April 16, 1968 J. E. ROBERTSON ET AL 3,378,218

PARACHUTE DEPLOYMENT AND DISCONNECTING PROJECTILE

Filed June 13, 1967

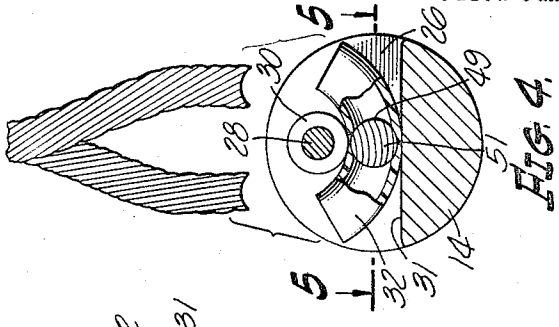


Fig. 4.

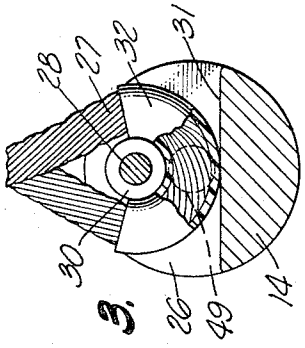


Fig. 3.

Fig. 1.

Fig. 5.

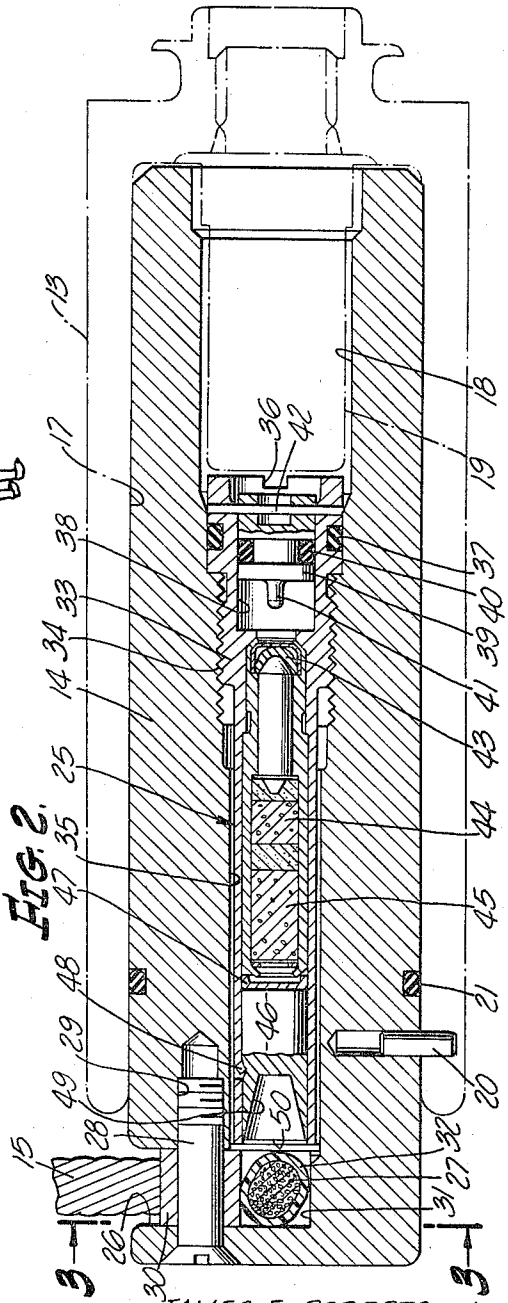


Fig. 2.

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United States Patent Office 3,378,218 Patented Apr. 16, 1968

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Filed June 13, 1967, Ser. No. 645,762
13 Claims. (Cl. 244—148)

ABSTRACT OF THE DISCLOSURE

A projectile device connected through a lanyard to a parachute for deploying the parachute when firing the projectile from a gun and having a pyrotechnic operated knife mechanism within the projectile initiated by such firing with a time delay for severing the lanyard from the projectile upon complete deployment of the parachute to separate the projectile from the parachute.

