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O. D. LUCAS

TIME FUSE

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Fig. 1.

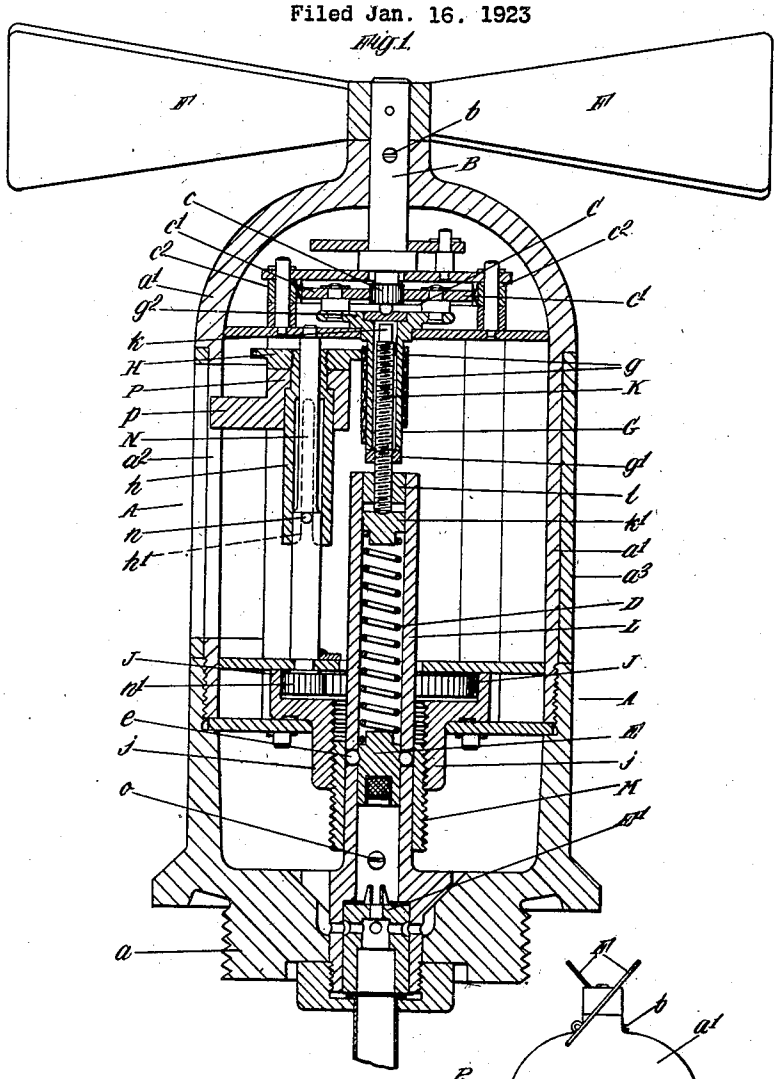


Fig. 2.

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UNITED STATES PATENT OFFICE.

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TIME FUSE.

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To all whom it may concern:

Be it known that I, OWEN DAVID LUCAS, a subject of the King of Great Britain, residing at 49 Linden Gardens, Bayswater, in the county of London, England, have invented certain new and useful Improvements in or Relating to Time Fuses, of which the following is a specification.

This invention relates to mechanically operated long time fuses, more especially for aerial bombs, flares and the like, but also adapted for use in shells or other missiles.

According to this invention the large time range for the mechanical operation of the fuse is obtained by the aid of a toothed change speed gear between the initial operating device and the releasing device for the firing spring, a succession of steps of progressive speed reduction being given by changing the wheels in gear, in conjunction with means for setting the timing release mechanism independently of the change speed gear. Associated in series with the aforesaid change speed gear it is also proposed to employ a reducing gear, which may be of epicyclic type, preferably connected to the initial operating device and transmitting the movement to the change speed gear, so that a large reduction of speed may be obtained for a long timing period. In the construction preferred the firing spring is normally unenergized and is energized by the initial operation during flight of the same mechanical device as finally effects its release for firing purposes, the energizing being effected independently of the change speed reduction gear and the setting of the release mechanism, so that only a relatively short portion of the flight is utilized for cocking the spring and the timing extends over a large range after cocking. When cocking is completed the gear is automatically disconnected from the energizing device so that there is no back pressure on the gear.

