June 7, 1955 R. BUTTERWORTH 2,709,963

VARIABLE TORQUE MECHANICAL TIME FUSE

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FIG. 1

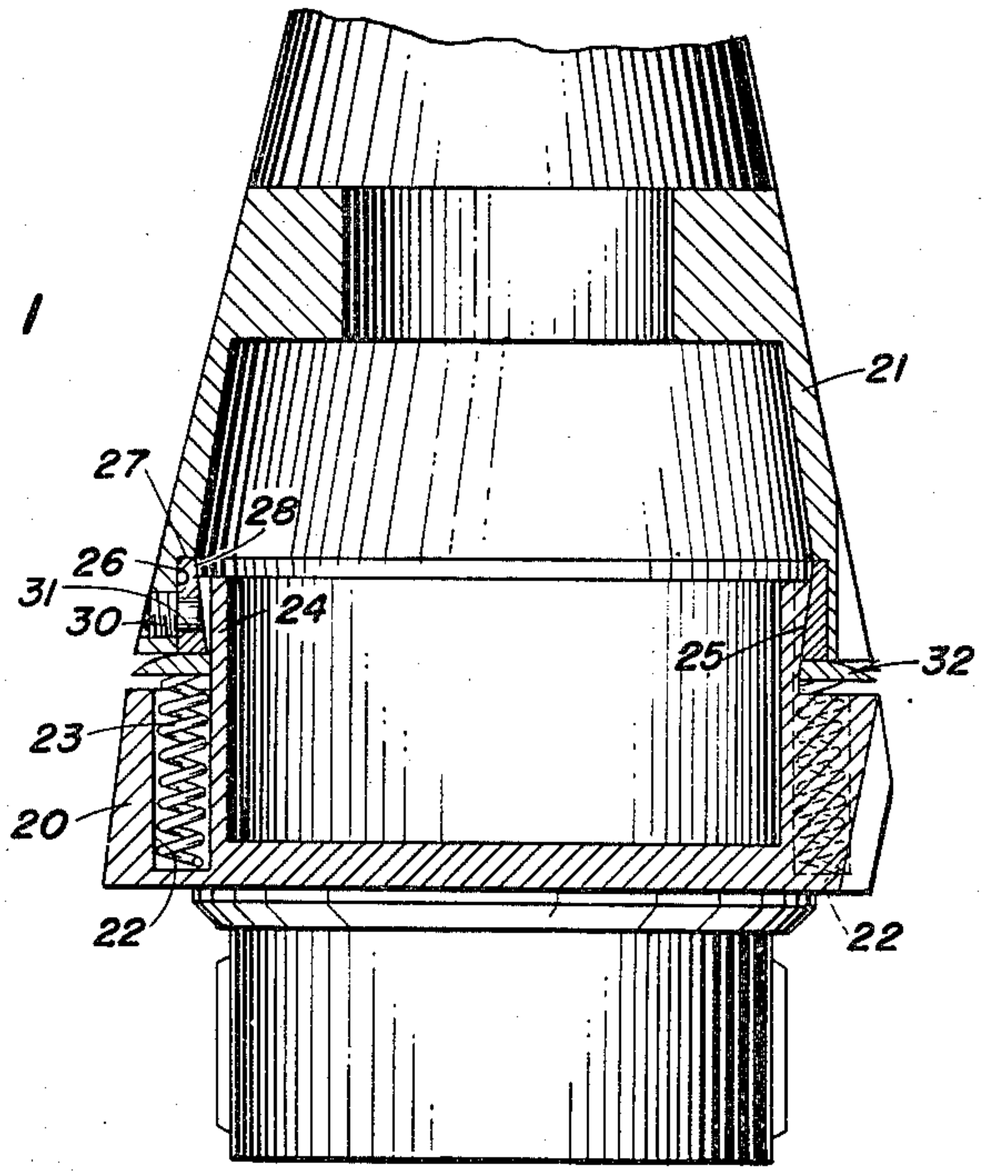