Background of the invention

This invention relates to a device for ballistically deploying a parachute by a projectile connected by a lanyard to the parachute and in particular is directed to a mechanism contained within the projectile for automatically severing the projectile from the lanyard and parachute after complete deployment of the parachute.

Conventionally a parachute is deployed by simply releasing the parachute from the pack with a small drogue parachute quickly deploying to cause full deployment of the main chute. Recently in connection with accomplishing the safe ejection of personnel from aircraft at low altitudes it has become necessary to more rapidly deploy the main parachute. To this end one solution has been to attach a projectile to the drogue chute and to ballistically fire the projectile whereby the main chute is quickly pulled from the parachute pack and fully extended for rapid deployment and inflation of the parachute. To successfully accomplish the rapid deployment the projectile must be of substantial weight, as for example one pound. Once the parachute has been deployed and inflated, the projectile normally will merely rest on the canopy. However it has been found that in some instances the projectile can interfere with the inflation of the parachute or cause damage to the canopy after inflation. Moreover with the projectile resting on the canopy there is always the risk that upon landing the projectile will strike the person.

Summary of the invention

By this invention there is provided an automatically operated mechanism for severing the parachute deploying projectile from the lanyard connected to the parachute after a predetermined lapse of time adequate to insure that the projectile has completely deployed the parachute.

An object of this invention is to provide a novel form of disconnect mechanism for a projectile to accomplish the automatic release of the projectile from a connecting lanyard at a predetermined time in the ejection sequence corresponding to complete deployment of the parachute.

Another object of this invention is to provide a disconnect mechanism in a projectile which is initiated by the firing of the projectile and automatically precedes to accomplish disconnect after a predetermined time delay.

A further object of this invention is to provide such an arrangement which physically severs the lanyard connected to the parachute to accomplish complete release of the projectile. A still further object is to provide such an arrangement wherein severing is accomplished by an annular knife blade which is effective in any orientation by laterally cutting out a section of the lanyard.

Brief description of the drawings

FIGURE 1 is a perspective view of a personnel parachute being deployed by a projectile which may be a conventional projectile or the projectile of this invention.

FIGURE 2 is an enlarged sectional elevation of the projectile of this invention positioned within the drogue gun, shown in phantom lines, for firing the projectile.

FIGURE 3 is a sectional end view taken substantially on the line 3—3 in FIGURE 2 and illustrating the connection of the lanyard to the projectile.

FIGURE 4 is a sectional end view similar to FIGURE 3 and illustrating the lanyard immediately following disconnect.

FIGURE 5 is a fragmentary sectional view taken substantially on the line 5—5 in FIGURE 4 and illustrating the final, lanyard-severing position of the cutting means of the device.

Description of the preferred embodiment

As is relatively convention with aircraft having a personnel ejection system, the pilot or crew member **10** wears a parachute pack **11** strapped to his back from which the parachute **12** is automatically deployed at the conclusion of the ejection sequence. Some conventional systems and the arrangement of this invention employ a drogue gun **13** mounted on the parachute pack **11** for firing a projectile **14** which is connected by a lanyard **15** to the drogue chute **16** which in turn is conventionally connected to the main parachute **12** for assisting in deploying the parachute. The drogue gun **13** is pointed in a direction to fire the projectile **14** away from the person **10**. The drogue gun **13** may be of a conventional pyrotechnic type which is fired after a predetermined delay from the start of the ejection sequence. This delay may be accomplished by a timing mechanism associated with the drogue gun or by actuating the drogue gun upon physical separation of the person **10** from the ejection seat (not shown). The time delay in firing permits the person **10** to become completely separated from the aircraft and to achieve the highest possible altitude for allowing the parachute to inflate when the ejection takes place while the aircraft is near or on the ground. A conventional override device may be provided for preventing firing of the drogue gun **13** when ejection is at extremely high altitudes which would subject the person to prolonged exposure to the rarefied atmosphere and low temperatures but rather the drogue gun is fired after the person free falls to a comportable elevation.

