

Sept. 23, 1947.

R. L. GRAUMANN ET AL

2,427,671

FUZE

Filed July 1, 1942

4 Sheets-Sheet 1

Fig. 1.

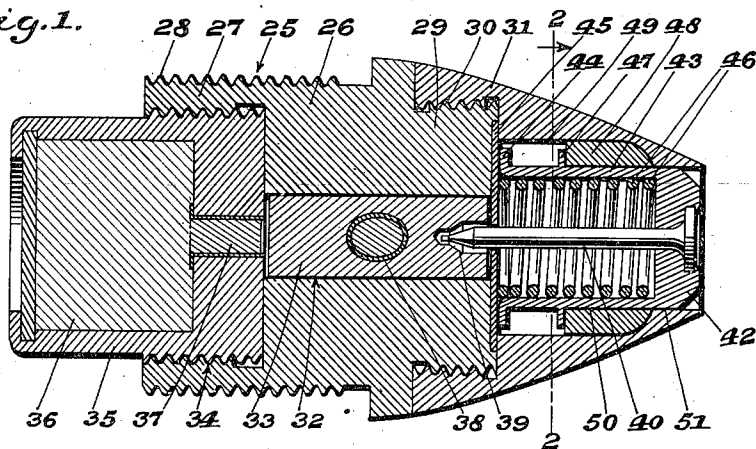


Fig. 3.

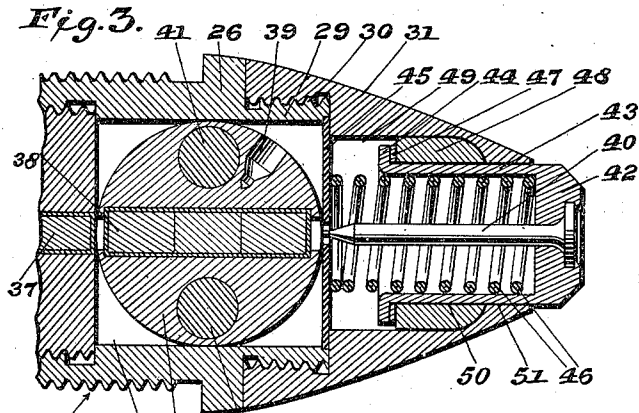


Fig. 2.

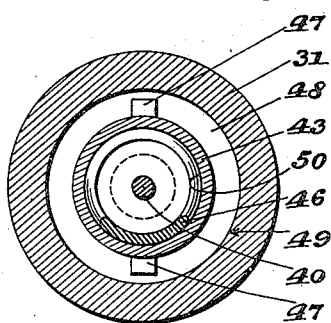


Fig. 4.

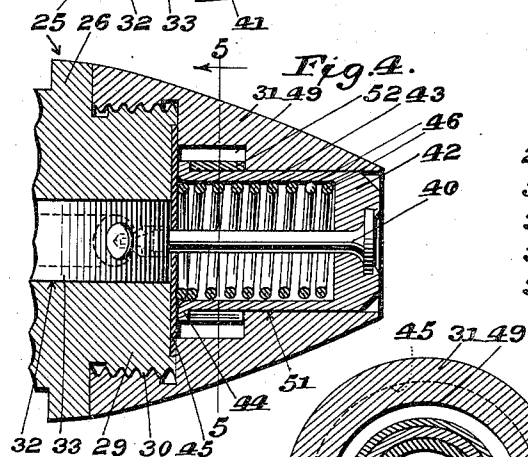


Fig. 6.

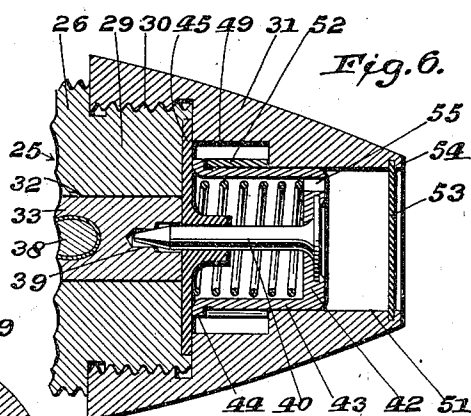
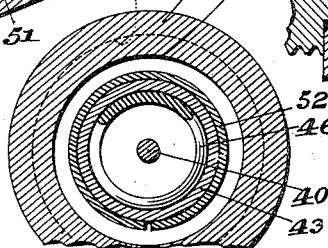


Fig. 5.



