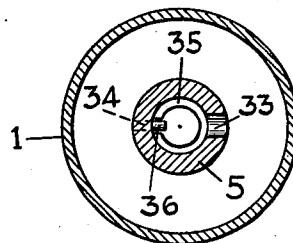


Fig. 3



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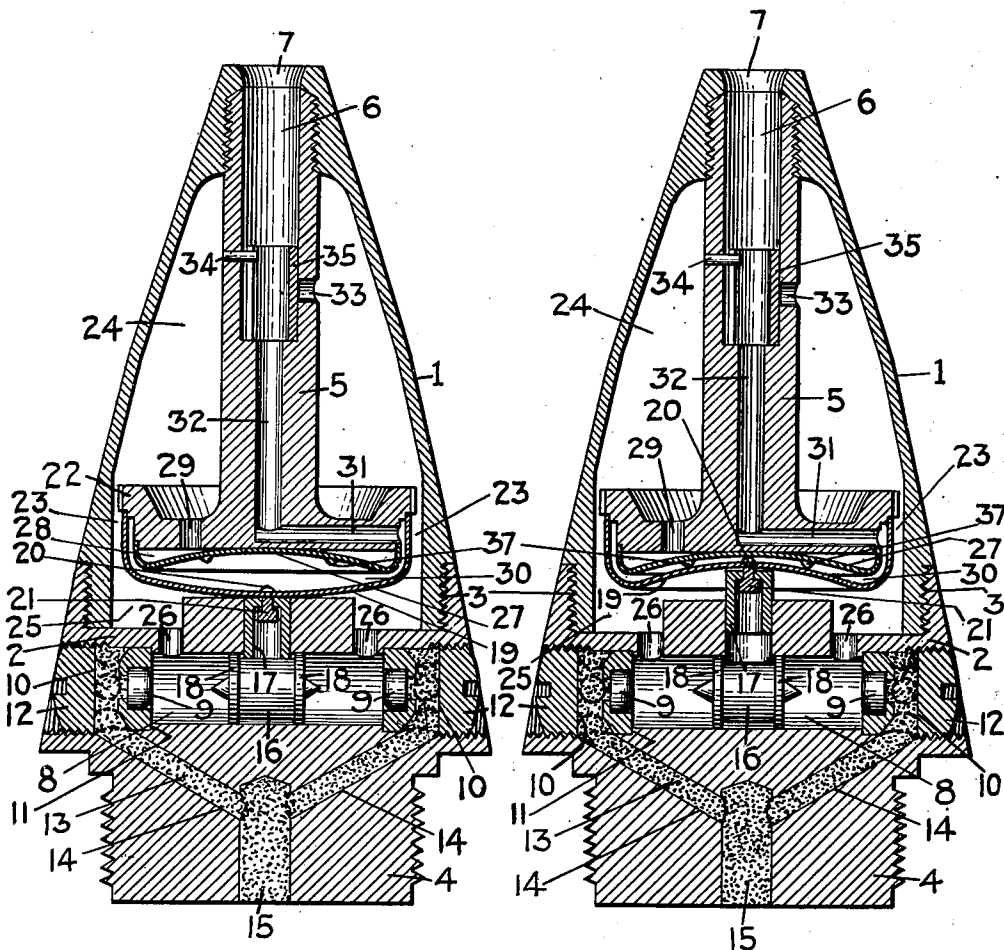
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Fig. 4

Fig. 5



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FUSE

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4 Claims. (Cl. 102—70)

This invention relates to fuses for projectiles and more particularly to fuses for detonating a projectile at a desired point in its flight.

An object of the invention is to provide a fuse for a projectile which functions upon the projectile being retarded to a velocity corresponding to the desired point in its flight to detonate the projectile.

Another object of the invention is to provide a fuse for a projectile in which a predetermined difference between the air pressure on the nose of the fuse and a selected air pressure set in a sealed chamber within the fuse causes the fuse to function.

Another object of the invention is to provide a fuse for a projectile in which the firing pin or hammer, which is held in an inoperative condition until the projectile has reached a predetermined point in its flight, is released when the set air pressure predominates by a predetermined value.

