May 14, 1946. J. C. BYRNES ET AL 2,400,100

BOMB FUSE

Filed Feb. 15, 1934 2 Sheets-Sheet 1

Fig. 1

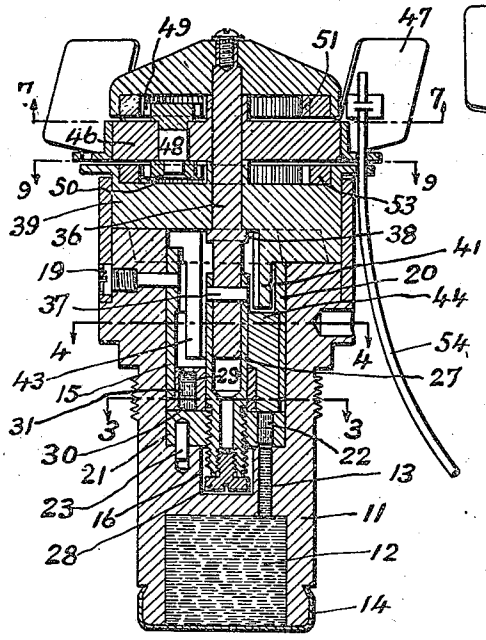

Fig. 2

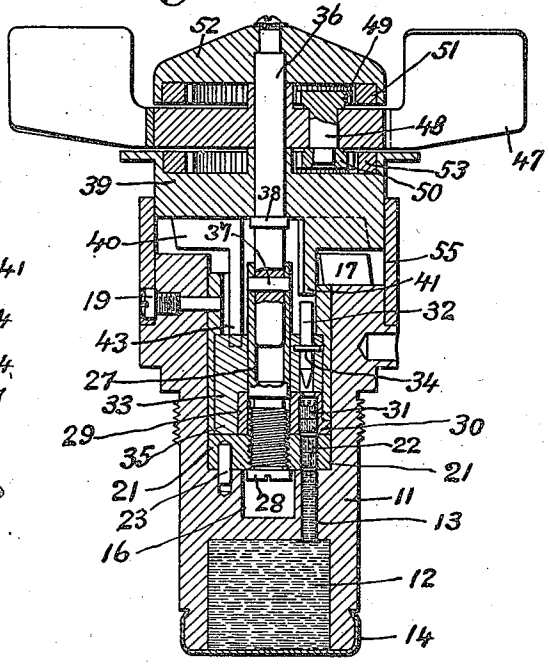

Fig. 3

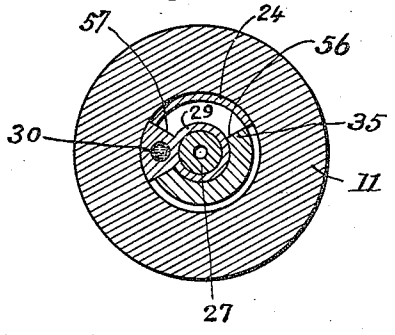

Fig. 4

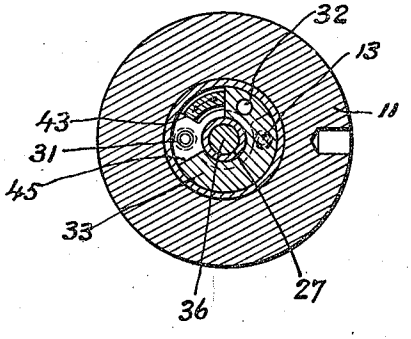

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Fig. 5

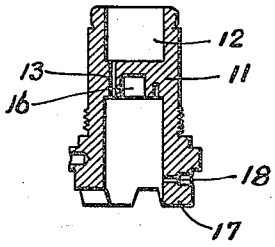


Fig. 6

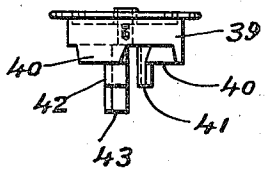


Fig. 7

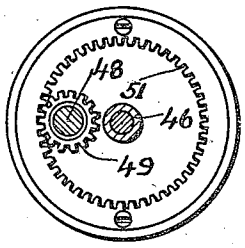


Fig. 8

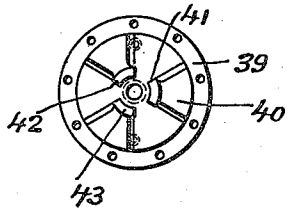


Fig. 9

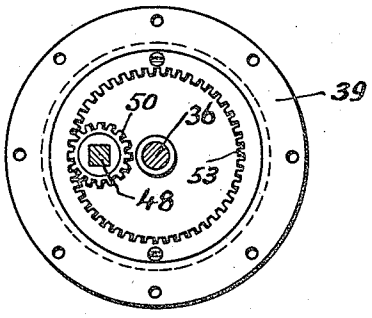
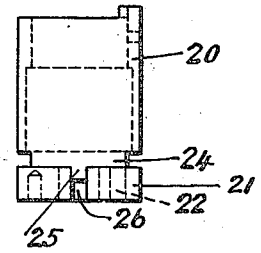


Fig. 10



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UNITED STATES PATENT OFFICE

2,400,100

BOMB FUSE

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Application February 15, 1934, Serial No. 711,430

10 Claims. (Cl. 102—81.2)

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

This invention relates to bomb fuses, and more particularly to that type thereof in which the firing mechanism, initially in an unarmed condition, is moved to the armed condition by action of the air upon parts of the fuse.

It is the object of this invention to provide a bomb fuse that has great resistance to firing when unarmed, and further to provide delay means for arming the fuse after the bomb has been released.

With the above and other objects in view, this invention consists in the construction, combination and arrangement of parts as will be described more fully hereinafter.

In the drawings:

Fig. 1 is a longitudinal axial section of our invention showing the parts in the unarmed condition;

Fig. 2 is a view similar to Fig. 1 but with the parts in the armed condition;

Figs. 3, 4, 7 and 9 are transverse sections taken on lines 3—3, 4—4, 7—7 and 9—9 of Fig. 1, respectively;

Fig. 5 is a longitudinal sectional view of the fuse body;

Figs. 6 and 8 are respectively a side elevation and a bottom plan view of the element that carries the striker;