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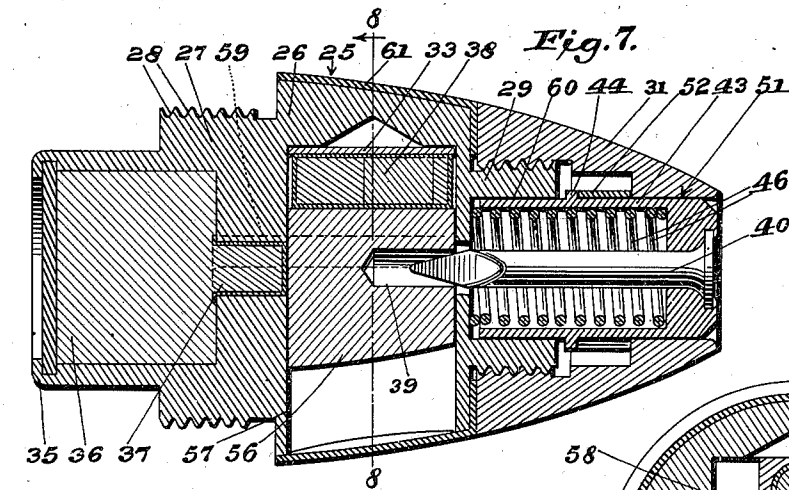
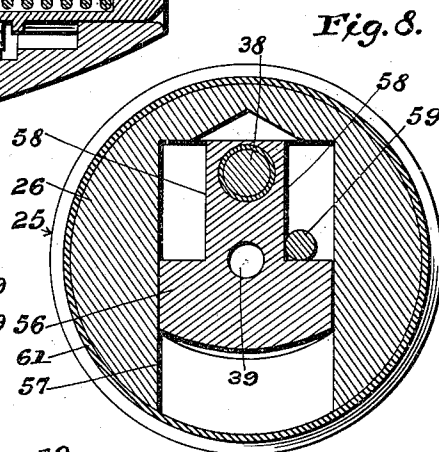
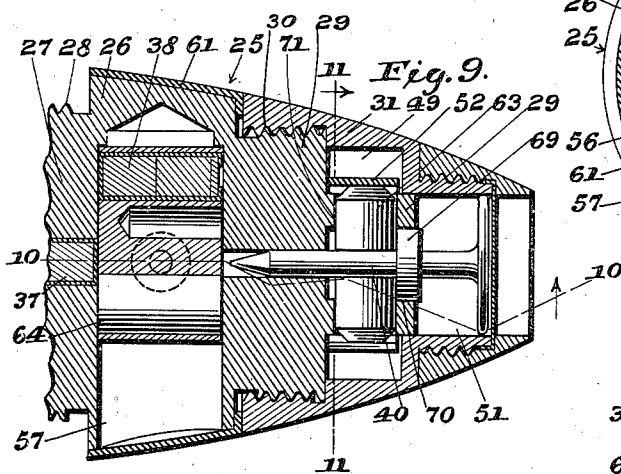
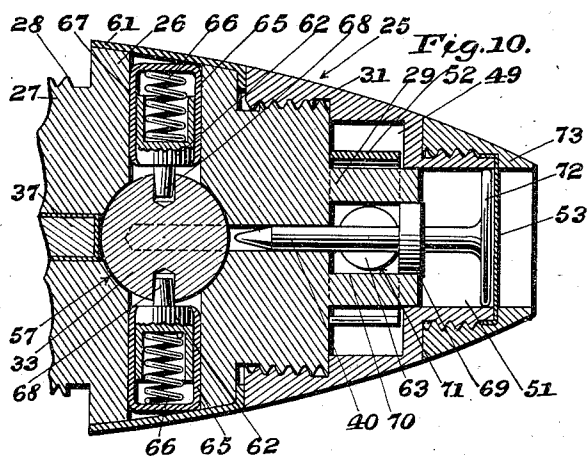
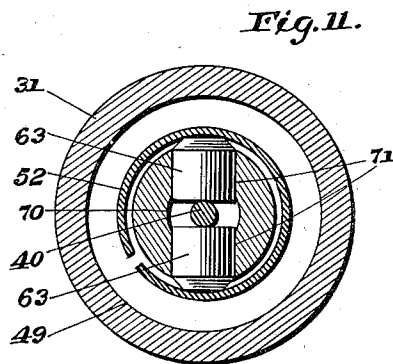
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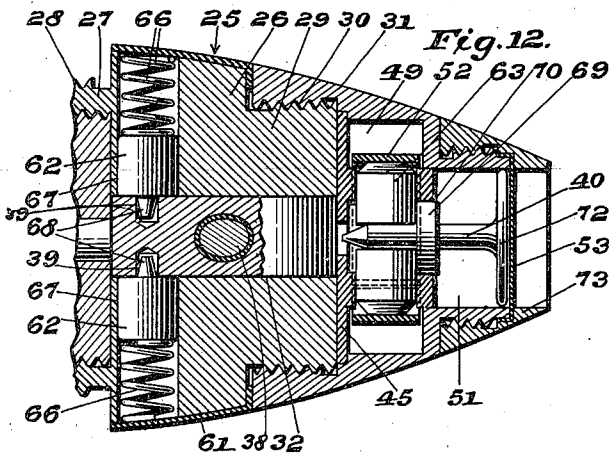
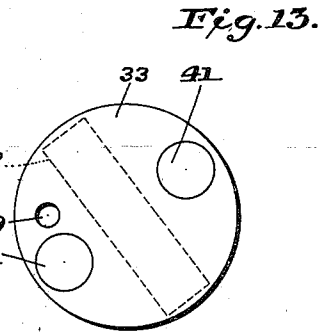
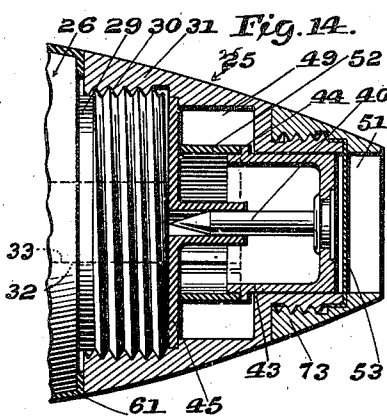