FIG. 2

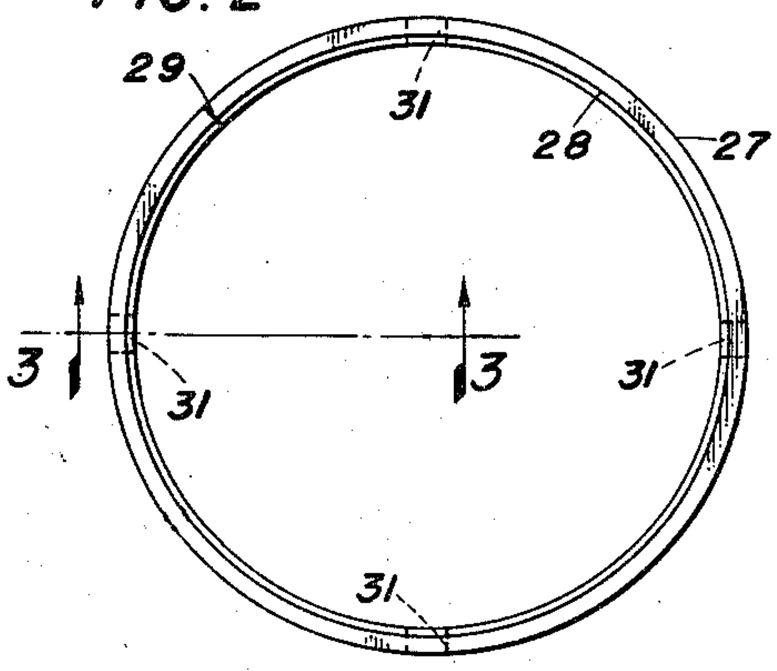


FIG. 3

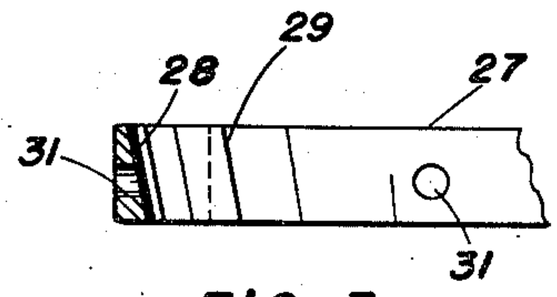
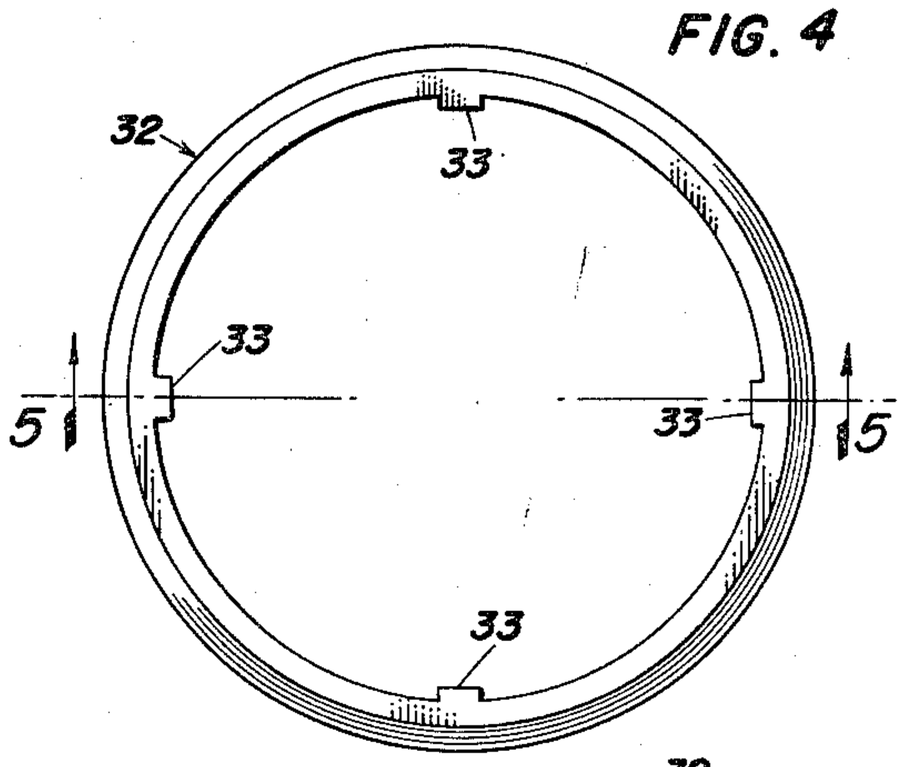