Fig. 10 is a side elevation of a sleeve in which certain parts are housed and a threaded nut associated therewith.

The body 11 of the fuse has in it a cavity for the reception of the booster charge 12 and a passage 13 communicating with the booster cavity in which the material of the booster lead-in is disposed. A thin metal cap 14 is clamped over the end of body 11 to retain the booster charge. At the other end of body 11 is a recess 15 in which are disposed certain parts of the firing mechanism to be described hereinafter, the cavity 15 being extended downwardly with reduced diameter as indicated at 16. The upper end of body 11 is formed with a series of projections 17 and has an aperture 18 through the body wall to receive a locking pin 19 that is screwed into the body wall to hold sleeve 20 against both rotatory and longitudinal movement in cavity 15.

Seated upon the shoulder formed at the junction of cavity 15 and extension 16 thereof is an internally threaded nut 21 having through it a hole 22 to receive fuse train pellets, and held against rotation by a pin 23 that engages both nut 21 and body 11. As shown in Fig. 10, the wall of sleeve 20 at its lower end is cut away throughout the major portion of its circumference, leaving a tab 24 that seats upon nut 21 and has a tongue 25 extending into a slot 26 in nut 21. A sleeve 27 has external threads at its lower end that engage the threads of nut 21, the longitudinal movement of the sleeve being limited by a shoulder at the upper end of the threaded portion and by a screw 28 threaded into the lower end thereof.

A detonator holder 29 is rotatable upon sleeve 27 and is seated upon the upper face of nut 21, the rotation of the detonator holder being limited by a tongue 30 that extends into the cutaway portion at the lower end of sleeve 20 and contacts the two edges of tab 24 at its two limits of movement. The detonator 31 in detonator holder 29 is angularly spaced 180° from the fuse train and booster lead-in when the parts are in the unarmed condition, as shown in Fig. 1.