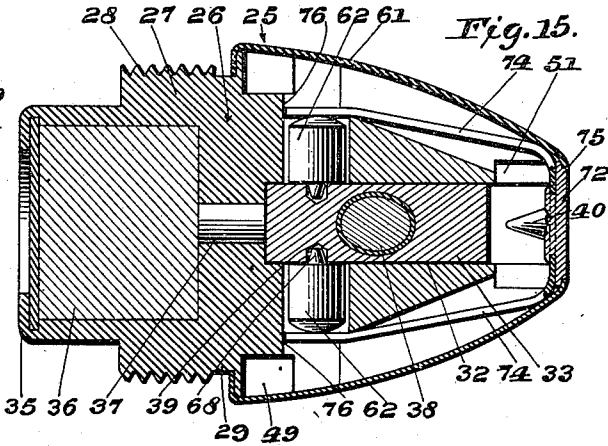
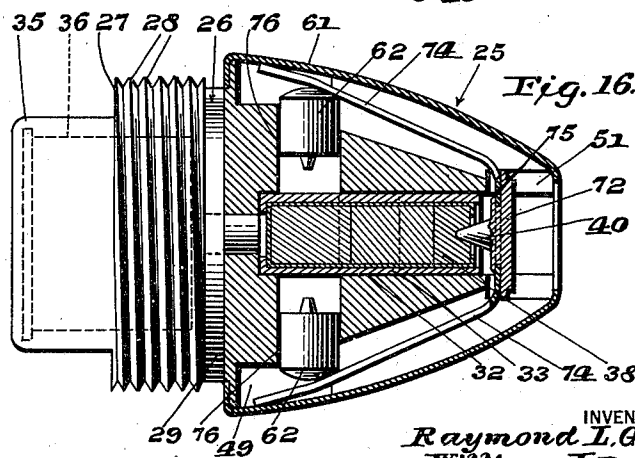
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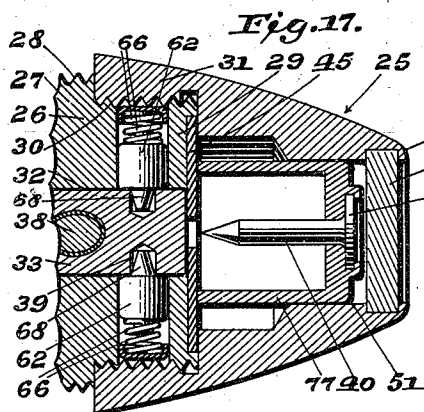
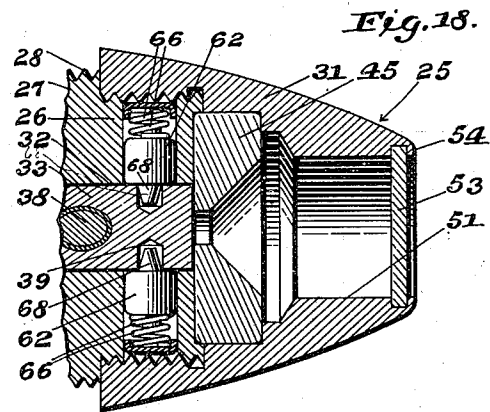
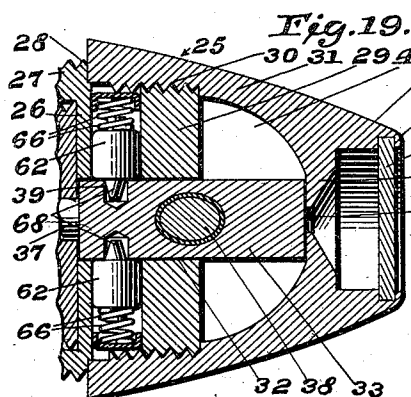
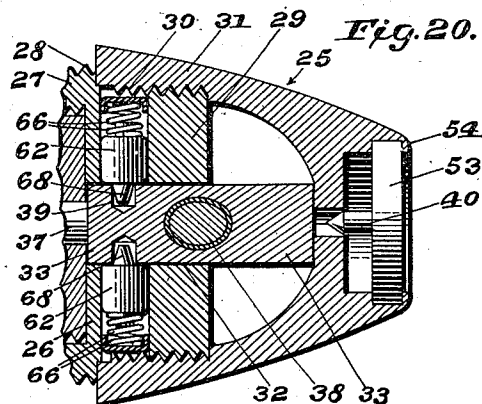
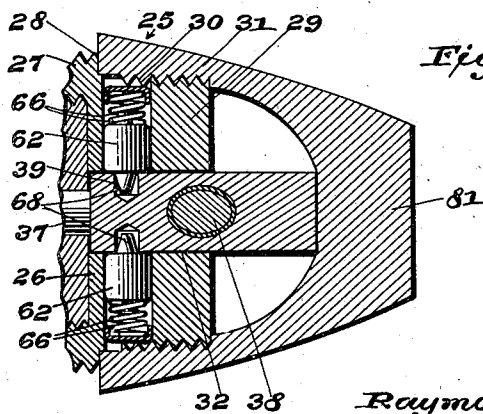
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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