FIG. 4



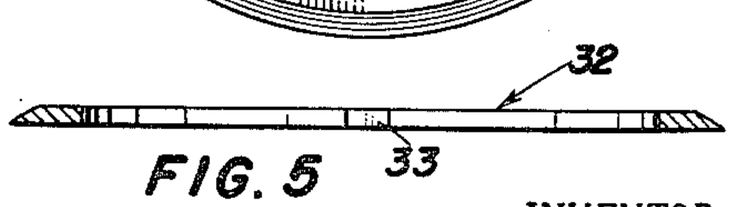


FIG. 5

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FIG. 6

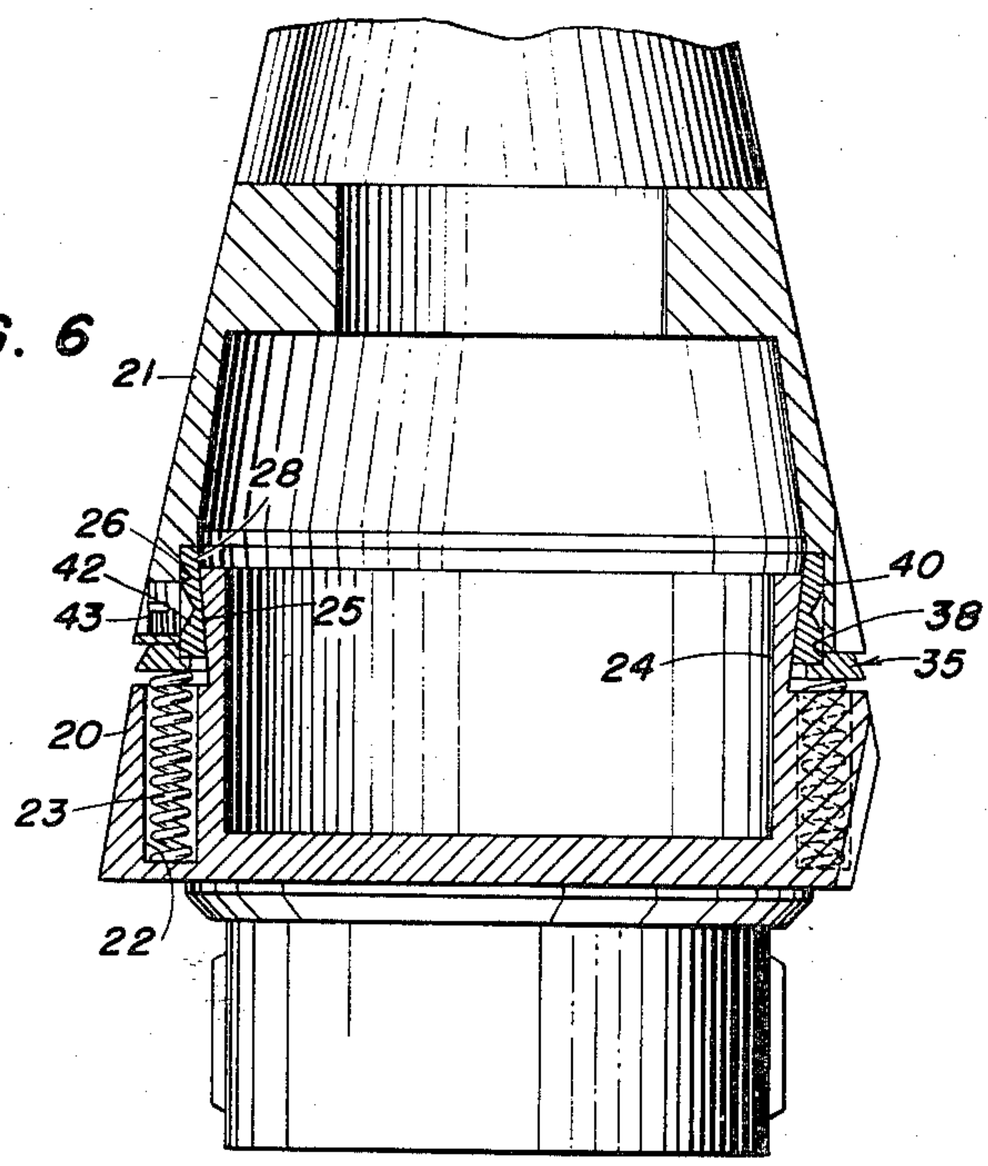
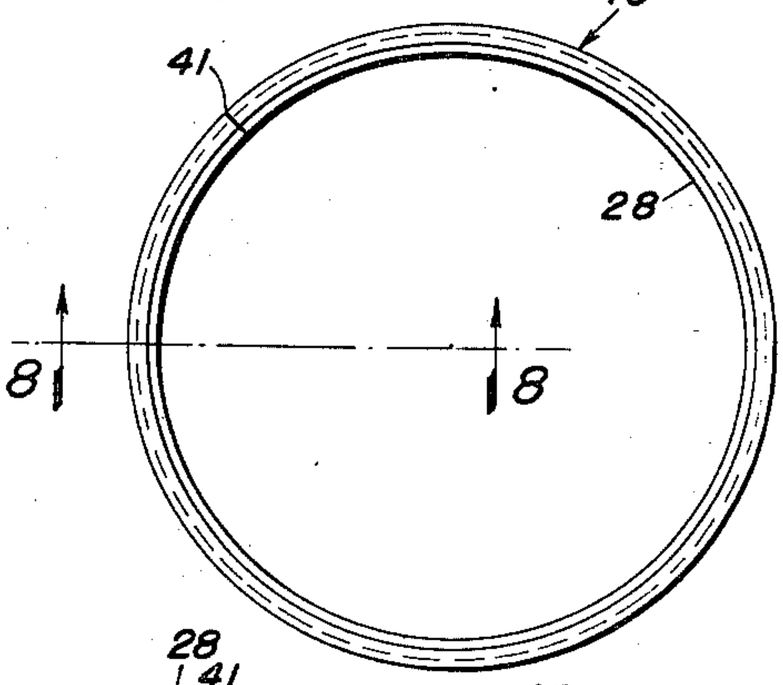