The firing pin 32 is secured in firing pin carrier 33 by a shear pin 34. As shown in Figs. 1, 2, 3 and 4, the firing pin carrier 33 is disposed to rotate upon the detonator holder 29 and sleeve 27, there being a portion 35 of the carrier that extends downwardly to engage the detonator holder 29 and cause the detonator holder to rotate with the firing pin carrier, but since the portion 35 is of only substantially 180° in angular extent, the firing pin carrier will rotate for some time before engaging the detonator holder. A thrust rod 36 is secured in the upper end of sleeve 27 by a shear pin 37 and has on it a laterally extending flange or collar 38. The element 39 is seated upon collar 38 and is rotatable on thrust rod 36, the lower surface of element 39 having formed on it projections 40 that seat between projection 17 of body 11 and hold the element 39 against rotation when in the unarmed condition. Extending from the radial inner ends of projections 40 are three lugs 41, 42 and 43, the former two being of substantially equal length and extending approximately to the upper face 44 of firing pin carrier 33, while lug 43 is of sufficient length to contact face 45 of the firing pin carrier and cause the carrier to rotate with element 39; however, the angular extent of the portion of the firing pin carrier contacted by lug 43 is such that element 39 rotates through a number of degrees before lug 43 engages the firing pin carrer.

Rotatably disposed on thrust rod 36 above the element 39 is vane carrier 46 to which are secured the vanes 47 to rotate the firing mechanism. Upon a shaft 48 that is journaled in vane carrier 46 are fixed two pinions 49 and 50 having the same number of teeth, the former being meshed

with an internal gear 51 having 47 teeth carried by the head 52 that is non-rotatably secured on thrust rod 36 and the latter being meshed with a second internal gear 53 having 48 teeth and secured in the upper face of vane carrier 46. It is obvious that since gear 53 has one tooth more than gear 51, when one of those gears is held against rotation and the other is left free to turn, the latter will be rotated with respect to the former through an angular distance equal to that subtended by one tooth on gear 53. If it is desired to increase the rate of relative rotation between the internal gears, the number of teeth on the one gear in excess of that on the other may be made greater than one. Arming wire 54 is passed through aligned holes in element 39 and vane carrier 46 to prevent arming of the fuse before the bomb is released, the arming wire being withdrawn at the time of launching the bomb as is the usual practice. An exterior sleeve 55 is secured to the upper part of body 11 and encloses element 39 to prevent entry of any object between the element 39 and body 11 when in the armed condition, which object might prevent the firing of the bomb upon impact.

The operation of our bomb fuse is as follows:

It will be noted in Fig. 4 that the detonator 31, the firing pin 32 and the booster lead-in passage 13 are all angularly separated from one another in the unarmed condition, the firing pin being housed between lugs 41 and 42, the former of which serves as a striker to drive the firing pin against the detonator to explode the bomb. When the bomb is released the pressure of the air upon vanes 47 causes the vane carrier 46 to rotate in a clockwise direction as seen from the top of the fuse. This rotation of vane carrier 46 causes the pinions 49 and 50 to travel over the internal gears 51 and 53 respectively meshed therewith. However, since the element 39 to which internal gear 53 is secured is held against rotation by the interlocking of projections 40 with the projections 17 on body 11 and further, since the number of teeth in the two internal gears is not the same, the head 52 is caused to rotate slowly which, in turn, rotates thrust rod 36 and sleeve 27, causing the sleeve to be translated upwardly due to its being in threaded engagement with the fixed nut 21. The translational movement of sleeve 27 is transmitted to element 39 and lifts that element so that the projections 40 thereon will clear projections 17 on body 11. When screw 28 has been brought up against nut 21, further rotation of sleeve 27 is prevented and holds head 52 also against rotation. Element 39 being now free to rotate, it is driven slowly around by the gears, thus bringing lug 43 into contact with face 45 of the firing pin carrier, which causes the firing pin carrier to rotate until the firing pin 32 is directly above detonator 31 at which time face 56 on the firing pin carrier contacts face 57 on the detonator holder and the two rotate in unison until tongue 30 on the detonator holder contacts the opposite edge of tab 24, at which time the detonator 31, the firing pin 32 and striker 41 are all aligned with each other and with the booster lead-in passage. The fuse is then in the armed condition shown in Fig. 2 and all parts of element 39 are spaced from the respectively opposed parts of body 11. Impact of head 52 upon a target will drive thrust rod 36 inwardly and shear the pin 37, permitting striker 41 to drive firing pin 32 inwardly which will shear the pin 34 and drive the firing pin 32 against detonator 31 to initiate the explosion of the bomb. If the fuse should be accidentally armed, it can be unarmed by manually rotating vanes 47 in the direction opposite to that in which they are driven by the air pressure until movement thereof is stopped by the interlocking of the parts of the fuse.