2,427,671

FUZE

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Application July 1, 1942, Serial No. 449,324

5 Claims. (Cl. 102—79)

(Granted under the act of March 3, 1883; as
amended April 30, 1928; 370 O. G. 757)

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This invention relates to improvements in explosive projectiles of the bore safe type, a particular purpose being to assure the lack of continuity of the explosive train until the projectile actually begins its flight from the muzzle of the gun. Thereupon the centrifugal force developed by the spinning of the projectile becomes effective to establish the continuity of the explosive train in readiness for the firing thereof when the projectile strikes the target.

The general principle just stated is given mechanical expression herein in a number of ways, the disclosure comprising two types of fuzes, namely super-sensitive fuzes which will function instantaneously upon impact with a relatively fragile substance, such as the fabric of an airplane, and insensitive fuzes which will function instantaneously upon impact with more solid substances, such as the structural members and armored parts of an aircraft or their equivalents.

With this preamble in mind it can readily be understood that one of the objects of the invention is to provide a nose fuze which is contrived to insure the deferment of registration of the components of the explosive train with the firing pin or its equivalent, until the projectile is subjected to centrifugal and/or set-back forces such as will ordinarily be developed therein only upon firing said projectile from a gun.

Another object of the invention is to provide a nose fuze which in most of its forms employs a firing pin for the detonation of the explosive train, said firing pin being locked in a predetermined position in respect to the explosive train in which position said pin directly holds the movable component of said train in an unarmed or safe position, or itself is held in a retracted position wherein it is incapable of detonating said train upon accidental dropping of the projectile upon its nose if the explosive train were by some remote chance to assume an armed position in respect to the firing pin.

A further object of the invention is to provide a nose fuze wherein the firing pin can be released from its locked position in respect to the explosive train only in response to one of the forces set up in the projectile as the result of its being fired from a gun.

Other objects and advantages will appear in

the following specification, reference being made to the accompanying drawings in which:

Fig. 1 is a longitudinal section of a nose fuze wherein the firing pin is used to lock the rotor in the unarmed position in respect to the explosive train and itself is locked in an unarmed position in respect to the rotor.

Fig. 2 is a cross section taken on the line 2—2 of Fig. 1.

Fig. 3 is a longitudinal section of Fig. 1, showing the firing pin and rotor in their respective armed positions.

Fig. 4 is a fractional longitudinal section of a nose fuze illustrating a modified lock for the firing pin.

Fig. 5 is a cross section taken on the line 5—5 of Fig. 4.

Fig. 6 is a fractional longitudinal section of another modified form of nose fuze employing a shorter firing pin.

Fig. 7 is a longitudinal section of a nose fuze wherein the firing pin is used to lock a slider in the unarmed position in respect to the explosive train and itself is locked in an unarmed position by a split ring.

Fig. 8 is a cross section taken on the line 8—8 of Fig. 7.