FIG. 7



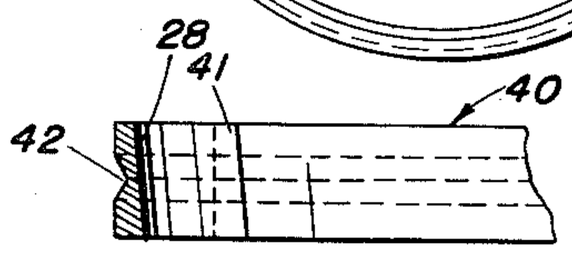


FIG. 8

FIG. 9

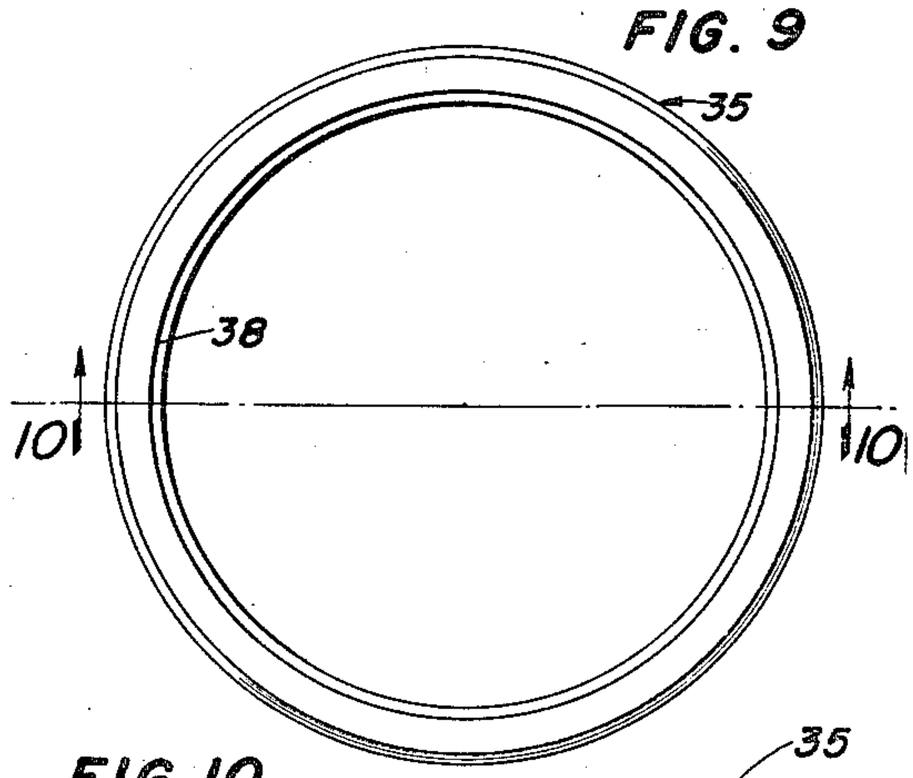
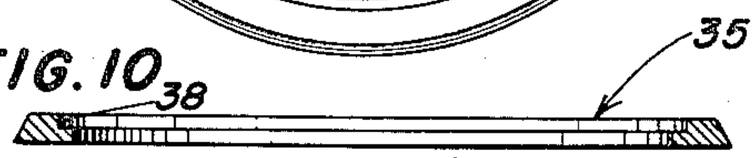


FIG. 10



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VARIABLE TORQUE MECHANICAL TIME FUSE

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9 Claims. (Cl. 102—83)

(Granted under Title 35, U. S. Code (1952), sec. 266)

This invention relates to time delay fuses for projectiles or the like wherein a part, such as the projectile nose, is capable of bodily rotation to vary the time delay of the fuse.

The usual projectile time fuse consists of three major parts; namely, an upper cap, a lower cap and a body portion which later in turn may be screwed into the nose of the projectile. Thereafter the nose of the projectile is inserted into the fuse setting portion of the gun where fingers or pawls engage appropriate slots in the surfaces of the body and lower cap, and by suitable mechanical means the lower cap may be rotated relative to the body to set the fuse. At least one complete revolution is normally required in setting the fuse. Heretofore difficulty has been encountered in constructing such fuses so that they will require a minimum torque during the setting operation whereby a minimum strain is imposed upon the operative parts of the fuse setting mechanism. However, it is always desirable that a large torque be otherwise required so that the fuse adjustment cannot be inadvertently moved during handling to change the setting and whereby centrifugal force during the flight of the projectile will not change the setting. It will be apparent that any means which will permit retention of torque during usual handling but will reduce the torque between the rotatable members during the setting operation is very desirable.

In time fuses of the character used heretofore, the torque required to turn the lower cap due to the friction between the engaging surfaces of the rotatable members was approximately 120 inch pounds. In the present device the setting torque has been reduced substantially and a torque of only 25 to 35 inch pounds is required to rotate the lower cap with respect to the body.

This reduction in the setting torque tends to reduce to a minimum errors resulting from lost motion and deflection of the fuse setter parts. In other words the errors decrease with decrease in torque during setting.