It will be noted that considerable space is left in the fuse body above the detonator holder. This is to permit expansion of gases evolved by the detonator without igniting the fuse if the detonator should be accidentally fired when the parts are not in the armed condition. When in the armed condition, escape of the detonator gases into the body of the fuse is prevented by the firing pin holder and firing pin, as shown in Fig. 2.

It will be understood that the above description and accompanying drawings comprehend only the general and preferred embodiments of our invention, and that various changes may be made within the scope of the appended claims without sacrificing any of the advantages of this invention.

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

We claim:

1. A fuse, comprising a body having projections at one end, a cavity for a booster charge and a booster lead-in communicating with said cavity; a nut non-rotably fixed in said body and having an aperture that forms a continuation of said lead-in, a translating sleeve having external threads engaged with the threads in said nut and stops to limit longitudinal movement thereof in both directions, a fixed sleeve in said body having a major arc segment of its wall cut away adjacent said nut, a detonator carrier rotatable on said translating sleeve against a face of said nut and having a tongue extending into the cut-away portion of said fixed sleeve, the remaining minor arc segment of said wall forming limit stops for said detonator carrier, a detonator in said carrier, a firing pin carrier rotatable on said translating sleeve having a delay motion engagement with said detonator carrier, a firing pin secured in said firing pin carrier by means of a shear pin and disposed to be aligned with said detonator when the two said carriers are engaged, an element operatively connected to said translating sleeve, said element normally being locked with the projections on said body and having a portion that forms a delay motion connection with said firing pin carrier and a striker portion, and means to rotate said translating sleeve to disengage said element from said body and thereafter to rotate the aforesaid rotatable members to align said detonator, said firing pin and said striker portion with the said lead-in.

2. A fuse, comprising a body having in it a fuse train passage, a rotatable detonator carrier in said body having in it an aperture to receive a detonator, a rotatable firing pin carrier in said body adjacent said detonator carrier having a portion to form a delay motion connection with said detonator carrier; a rotatable element having portions engaged with portions of said body when in the unarmed condition, a portion forming a delay motion connection with said firing pin carrier and a striker; a firing pin in said firing pin carrier, and means to translate said element to disengage it from said body and thereafter to rotate said carriers and said element to align

said detonator aperture, said firing pin and striker.

3. A fuse, comprising a body having in it a fuse train passage, a rotatable detonator carrier in said body having in it an aperture to receive a detonator, a rotatable firing pin carrier in said body adjacent said detonator carrier having a portion to form a delay motion connection with said detonator carrier; a rotatable element having portions engaged with portions of said body when in the unarmed condition, a portion forming a delay motion connection with said firing pin carrier and a striker; a firing pin in said firing pin carrier, and means to translate said element to disengage it from said body and thereafter to move said carriers and said element into the armed condition.