Fig. 9 is a fractional longitudinal section of a slider type nose fuze wherein the firing pin is held retracted by centrifugally actuated detents and a split ring.

Fig. 10 is a section taken on line 10—10 of Fig. 9.

Fig. 11 is a cross section taken on line 11—11 of Fig. 9.

Fig. 12 is a fractional longitudinal section of a nose fuze wherein centrifugally actuated detents are used in conjunction with a firing pin and a rotor.

Fig. 13 is a plan view of the rotor shown in Fig. 12.

Fig. 14 is a fractional longitudinal section of a rotor-type nose fuze employing a modified firing pin and split ring assemblage.

Fig. 15 is a longitudinal section of a nose fuze employing a yoke spring in conjunction with the firing pin and rotor detents.

Fig. 16 is a view similar to Fig. 15 showing the parts in the firing position, after impact.

Fig. 17 is a fractional longitudinal section of a

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rotor-type nose fuze employing a crusher-type firing pin housing.

Fig. 18 is a fractional longitudinal section of a rotor-type nose fuze wherein the explosive train is detonated solely by the shock of impact.

Fig. 19 is a fractional longitudinal section of a modification of the nose fuze in Fig. 18.

Fig. 20 is a fractional longitudinal section of another modification of the nose fuze in Fig. 18, wherein the nose disc is supplemented by a firing pin.

Fig. 21 is a fractional longitudinal section of a rotor-type nose fuze wherein firing is accomplished by a blind nose cap.

In carrying out the invention provision is made of a fuze 25, so identified in all of the forms thereof, each of said forms comprising a body 26 which has a boss 27 threaded at 28 for screwing into the nose of an explosive projectile. The body 26 includes a boss 29 provided with threads 30 to which a nose cap 31 is screwed. There is a departure from this particular structure in one of the forms (Fig. 15) but in all instances the body 26 contains a chamber 32 which is occupied in part by a carrier 33.

This carrier is movable by centrifugal force from an initially unarmed or safe position to an armed or firing position in all forms of the invention. Detent means is used in each form of the invention to hold the carrier in said unarmed position, and the description is devoted to the variations involved in this particular phase of the invention as well as to variations in other details.

The forms of the invention shown in Figs. 1 to 16 are known as the super-sensitive type of fuzes because they are capable of firing the explosive charge of the projectile by contacting relatively fragile objects, such as the fabric of an aircraft to which a less sensitive fuze would not respond. In Figs. 1, 2, and 3 an internally threaded bore 34 provides the mounting for a booster thimble 35. A booster 36 is held in the thimble by suitable means, there being communication between the booster and the chamber 32 through a lead 37 which, with a detonator 38, completes what is herein known as an explosive train. The carrier 33 contains the detonator 38, and because of its mobility controls the continuity or lack of continuity of the explosive train.

The lead opens directly into the chamber 32, almost touching the contiguous side of the detonator carrier 33. Initially the detonator 38 is held out of registration with the lead 37 by the previously mentioned detent means which engages the carrier. For this purpose the carrier which is turnably pocketed in the chamber 32, has a recess 39 which is occupied by the point of the firing pin 40 to prevent turning. The recess is radially spaced (Fig. 3) from the detonator 38 for which reason the detonator necessarily is in the non-registering position when the firing pin is engaged with the recess as stated. A pair of weights 41 (Fig. 3) are sustained in the carrier in an unbalanced relationship to the fuze axis, awaiting the moment of release from the firing pin.

The firing pin is fixedly attached at its outer end to the head end 42 of a sleeve 43. A flange 44 on the other end of the sleeve engages a partition 45 which also provides the abutment for the rear end of a spring 46. The outer end of said spring abuts the head 42, tending to displace the firing pin assembly, consisting of the firing pin 40 and the sleeve 43, outwardly. This tendency

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is prevented by the engagement of a pair of frangible tabs 47 (Fig. 2) on the sleeve 43 with a set-back collar 48. This collar occupies the front end of a chamber 49 in the nose cap 31, being held there by the force delivered thereto through the contacting tabs 47.

Upon firing the projectile equipped with the nose fuze 25 from a gun, the inertia of the set-back collar 48 causes the movement of said collar toward the rear end of the chamber 49. The tabs 47 are sheared from the sleeve 43, and the collar 48 comes to rest against the flange 44. At the cessation of the aforesaid inertia or set-back force, which also affects the firing pin assembly, and as the projectile leaves the muzzle of the gun, said firing pin assembly moves outwardly in the matching bores 50, 51 respectively in the collar 48 and cap 31 by action of the spring 46. The collar 48 is then moved outwardly because of the engagement of the flange 44 therewith (Fig. 3).