Another object of the invention is to provide a fuse for a projectile in which a plurality of diaphragms form surfaces on which the action of air from a chamber in the fuse set at a predetermined pressure and of air from an opening at the nose of the fuse under a pressure due to the velocity of the projectile in its flight cause the fuse to function at a predetermined point in its flight.

Fig. 1 is a vertical cross-sectional view of an embodiment of the invention taken on line 1—1 of Fig. 2;

Fig. 2 is a horizontal cross-sectional view taken on line 2—2 of Fig. 1;

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

Fig. 4 is similar to Fig. 1, but showing the relation of parts within the fuse after the projectile is fired;

Fig. 5 is a view similar to Fig. 4, but showing the relation of parts within the fuse when the hammer is released and the fuse is about to be fired.

In many of the fuses in use heretofore a powder train leading from a firing cap to the detonating charge in the projectile is ignited at the time the projectile is fired and burns to the detonating charge of the projectile in an interval of time depending on the point of ignition of the powder train. These fuses not only require that there be placed in the fuse itself a considerable amount of powder, which must be manufactured with care that the rate of propagation of the flame be known and constant, but their con-

struction has been such that they also require that the powder train be assembled with the fuse at the factory, with the attending dangers during assembly, shipment and storage.

To overcome these disadvantages, the present invention provides a fuse which may be manufactured, shipped and stored without any powder or detonating caps therein. The loading of the fuse with powder and the insertion of the firing caps are such simple operations that they may be done just before securing the fuse on the projectile.

The fuse of the present invention is fired by a firing pin or firing hammer which is moved by centrifugal force acting upon the hammer mass, the hammer being held in a fixed position by a detent until the desired time of detonation. This detent is pulled out of engagement with the hammer when the projectile has reached a predetermined point in its flight.

It is well known that the air pressure on the nose of a fuse of a projectile varies with the velocity of the projectile and the conditions of the atmosphere through which it passes and that the velocity of the projectile varies with the time of flight and the angle of elevation until the projectile has reached its maximum height in the trajectory. Data for the various sizes of projectile and initial velocities are well known and are available in easily interpretable curves and tables.

To release the detent there is provided an opening in the nose of the fuse which is in communication with one side of each of two diaphragms, the other sides of which are in communication with an air chamber in the fuse in which has been sealed air at a pressure corresponding to the point of detonation desired. The detent is connected to one of the diaphragms and releases the firing hammer when the nose air pressure has been reduced to an amount such that this diaphragm is moved under the pressure of the air in the sealed chamber. The required pressure in the sealed chamber is determined by the range at which it is desired that the projectile be detonated and the difference in pressure on the two sides of the diaphragm that is necessary to snap it over from one position to another.

It will therefore be seen that when the projectile has reached the desired range, the diaphragm will be snapped over and the firing hammer will be released from its restrained position. The hammer will then move outward against one of the firing caps under the action of centrifugal

force created by the rotation of the shell about its central axis.

It is realized that other fuses have been disclosed whose functioning depends upon the balancing of the nose air pressure due to the velocity of the projectile against the reaction of springs or the centrifugal force acting on the masses of certain parts of the fuse. These mechanical parts are subject to disarrangement or sticking which causes unreliability in their movement. It will be apparent at once that the present invention has overcome the disadvantages inherent in these previously disclosed arrangements.

Referring to the drawings and particularly to Fig. 1, 1 represents the conical walls of the fuse secured to the core 2 by screw threads 3. The lower part of core 2, base 4, is adapted to be screwed into the nose of the projectile. A hollow cylindrical-shaped member 5, is adapted to be secured by screw threads to the nose of the fuse such that the bore 6 of member 5 is aligned with an opening 7 in the nose of the fuse.

In the base 4 is formed a cylindrical cavity 8 at each end of which are firing caps 9 held against passages 10 in screw plugs 12 which abut against the shoulders 11 at the ends of cavity 8. The passages 10 are filled with ignition powder 13 which is in contact with firing caps 9. Ignition powder also fills the passages 14 and 15 leading to the lower face of the base 4. Passage 15 is in communication with the detonating charge in the projectile (not shown). Firing caps 9, screw plugs 12 and ignition powder 13 may be placed in position just before the fuse is secured on the projectile.