Notwithstanding the low setting torque obtained with the present invention, a relatively high torque, on the order of 80 to 120 inch pounds, opposes relative rotational movement between the lower cap and the body during handling or while the projectile is in free flight.

It is an object of the present invention, therefore, to provide a mechanical time fuse having a variable torque connecting means between the relatively rotatable parts thereof.

Another object is the provision of a fuse of the above character having a relatively low setting torque and a relatively high normal torque.

A further object is the provision of a fuse of the above character which reduces the strain on the fuse setting mechanism during the setting operation.

Other objects and attendant advantages will become apparent from the following description when read in conjunction with the accompanying drawings, in which:

Fig. 1 is a vertical sectional view illustrating one embodiment of the present invention;

Fig. 2 is a top plan view of a split cone which forms one element of a friction cone clutch used in the embodiment of Fig. 1;

Fig. 3 is a sectional view taken substantially along the line 3—3 of Fig. 2;

Fig. 4 is a top plan view of a beveled edge thrust ring shown in Fig. 1;

Fig. 5 is a sectional view taken substantially along the line 5—5 of Fig. 4;

Fig. 6 is a vertical sectional view of an alternative construction of the invention;

Fig. 7 is a top plan view of a split cone used in the construction shown in Fig. 6;

Fig. 8 is a sectional view taken substantially along the line 8—8 of Fig. 7;

Fig. 9 is a top plan view illustrating a beveled edge thrust washer used in the construction of Fig. 6; and

Fig. 10 is a sectional view taken substantially along the line 10—10 of Fig. 9.

In the embodiment illustrated in Fig. 1, the fuse body portion 20, is provided with a plurality of spring sockets 22 spaced at intervals around its periphery. A spring 23 is located in each of these sockets.

The upper end of body 20 may be provided with an integral tubular extension 24 for telescopically connecting it with the lower cap assembly. The outer surface of this extension may have a reentrant taper as indicated at 25 to form one of the surfaces of a conical clutch. The taper may be on the order of 5 degrees.

The lower cap 21 may be of the shape illustrated and be provided with a recess 26 formed in the lower end thereof for receiving a split cone ring 27. The outer surface of the cone ring fits snugly against the wall of recess 26 and may be securely held in place by a plurality of setscrews 30 which are threaded into the wall of the lower cap with their inner unthreaded ends extending into aligned openings 31 in the cone as shown. The inner surface 28 of the cone may be tapered to correspond to the angularity of the corresponding engaging tapered surface 25 on the tubular extension 24. The surface 28 forms the second tapered surface of a conical clutch when the parts are assembled.

Interposed between the adjacent faces of the lower cap and the body is a beveled edge thrust washer 32 which receives the pressure of springs 23 to normally maintain the tapered surfaces 25 and 28 in frictional engagement. Referring to Fig. 4, it will be noted that the inner periphery of thrust washer 32 is provided with a plurality of lugs 33 corresponding to the number of spring sockets 22. In order that the thrust washer 32 may be telescoped over the enlarged tapered portion 25 suitable vertical grooves may be formed in the tapered surface in linear alignment with the spring sockets. The lugs 33 may be either angular in shape as shown or they may be arcuate. In either event the lugs may be a relatively close fit with the grooves in order to prevent the thrust ring 32 from rotating about the tubular extension 24 during the fuse setting operation but sufficient clearance should be provided to allow the thrust ring to move up and down on the extension 24 as springs 23 are flexed.

In assembling the several parts of the fuse hereinbefore described, the thrust washer 32 is telescoped over the tubular extension 24 so as to rest upon the upper ends of springs 23 contained in the spring sockets. The cone 27 which is split or severed at 29, Figs. 2 and 3, is spread a sufficient amount to allow it to be slipped over the enlarged tapered portion of tubular extension 24. The lower cap 21 is then telescoped over the cone 27 with the cone fitted into the recess 26 in the lower end thereof. Setscrews 30 may then be threaded into the appropriate openings in the wall of the lower cap so that their inner

ends project into the aligned opening 31 in the cone 27.