The withdrawal of the point of the firing pin from the recess 39 leaves the carrier 33 free to turn under the centrifugal force which acts upon the projectile. The weights 41 fly as far out as possible (Fig. 3), thus turning the carrier 33, thereby aligning the explosive train 36, 37, and 38 with the firing pin. Upon striking the target the firing pin assembly is driven inwardly, causing the firing pin to stab the detonator 38 and fire the booster 36. Thereupon the projectile filler is exploded. The feature of the form of the invention shown in Figs. 1, 2, and 3 is the employment of the firing pin 40 as the detent for locking the carrier 33 in the safe or unarmed position, the spring lift for the firing pin assembly, in turn, being held in the safe or unarmed position by the combination of the frangible tabs 47 and the set-back collar 48.

Figs. 4 and 5 show the second form of the invention which is similar to the form shown in Figs. 1, 2, and 3, the main distinction between the two forms being in the use of a split ring 52 to maintain the firing pin 40 in the unarmed position. This ring is substituted for the frangible tabs 47 since it normally restrains the spring 46 and thereby holds the firing pin assembly 40, 42 in the retracted position (Fig. 4). Said ring 52 initially remains seated upon the sleeve 43 between the flange 44 and the front wall of the chamber 49. This keeps the firing pin in locked relationship to the carrier 33.

Upon firing this projectile, the centrifugal force opens the split ring 52, thereby releasing the firing pin assembly 40, 42. When the set-back force ceases, which force initially holds the firing pin assembly back, said assembly moves forwardly by action of the spring 46. The travel of the assembly is limited by the engagement of the flange 44 with the front wall of the chamber 49. The head 42 is then in an exposed position, in readiness to detonate the explosive train upon contact with the target. It will be understood that the carrier 33 is turned upon its release from the point of the firing pin as in the case of the previous example by the same centrifugal force which earlier spread the ring 52, the detonator 38 thereby completing the registration of the explosive train with the firing pin.

Fig. 6 will be recognized as a structure substantially the same as that of the fuze in Fig. 4. The split ring 52 is used as is also its centrifugal expansion in the chamber 49 for the release of the firing pin assembly 40, 43. The latter is made shorter than in Fig. 4, thus enabling the fuze to be sealed with a thin disc 53. Said disc is seated

by a nose crimp 54 in the otherwise open end of the bore 51. The turnable carrier 33 is locked initially by the engagement of the point of the firing pin 40 in the recess 39. The release of the firing pin assembly allows the spring 46 to displace said assembly so that the carrier becomes free to move under the influence of centrifugal force.

A hole 55 provides for a back-flow of air from the space between the head 42 and the disc 53 to avoid a compression of air which would check the motion of the firing pin assembly. Upon the striking of the projectile the nose crimp 54 cuts a wad from the target, thus shearing the disc 53 and driving the firing pin assembly backwards to detonate the then aligned explosive train.

Figs. 7 and 8 differ chiefly from Figs. 1, 4, and 6 by making the carrier 33 in slider form. The body 56 is cylindrical to fit the bore 57 which is driven in from one side of the body 26. The rabbeting at 58 (Fig. 8) of opposite sides of the body 56 overbalances the slider. A pin 59 mounted on the body 26 (Fig. 7) to project into one of the rabbet spaces (Fig. 8) keeps the detonator 38 in a registrable position with the rest of the explosive train and the firing pin assembly by preventing the slider from turning in its bore.

The sleeve 43 of the firing pin assembly is guided both in the bore 51 and an extension 60 thereof in the boss 29 of the fuze body 26. The flange 44 is located on the sleeve 43 at a place medially of the ends of the sleeve to suit this particular mode of slidable mounting. The split ring 52 holds the spring 46 in check as before, initially keeping the firing pin assembly in its locking position in reference to the detonator carrier.

Upon firing the projectile carrying the nose fuze as shown in Fig. 7, the split ring 52, firing pin assembly 40, 43 and carrier 33 make the same sequential responses as in Figs. 4 and 6. The overbalanced slider-carrier moves over against a cover 61, thus bringing the detonator 38 in line with the firing pin and the rest of the explosive train. Said cover is secured in place between the body 26 and the nose cap 31 as shown when the two are screwed together.

Figs. 9, 10, and 11 illustrate the use of detent plugs 62 and 63 both in conjunction with the slider carrier 33 and the split ring 52. Said detents are desirably employed in pairs, thus providing an arrangement which is balanced throughout, except in the carrier itself. Here a lead slug 64 is used to overbalance the carrier and make sure that the carrier will move out in its bore 57 against the cover 61 by centrifugal force, when permitted to do so.