In cavity 8 is a double ended firing pin or firing hammer 16 which is acted upon by centrifugal force when the shell is in flight, due to its rotation about its longitudinal axis. Hammer 16 is held in its central position by detent 17 engaging shoulders 18 of the hammer 16. Detent 17 slides in and out of engagement with hammer 16 with the movement of diaphragm 19 to which it is attached by a riveted or soldered head 20 on a shouldered lug 21. It is preferable to assemble lug 21 to diaphragm 19 with a slight clearance between lug 21 and detent 17 to allow the diaphragm 19 to move slightly under pressure before it is required to overcome the static resistance of detent 17 in core 2. It has been found that with this clearance the differential pressure required to snap over the diaphragm is more uniform.

Diaphragm 19 is secured to an outwardly extending flange portion 22 of member 5. The upwardly extending portion of diaphragm 19 and the outer vertical sides of flange 22 form with the walls 1 a passage 23 connecting chamber 24, formed by the walls 1 and the outer surface of the member 5, with the space 25 surrounding the diaphragm 19. Space 25 is also in communication with cavity 8 by passages 26. Cavity 8 is placed in communication with chambers 24 and 25 to avoid the necessity of making the detent 17 air-tight as to cavity 8.

On the under side of flange 22 and above the diaphragm 19 is a second diaphragm 27. The space 28 between the diaphragm 27 and the lower face of flange 22 is in communication with chamber 24 by passageway 29. The space 30, between diaphragms 19 and 27, is in communication with bore 6 by passage 31 and reduced bore 32 in member 5.

In the wall of member 5 is a port 33 giving communication between chamber 24 and bore 6

and diametrically opposite port 33 and above it is secured a pin 34 which extends into bore 6. Within bore 6 slides a hollow split cylinder 35, whose outside diameter is very slightly greater than the diameter of bore 6 so that the cylinder may fit tightly within bore 6. Pin 34 engages the slot 36 in split cylinder 35 and acts as a guide to assure that the slot 36 is always out of alignment with the port 33.

Operation

When it is desired to set the fuse to detonate the projectile at a predetermined point in its flight, the air pressure on the nose of the projectile is found from range-nose pressure curves and chamber 24 is charged with this pressure, plus the differential pressure required on the two faces of diaphragm 19 to snap it over from one position to another. This differential pressure has been found to be approximately ten pounds. If, for example, it is desired to detonate the projectile when it has reached a point in its flight corresponding to seventy-five pounds per square inch of nose pressure, chamber 24 and space 25 are charged to a pressure of eighty-five pounds per square inch through opening 7 and bore 6. This pressure is also exerted in space 28 through passage 29 and temporarily to space 30 through bore 32 and passage 31. Diaphragms 19 and 27 are kept a minimum distance apart by protuberances 37 extending from the lower side of diaphragm 27.

When the chamber 24 and associated spaces are charged to the desired pressure, split cylinder 35 is shoved down to the bottom of bore 6, as shown in Fig. 4, thus sealing chamber 24 and associated spaces. The outside source of compressed air is then disconnected and space 30 is reduced to atmospheric pressure through passageway 31, bores 32 and 6, and opening 7.

The diaphragms 19 and 27 remain in the position shown in Fig. 1 as the set pressure in the fuse acting on the outside of diaphragm 19 and the inside of diaphragm 27 are balanced through the protuberances 37 which are in contact with the inner side of diaphragm 19.

It will be noted that diaphragm 27, both before and after charging the fuse to the set pressure, acts as a safety element to support the diaphragm 19 in its normal position. The diaphragm 27 is preferably made stiffer than diaphragm 19 and thereby makes a strong mechanical support for the diaphragm 19 before the fuse is charged. A convenient way to make diaphragm 27 stiffer than diaphragm 19 is to make its radius of curvature smaller than that of diaphragm 19.