In order that the said invention may be clearly understood and readily carried into effect, the same will now be described more fully with reference to the accompanying drawings, in which:—

Figure 1 is a longitudinal section of a time fuse embodying this invention, and

Figure 2 is a side view taken at right angles to Figure 1.

A is the fuse body, comprising a base *a* and a domed casing a^1 screwed into the upper end of the base. B is the operating spindle mounted in the domed end of the body. C is an epicyclic gear actuated by the spindle. D is the firing spring acting on the detonator pellet E.

In the construction shown the spindle B carries vanes F which are turned by the flight of the body through the air, the spindle B acting through the epicyclic gear C giving a considerable speed reduction on a sleeve G carrying a succession of toothed rings *g* comprising progressively a single tooth at the bottom of the set and two, four, eight or sixteen teeth or a number consisting of a higher power of two if required. These toothed rings *g* gear selectively with a pinion H which releases the firing mechanism through a second epicyclic reducing gear comprising a toothed ring J. The toothed ring C encloses a screwed rod K, the upper end *k* of which is left plain while the lower end passes into a nut or tapped ring *l* in the end of the firing spring casing L, which is preferably in the form of a central tube secured to the lower end or base *a* of the fuse body A in a gas-tight manner and enclosing, below the firing spring D, the detonator pellet E held in place by balls *e* or like retaining devices in recesses in the firing spring tube and maintained in safety position by an external sleeve M operated by the transmission ring J to release the balls after a predetermined range of movement of the gear.

The screwed rod K turns with the toothed sleeve G but is free to slide therein so that as the sleeve is turned the rod screws down through the nut or ring *l* in the firing spring tube L, the end of the rod K bearing upon a plug k^1 sliding in the said tube and compressing the spring D in front of it as it is moved down by the screwed rod. This operation continues until the plain end *k* of the screwed rod reaches the end g^1 of the sleeve G when the screwed rod is freed and further rotation of the sleeve has no effect on the rod, the spring D being fully cocked in this position. The thrust of the spring is taken by the screwed rod K and the nut *t* of the spring tube so that the gear is free from the thrust.

The spindle B carrying the vanes F, which spindle is locked normally by a safety pin *b*

passing through it and its bearing in the end of the fuse body, terminates in a small sun wheel c which gears with planet wheels c^1 mounted on a disc g^2 belonging to the aforesaid multiple toothed sleeve G, the planet wheels turning inside a toothed ring c^2 so that the sleeve rotates through the epicyclic gear at a greatly reduced speed as compared with the vanes. The lower end g^1 of the sleeve G is plain externally, the single tooth ring g terminating a short distance above the end of the sleeve, and the pinion H, which is placed at the side, is mounted on the sleeve h adapted to slide upon the spindle N and to rotate the spindle through a pin n and longitudinal slot h^1, the pinion H being free to slide down from one toothed ring g to the next until it reaches the single tooth and then past the tooth on to the plain portion g^1 of the toothed sleeve G, which leaves the pinion free. One tooth of all the rings g is continuous throughout the rings in order to allow for the sliding of the pinion when setting the gear according to the delay required, the pinion engaging first with the single tooth and then passing up in line with this tooth to the ring with which it is required finally to engage. The pinion H is turned one tooth at a time by each engaging tooth of the sleeve G.

The pinion driven spindle N carries at its lower end a small wheel n^1 gearing with the internally toothed ring J, the boss j of which is screw-threaded and receives the screwed sleeve M that effects the release of the firing mechanism, this screwed sleeve sliding on the spring casing L without turning. When the sliding pinion H is freed from the toothed rings g, as already described, it can be turned so as to set the screwed sleeve M to any required initial position, giving a larger or smaller movement of the sleeve before the end passes the balls e retaining the detonator pellet E, the pellet being freed as soon as the screwed sleeve M passes the recesses holding the balls, whereupon the energized firing spring D drives the pellet against the fixed firing pin E^1. Or the pellet E and firing pin E^1 may be reversed, the firing spring acting upon the pin while the detonator is stationary.

A safety pin O, which is removed prior to the release of the bomb or flare but preferably after setting the fuse, is inserted between the pellet E and striker E^1 so that both safety pins O and b (sleeve and vane spindle pins) remain in place with the fuse set, but the spring uncocked.