The detents 62 are slidably pocketed in thimbles 65 in common with springs 66. Each thimble is forced the required distance into a lateral bore 67 extending from the bore 57 to properly position the pin end 68 in an opening in the side of the carrier. The carrier is thus held initially by spring-pressed plugs instead of being detained by the firing pin 40. The firing pin has a collar 69 beside which the detents 63 are stationed to prevent premature inward displacement of the firing pin. This collar slidable fits a central hole 70 in the boss 29 (Fig. 10), the lateral bores 71 of which are occupied by the detents 63.

A pad 72 constitutes the outer terminal of the firing pin 40. Said pad is positioned close to the thin disc 53 which, in this case, is clamped

at its peripheral flange between the nose cap 31 and a crimp tip 73. Upon firing a projectile equipped with this fuze, the centrifugal force will cause the detent plugs 63 to move outwardly against the split ring 52 opening it and releasing the firing pin 40. The centrifugal force also causes the detent plugs 62 to move outwardly, compressing the springs 66 and releasing the slider-carrier 33 which is overbalanced by the lead slug 64, said slider moves over against the cover 61, thus bringing the detonator 38 in line with the firing pin and the rest of the explosive train. The same centrifugal force which displaces the detent plugs 62 and the carrier 33 in serial order, exercises a stabilizing effect upon the carrier, preventing any tendency toward its turning on its axis and therefore keeping the detonator 38 in alignment with the firing pin 40. When striking the target the crimp tip 73 cuts a wad which is driven backwardly in the bore 51, rupturing the disc 53 and displacing the firing pin to strike the detonator.

Fig. 12 will be recognized as similar to Fig. 10, the main difference being the substitution of a turnable carrier similar in general to that of Fig. 1 for the slider-carrier of Fig. 10. A minor difference comprises slidably mounting the detent plugs 62 directly in the lateral bores 67 instead of confining them to thimbles 65 as in Fig. 10. The springs 66 bear against the cover 61 at their outer ends. The pin ends 68 initially engage in recesses 39 in the flat sides of the turnable carrier 33, restraining the turning thereof under the influence of the centrifugal force upon its weights 41 (Fig. 13) until the detent plugs 63 are centrifugally displaced sufficiently far out. Otherwise the same actions occur as in the fuze shown in Fig. 10 upon firing the projectile.

Fig. 14 is to be regarded as the same type of fuze as Fig. 12. The turnable carrier 33 is initially held by detent plugs as in Fig. 12. However, the detent plugs 63 are omitted, the split ring 52 being used alone in conjunction with the firing pin sleeve 43. Said sleeve has a flange 44 which is initially obstructed by the split ring 52 to hold the firing pin 40 in its outward position. The internal action of this fuze during the flight of the projectile is the same as that of the fuze in Fig. 12, noting the omission of the detent plugs 63, as is also the internal response when the crimp tip 73 strikes the target.

Figs. 15 and 16 illustrate a type of fuze wherein the modification occurs mainly in the firing pin assembly. The chamber 49 in the boss 29 now consists of passageways merely wide enough to accommodate the diverging arms 74 of a yoke spring 75. A shoulder 76 is provided in the formation of the chamber-passageways 49, with which the tips of the arms 74 are abutted initially as shown in Fig. 15. The circumferential limits of the two shoulders comprise external reliefs past which the tips of the arms are moved by centrifugal force, thereby to escape the shoulders. The yoke spring 75 is secured centrally to the pad 72 of the firing pin 40, which pad, as in Figs. 9 and 10, is slidable in the bore 51 at the forward terminal of the fuze.

Plug detents 62 are used in conjunction with the turnable carrier 33, said detents being held in their initial spring arms 74 which, in turn, are held locked because of their abutment against the shoulder 76. Upon cessation of the set-back force set up in the fuze when firing the projectile, the centrifugal force causes the detent

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plugs 62 to move outwardly, spreading the yoke spring 75 outwardly away from the shoulder 76 and driving the tips of the arms 74 against the cover 61. The firing pin 40 remains in the forward position during flight due to the friction between the yoke spring arms 74 and the cover 61.

The carrier 33, being free to arm, responds to the centrifugal force acting upon its weights, thereby bringing its detonator 38 into alignment with the firing pin 40 and the rest of the explosive train. In striking the target (a position suggested by Fig. 16), the firing pin 40 and yoke spring 75 are driven to the rear, striking the detonator 38 and firing the explosive train.

As previously pointed out, the remaining fuzes are of insensitive types. They are intended to function instantaneously upon impact, but against more durable structures such as the framing and armored parts of an aircraft or the like. In each of Figs. 17 to 21 the turnable type of carrier 33 is used, as are also the spring-pressed dent plugs 62. The latter move outwardly under the influence of centrifugal force when the projectile is fired so that the carrier 33 is free to arm by aligning its detonator 38 with the firing pin 40 and the rest of the explosive train.