When the projectile is fired, the nose air pressure increases to about one hundred and fifteen pounds per square inch for an initial velocity of the projectile of 2400 feet per second. This pressure is communicated to space 30 through opening 7, bores 6 and 32 and passageway 31, and as this pressure is greater than the pressure exerted on the upper side of diaphragm 27, diaphragm 27 is snapped over to the position shown in Fig. 4, thus removing the protuberances 37 from contact with diaphragm 19 and thereby arming the fuse. The increased nose pressure, however, is also exerted on the upper face of diaphragm 19, thus overcoming any tendency for the set pressure to snap the diaphragm 19.

When the projectile has reached the predetermined point in its flight and the nose pressure has been reduced correspondingly, the air pres-

sure from chamber 24 acting on the lower side of diaphragm 19 will then snap it over into the position shown in Fig. 5. Detent 17, connected to diaphragm 19, is thereby drawn out of engagement with hammer 16 which is free to be moved by centrifugal force to one end or the other of cavity 8 where it sets off one of the firing caps 9, igniting powder train 13, which detonates the powder in the projectile.

While the preferred embodiment of the invention has been described it is evident that various modifications are possible without departing from the scope of the invention as expressed in the claims.

We claim:

1. In a fuse for projectiles, the combination of a core and a firing cap therein, a firing hammer movable in the core and adapted to strike the firing cap, a movable member having two opposed sides and normally biased toward the firing hammer, a detent attached to the side of the member toward the firing hammer and normally adapted to hold the hammer in a fixed position, a second movable member normally biased toward the first movable member and having two opposed sides, one of said sides being positioned adjacent to the second side of the first movable member, an air chamber formed in part by the adjacent sides of the two movable members, a second air chamber formed in part by the outer sides of the two movable members, a passage connecting the first mentioned air chamber to an opening in the nose of the fuse, an externally accessible port communicating with the second air chamber, and valve means controlling said port.

2. In a fuse for projectiles, the combination of a core and a firing cap therein, a firing hammer movable in the core and adapted to strike the firing cap, a snap diaphragm secured at its periphery to the core and normally dished toward the firing hammer, a detent attached to the diaphragm and normally adapted to hold the hammer in a fixed position, a second snap diaphragm secured at its periphery to the core adjacent to the second side of the first diaphragm, said second diaphragm being normally dished in the same direction as the first diaphragm, an air chamber formed in part between the adjacent sides of the two diaphragms, a second air chamber formed in part by the 50

outer sides of the two diaphragms, a passage connecting the first mentioned air chamber to an opening in the nose of the fuse, an externally accessible port communicating with the second air chamber, and valve means controlling said port.

3. In a fuse for projectiles, the combination of a core and a firing cap therein, a firing hammer movable in the core and adapted to strike the firing cap, a snap diaphragm secured at its periphery to the core and normally dished toward the firing hammer, a detent attached to the diaphragm and normally adapted to hold the hammer in a fixed position, a second snap diaphragm secured at its periphery to the core adjacent to the second side of the first diaphragm, said second diaphragm being normally dished in the same direction as the first diaphragm, an air chamber formed in part between the adjacent sides of the two diaphragms, a second air chamber formed in part by the outer sides of the two diaphragms, a passage connecting the first mentioned air chamber to an opening in the nose of the fuse, a port connecting the second air chamber to the passage, and valve means for controlling the port.

4. In a fuse for projectiles, the combination of a core and a firing cap therein, a firing hammer movable in the core and adapted to strike the firing cap, a snap diaphragm secured at its periphery to the core and normally dished toward the firing hammer, a detent attached to the diaphragm and normally adapted to hold the hammer in a fixed position, a second snap diaphragm secured at its periphery to the core adjacent to the second side of the first diaphragm, said second diaphragm being normally dished in the same direction as the first diaphragm, means attached to one of the diaphragms for keeping said diaphragms separated a minimum distance from each other, an air chamber formed in part between the adjacent sides of the two diaphragms, a second air chamber formed in part by the outer sides of the two diaphragms, a passage connecting the first mentioned air chamber to an opening in the nose of the fuse, an externally accessible port communicating with the second air chamber, and valve means controlling said port.

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