4. A fuse, comprising a body, a detonator carrier therein, a firing pin carrier therein having a delay motion connection with said detonator carrier, a firing pin in said firing pin carrier, the aforesaid parts being normally in an unarmed condition, a portion forming a delay motion connection with said firing pin carrier and a striker; and means to move the above mentioned parts to the armed condition including a fixed nut in said body, a translating sleeve in screw-threaded engagement therewith, a thrust rod rotatable in said element having an end disposed in said sleeve and a collar seated against the inner face of said element, a shear pin connecting said rod and said sleeve, an internal gear carried by the outer face of said element, a vane carrier rotatable on said rod adjacent said element, a head non-rotatably mounted on the outer end of said rod, an internal gear carried by the inner face of said head and having a smaller number of teeth than the first-mentioned internal gear, a shaft rotatably mounted in said vane carrier, a pinion on one end thereof meshed with the first mentioned internal gear, a pinion on the other end thereof meshed with the second mentioned internal gear, both of said pinions having the same number of teeth, and vanes actuatable by air pressure mounted on said vane carrier.

5. A fuse, comprising a body, a detonator carrier therein, a firing pin carrier therein having a delay motion connection with said detonator carrier, a firing pin in said firing pin carrier, the aforesaid parts being normally in an unarmed condition; an element having parts engaged with said body in the unarmed condition, a portion forming a delay motion connection with said firing pin carrier and a striker; and means to move the above mentioned parts to the armed condition including a fixed nut in said body, a translating sleeve in screw-threaded engagement therewith, a thrust rod rotatable in said element having an end disposed in said sleeve and a collar seated against the inner face of said element, a shear pin connecting said rod and said sleeve, and mechanism operable by air pressure to rotate said translating sleeve to move said element out of engagement with said body and thereafter rotate said carriers and said striker into the armed condition.

6. A fuse, comprising a body, a detonator carrier therein, a firing pin carrier therein having a delay motion connection with said detonator carrier, a firing pin in said firing pin carrier, the aforesaid parts being normally in an unarmed condition; an element having parts engaged with said body in the unarmed condition, a portion forming a delay motion connection with said firing pin carrier and a striker; and means operable by air pressure to translate said element out of engagement with said body and thereafter rotate the said carriers and striker into the armed condition.

7. A fuse, comprising a body, a detonator carrier therein, a firing pin carrier therein having a delay motion connection with said detonator carrier, a firing pin in said firing pin carrier, the aforesaid parts being normally in an unarmed condition; an element having parts engaged with said body in the unarmed condition, a portion forming a delay motion connection with said firing pin carrier and a striker; and means to move the above mentioned parts to the armed condition including a fixed nut in said body, a translating sleeve in screw-threaded engagement therewith, a thrust rod rotatable in said element having an end disposed in said sleeve and a collar seated against the inner face of said element, a shear pin connecting said rod and said sleeve, and mechanism operable by air pressure to rotate said translating sleeve to move said element out of engagement with said body and thereafter rotate said carriers and said striker into the armed condition, said mechanism including differentially operating gears.

8. A fuse, comprising a body, a detonator carrier therein, a firing pin carrier therein having a delay motion connection with said detonator carrier, a firing pin in said firing pin carrier, the aforesaid parts being normally in an unarmed condition; an element having parts engaged with said body in the unarmed condition, a portion forming a delay motion connection with said firing pin carrier and a striker; and means operable by air pressure to translate said element out of engagement with said body and thereafter rotate said carriers and striker into the armed condition, said means including differentially operating gears and a device that moves longitudinally also when rotated through the action of said gears.

9. A fuse, comprising a body; in said body a rotatable detonator carrier having in it an aperture to receive a detonator, a rotatable firing pin carrier having an operating connection with said detonator carrier, a firing pin mounted in said firing pin carrier; a rotatable element having a striker and a portion forming an operating connection with said firing pin carrier, said striker, said aperture and said firing pin being angularly separated and said element and said body being interengaged in the unarmed condition, and means actuatable by air pressure to translate said element to disengage it from said body and then to rotate said carriers and said element to move said firing pin, said striker and said aperture into the armed condition.

10. A fuse, comprising firing mechanism having members that are both translatable and rotatable and other members that are rotatable only, actuating connections to translate the first-mentioned members and thereafter to rotate the second mentioned members when the first mentioned members are rotated, and air driven means connected to rotate said first mentioned members.

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