In Fig. 17 the firing pin pad 72 is fixed in the base of a crushable housing 77. This housing is slidable in the bore 51, which is closed at its outer end by a heavy disc 78. This disc is secured by the nose crimp 54. Upon striking the target the heavy nose disc 78 is driven inwardly, crushing the firing pin housing 77 and driving the firing pin into the previously aligned explosive train.

In Fig. 18 the partition 45, previously appearing as a thin disc, is now made in the form of a heavy body which, because of its volume, is capable of firing the detonator 38. The bore 51 is unoccupied except by the disc 53 which is held in place by the nose crimp 54. Upon striking the target, the previously armed detonator 38 is exploded by the violent shock imparted to it by means of the discs 53 and 45 and the collapsing front part of the nose cap 31.

Fig. 19 illustrates a variation of the fuze in Fig. 18 in that the turnable carrier 33 is placed nearer to the front end with a view toward compactness. The forward side of the carrier 33 extends into the chamber 49 into confronting relationship with a wall 79 which separates said chamber from the bore 51 except for a central orifice 80. Upon striking the target the fuze in Fig. 19 will function solely by the ensuing violent shock imparted to it by the impact.

In Fig. 20 the structural parts are the same as in Fig. 19 except that the sealing disc 53 is made of a heavy body as in Fig. 17 and forms the base for the firing pin 40. The detonation of the explosive train upon impact of the fuze with the target is much the same as in Figs. 18 and 19 with the added positive functioning of the firing pin as in Fig. 17.

Fig. 21 illustrates the simplest of all of the fuzes. The nose cap 31 is blind as at 81. Upon striking the target the detonator 38 is initiated by the violent shock imparted to it upon the collapse of the nose cap.

While the various modifications disclosed herein are to be regarded as preferred forms of the invention, it will be understood by those skilled in the art that further modifications and changes may be made without departing from the spirit of the invention or the scope of the appended claims.

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The invention herein described 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.

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

1. In a fuze, a body having a chamber and a lead included in a portion of an explosive train, a detonator carrier occupying said chamber initially assuming an unarmed position therein and being susceptible to centrifugal force set up in the flight of the fuze to align its detonator with said lead to complete said train, a firing pin engaging the carrier to hold it in said unarmed position, a sleeve carrying the firing pin, said sleeve having a frangible portion, tension means acting on the sleeve tending to displace the firing pin into an armed position, and a collar loose on the sleeve initially abutted by said frangible portion to resist said tension means, said collar responding to a set-back force to rupture the frangible portion and thus release the firing pin.

2. In a fuze, a body having a chamber and a lead included in a portion of an explosive train, a detonator carrier occupying said chamber initially assuming an unarmed position therein and being susceptible to centrifugal force set up in the flight of the fuze to align its detonator with said lead to complete said train, a firing pin engaging the carrier to hold it in said unarmed position, a sleeve having a head in which said pin is set, said sleeve having a frangible portion, a spring pocketed in the sleeve acting against the head tending to displace the firing pin into an armed position, a collar loose on the sleeve, initially abutted by said frangible portion to resist said spring, said collar responding to a set-back force to rupture the frangible portion and thus release the firing pin, and stop means on the sleeve obstructed by the collar in the resulting action of the spring limiting the displacement of the firing pin.

3. In a fuze, a body, a movable detonator carrier in the body, a nose cap attached to the body and having a chamber, a firing pin having one end confronting the carrier, a sleeve mounted in the nose cap and to which the other end of the firing pin is secured, a frangible portion projecting from the sleeve into the chamber, a set-back collar loose on the sleeve and occupying the chamber, and a spring acting on the sleeve, urging the frangible portion into engagement with the collar so as to push the collar against one end of the chamber.

4. In a fuze, a fuze body, a detonator carrier movably mounted on the fuze body, a firing pin engaging the carrier to hold it in an initially unarmed position, means movably mounted on the fuze body and carrying the firing pin, said means having a frangible portion, a set-back member loose on said movably mounted means in a position between the frangible portion and a part of the fuze body, and tension means acting on said movably mounted means, tending to displace the firing pin into an armed position and simultaneously causing said frangible portion to keep the set-back member pressed against said part of the fuze body.

5. In a fuze, a fuze body, a firing pin means movably mounted within said body for carrying said firing pin, said movably mounted means having integral external frangible means, a set-back member loosely surrounding said movable means at a position adjacent the frangible means and a

wall portion of the body, and compression means housed by said movably mounted means for transmitting pressure through the frangible means to the set-back member to keep said member initially seated against said wall portion.

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