In the event it is desired to obtain a more effective seal so as to prevent the entrance of moisture into the fuse cavity, the modification shown in Fig. 6 may be used. For convenience, similar parts have been given identical reference numerals as those used in the embodiment illustrated in Fig. 1. In this latter embodiment the grooves formed in the tapered surface 25 of the embodiment described above as well as the lugs 33 on the thrust ring 32 are entirely eliminated. This is accomplished by constructing the thrust ring 35, Fig. 9, with the central opening large enough to telescope over the large end of the tapered surface 25 on the tubular extension 24. Thrust ring 35 may be recessed at 38 as shown in Fig. 10 to receive the lower end of cone 40 which projects below the bottom face of the lower cap as shown, thus providing a shoulder when assembled with the cone to prevent lateral movement of the thrust ring. In the embodiment illustrated in Fig. 6, cone 40 may be split or severed at 41, Figs. 7 and 8, to facilitate assembly and there is also formed in the outer periphery of the cone, a peripheral groove 42 for cooperation with pointed setscrews 43 to secure the cone ring in recess 26 in the lower end of lower cap 21.

When the several parts of the fuse are assembled, the tapered inner surface 28 on the cone and the tapered outer surface 25 on the tubular cylinder will cooperate in the manner of a cone clutch. It will be seen that coil springs 23 act upon the thrust washer urging it upwardly against the lower face of the lower cap member, thus normally retaining the tapered surfaces of the clutch in frictional engagement. During handling or when in free flight these surfaces are frictionally engaged and will require approximately 80 to 120 inch pounds to rotate the lower cap 21 relative to the body 20.

However, when inserted into the fuse setter of the gun the beveled edge thrust ring is contacted by the lower edge of the split cone to compress springs 23 and thereby disengage the cone clutch surfaces 25 and 28. With these surfaces disengaged the torque required to rotate the lower cap 21 with respect to body 20 is materially reduced and has been found to be on the order of 25 to 35 inch pounds during the setting operation.

An important advantage of this invention is that the fuse setting torque requirements are reduced sufficiently to permit increased preloading of all bearings to allow desirable relaxation of the precision fittings now required in the fuse setting gear.

It should be understood, of course, that the foregoing disclosure relates to only a preferred embodiment of the invention and that numerous modifications or alterations may be made therein without departing from the spirit and scope of the invention as set forth in the appended claims.

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.

What is claimed is:

1. In a mechanical time fuse a body member having a plurality of vertical sockets disposed about its periphery, a spring in each socket, an externally tapered tubular extension on said body having grooves formed in the periphery thereof in axial alignment with said sockets, a lower cap rotatably connected to said extension and having a recess in the lower end thereof, a cone in said recess, the inner surface of said cone tapered to correspond to the first-named tapered surface and engageable therewith to form a conical clutch, a thrust ring interposed between the adjacent faces of said body and said lower cap and axially movable on said extension, lugs on the inner periphery of said thrust ring disposed in said grooves, said springs normally urging said thrust ring against said lower cap to thereby engage said tapered surfaces whereby a relatively high torque is required for relative rotation of said body and said cap, and said body and said cap being axially movable against the force of said springs to disengage said tapered surfaces to reduce the torque requirement.

2. In a mechanical time fuse a body member having a plurality of vertical sockets disposed about its periphery, a spring in each socket, an externally tapered tubular extension on said body, a lower cap rotatably connected to said extension and having a recess in the lower end thereof, a cone in said recess, the inner surface of said cone being tapered to correspond to the first-named tapered surface and engageable therewith to form a conical clutch, a thrust ring interposed between the adjacent faces of said body and said lower cap and being axially movable on said extension, said springs normally urging said thrust ring against said lower cap so as to frictionally engage said tapered surfaces whereby a high torque is required to cause relative rotation of said body and said cap, said body and said cap being axially movable against the force of said springs to disengage said frictional surfaces to reduce the torque requirement.