The adjustments both of the change speed gear and of the releasing mechanism is effected from outside the fuse through the aperture a^2 in the side of the casing a^1, as shown more clearly in Figure 3, a covering ring a^3 being provided for the aperture. At one side of the aperture an indicating scale a^4 is marked to show which toothed ring g is in engagement with the pinion H. As already described the pinion can be moved up or down the set of toothed rings and to support the pinion and its sleeve h at any required level the bearing member P is provided, having a projection p at the front for manipulating and extending at each side to embrace the two pillars p^1 on which it can be adjusted, the pillars having catch retaining grooves p^2 to serve in holding the member P at any one of the different levels corresponding to the different toothed rings g, so that the pinion H is held in engagement with any predetermined ring, giving the required gear ratio. Catches for the member P are indicated at p^3 in Figure 2. When the member P is lowered to the bottom grooves p^2 the pinion H is below the lowest or single toothed ring g and the pinion can then be turned by hand, turning the toothed ring J through the pinion n^1 until the sleeve M is raised or lowered to the required position according to the timing of the fuse.

The rate at which the releasing sleeve M is raised depends upon the position of the change speed gear, that is, upon which of the toothed rings g gears with the pinion H. With five rings g having respectively one, two, four, eight and sixteen teeth the speed ratios between the pinion H and the sleeve G change in corresponding proportions as the different rings are engaged. For a given range of movement of the sleeve M the time interval for firing is changed in the same proportions but as the timing depends also upon the initial setting of the sleeve M and its consequent range of movement up to the firing position any time interval is provided for between the setting of the firing spring and the maximum range for full movement of the sleeve M with the single toothed ring g in gear with the pinion H, that is, with the change speed gear giving its maximum reducing speed ratio.

What I claim and desire to secure by Letters Patent of the United States is:—

1. In a mechanically operated long time fuse, a firing spring, initial fuse operating mechanism, a spring release device, a toothed change speed gear between the initial operating mechanism and the spring release device, means for changing the wheels in gear to give any one of a succession of progressive speed reductions provided by the said change speed gear and means for timing the release device independently of the said change speed gear.

2. In a fuse as claimed in claim 1, a further speed reducing gear associated in series with the said change speed gear.

3. In a fuse as claimed in claim 1, an epicyclic speed reducing gear associated in series with the said change speed gear.

4. In a fuse as claimed in claim 1, a fur-

ther speed reducing gear interposed between the initial operating mechanism and the said change speed gear.

5. In a mechanically operated long time fuse, a firing spring, initial fuse operating mechanism, a spring release device, a reducing gear between the initial operating mechanism and the firing spring whereby the spring is energized by the preliminary movement of the mechanism during flight and a further timed reducing gear interposed between the first reducing gear and the spring release device whereby the further movement of the initial operating mechanism, after a substantial time interval due to the speed reduction, effects the release of the spring.

6. In a fuse as in claim 1, a speed reducing gear interposed between the initial operating mechanism and the said change speed gear, means whereby the said reducing gear effects the energizing of the firing spring and means whereby the reducing gear and the change speed gear combined effect the operation of the spring release device.

7. In a fuse as claimed in claim 1, a reducing gear interposed between the initial operating mechanism and the said change speed gear, a screw threaded firing spring energizing member connected detachably to the said reducing gear and means whereby the said screwed energizing member is released from the reducing gear after a predetermined range of movement.

8. In a mechanically operated long time fuse, a firing spring, initial fuse operating mechanism, a spring release device, a toothed change speed gear between the initial operating mechanism and the spring release device, which change speed gear comprises a rotatable spindle, a series of toothed rings on the said spindle, the number of teeth on any one of the second and succeeding rings being twice the number on the preceding rings, and a sliding pinion adapted to be slidden into gear with any desired ring, and means driven through the said change speed gear whereby the release device is operated.

9. In a fuse as claimed in claim 8, a screwed rod effecting the energizing of the firing spring, which rod is driven through the aforesaid ring carrying spindle.

10. In a mechanically operated time fuse, a firing spring, initial fuse operating mechanism, an adjustable screwed timing sleeve adapted to hold the said spring in cocked position, a speed reducing gear between the initial operating mechanism and the said sleeve and screwed connecting means between the gear and sleeve whereby the sleeve is moved into spring releasing position after a predetermined movement.

11. In a mechanically operated time fuse, a firing spring, initial fuse operating mechanism, and adjustable screwed timing sleeve adapted to hold the said spring in cocked position, a change speed reducing gear, a pinion terminating the said gear and an internally toothed ring meshing with the said pinion and having a screw engagement with the said screwed timing sleeve.

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