3. In a mechanical time fuse, a body member having a plurality of vertical sockets disposed about its periphery, a spring in each socket, an externally tapered cylindrical extension on said body, a lower cap having a recess in the lower end thereof, a cone secured in said recess, the inner surface of said cone engageable with said external tapered surface on said extension to form a conical clutch, said springs operable normally to urge said tapered surfaces into frictional engagement to require a large torque for relative rotation of said body and said lower cap, and said springs being compressible to reduce the torque.

4. In a mechanical time fuse a body member, an externally tapered cylindrical extension on said body, a lower cap having a recess in the lower end thereof, a cone secured to said lower cap in said recess for rotatably connecting said body and said lower cap, the inner surface of said cone and the outer surface of said extension forming clutch engaging surfaces, resilient means normally urging said body member and lower cap apart and said surfaces into frictional engagement whereby a relatively large torque is required for relative rotation of said body and said lower cap, and said resilient means being compressible to disengage said surfaces and reduce said torque.

5. In a mechanical time fuse a body member, a lower cap member, frictional clutch means rotatably connecting said body and said lower cap, said means comprising a tapered external surface on said body, a tapered internal surface in said lower cap, and resilient means positioned in said body member and pressing against said lower cap to normally urge said tapered surfaces into frictional engagement for producing a large torque requirement, said resilient means being compressed by the axial movement of said lower cap toward the body member to disengage said surfaces and thereby reduce the torque requirement.

6. In a mechanical time fuse a body member having an externally tapered cylindrical extension, a lower cap rotatably connected to said extension and having a recess in the lower end thereof, a cone secured in said recess, the inner surface of said cone engageable with the surface of said externally tapered extension to form a conical clutch, a thrust ring interposed between adjacent faces of said body and said lower cap and being axially moveable on said extension, and resilient means normally urging said thrust ring against said lower cap to thereby frictionally engage the surfaces of said cone and said extension so that a high torque is required for relative rotation of said body and said cap, said cap being axially moveable with respect to said body member against the force of said resilient means to disengage said surfaces to reduce the torque requirement.

7. In a mechanical time fuse a pair of relatively rotatable members, a tapered external surface on one of the members, a friction element mounted within the other of said members and having one of its surfaces frictionally

engageable with said tapered external surface, a thrust ring encompassing a portion of said external surface adjacent to the friction element, and resilient means normally urging said friction element into engagement with said tapered surface whereby a large torque is required for relative rotation of said members, said resilient means being compressible by said thrust ring to disengage the friction element and the tapered surface to reduce the torque requirement.

8. In a clutch device for a pair of relatively rotatable members, a tapered external surface on one of the members, a friction pressure multiplying means securely mounted on the other member and having a surface adjacent said tapered surface, and resilient means for urging said multiplying means into frictional engagement with said tapered surface to substantially increase the resistance of said members to relative rotation, said members being mounted for limited axial movement to compress said resilient means and thereby disengage the frictionally engaged surfaces to substantially decrease the resistance of said members to relative rotation.

9. In a clutch device for a pair of relatively rotatable members, a tapered external surface on one of the members, a friction pressure multiplying means securely

mounted on the other member and having a surface adjacent said tapered surface, resilient means for urging said multiplying means into frictional engagement with said tapered surface to substantially increase the resistance of said members to relative rotation, and a pressure distributing means disposed between the resilient means and the friction pressure multiplying means and axially movable therewith to evenly transfer the force of the resilient means to the multiplying means, said members being mounted for limited axial movement to compress said resilient means and disengage the frictionally engaged surfaces to substantially decrease the resistance of said members to relative rotation.

References Cited in the file of this patent

UNITED STATES PATENTS

1,237,816	Rimailho	Aug. 21, 1917
2,262,068	Towner	Nov. 11, 1941
2,446,745	Delay	Aug. 10, 1948

FOREIGN PATENTS

414,191	France	June 13, 1910