Referring now to FIGURE 2 a portion of the drogue gun **13** is shown in phantom lines and includes a barrel **17** in which the projectile **14** of this invention fits. The rear end of projectile **14** has a bore **18** within which is positioned the main cartridge or charge **19** of the drogue gun **13** used in firing the projectile. A shear pin **20** connects the projectile **14** to the barrel **17** of the drogue gun for retaining the projectile therein and serves to allow a build up in pressure within barrel **17** upon ignition of the charge **19** before discharge of the projectile **14** whereby a sufficient projecting force is developed. An O-ring seal **21** may be conveniently fitted between the barrel **17** and the projectile **14** to insure this pressure build up. All of the foregoing is now relatively conventional although of very recent development and forms no part of this invention.

Means are provided within the projectile **14** for disconnecting the lanyard **15** from the projectile after deployment of the parachute **12** and, as shown in the drawings, these means may include a pyrotechnic-operated knife mechanism, generally designated **25**. The forward end of

the projectile 14 has a lateral slot 26 therethrough in which a loop portion 27 of the lanyard 15 is positioned. A machine screw 28 extends inwardly from the forward end of projectile 14 passing through the loop 27 and is threaded into the bore 29 in the projectile 14 to bridge the slot 26. An annular bushing 30 fits in the slot 26 and encircles the screw 28 to confine the loop portion 27 of the lanyard between the bushing and the base 31 of the slot 26. A short length of tubing 32 encircles the portion of the lanyard positioned within the slot 26 and, for purposes that will hereinafter become apparent, the tubing 32 is of a relatively soft material such as many of the plastics.

For convenience of manufacture and assembly the disconnect mechanism 25 is housed in a removable case 33 threadedly mounted at 34 in the axial internal bore 35 in the projectile 14. The head of case 33 is provided with slots 36 for engagement by a tool to install or remove the case through the bore 18 in the rear end of the projectile 14. An O-ring 37 seals the exterior of the case 33 with the bore 35 of the projectile. The larger or head end of the case 33 is provided with an internal bore 38 in which a piston member 39 is slidably mounted and sealed therewith by an O-ring 40. The forward end of piston member 39 carries a firing pin 41. The firing pin member 39 is secured to the case 33 in the rear position by a shear pin 42. The member 39 is exposed to the bore 18 and the main charge 19 whereby it is urged forward (to the left as viewed in FIGURE 2) by ignition of the charge 19. The shear pins 42 and 20 are of relative size to cause shear pin 42 to shear first thereby urging the firing pin piston member 39 forwardly immediately before the projectile 14 moves relative to and is projected from the barrel 17 of the drogue gun.

A primer cap 43 is mounted in the case 33 spaced from the original position of the firing pin member 39 and adapted to be impacted by the firing pin 41 upon shearing of pin 42 and movement of member 39 in response to the firing of the drogue gun. The impact of firing pin 41 on primer cap 43 ignites a time delay fuse 44 mounted in the case 33. In turn the delay fuse 44 serves to ignite the main charge 45 of the disconnect mechanism 25 to rapidly generate gas after a predetermined time lapse. A piston 46 is mounted in the front end of case 33 and a cup seal 47 is positioned between the piston 46 and the main charge 45. The piston 46 is held in position by a prong 48 formed in the side of the case 33 and engaging a dimple in the side of piston 46. Upon the build up of sufficient pressure by the charge 45 against the seal 47 on the back of piston 46 the piston will force the prong 48 outwardly and the piston will be driven forward by the pressure.

The forward end of piston 46 is provided with an annular cup-shaped portion 49 having a knife edge 50 formed on its forward extremity. The knife edge 50 confronts the portion of the lanyard loop 27 confined between the bushing 30 and the base 31 of the slot and is just slightly smaller than the space between the bushing 30 and slot base 31. As the piston 46 is driven forward the annular knife edge 50 cuts the tube 32 and the lanyard taking what might be termed a lateral "core" 51 of lanyard and tube. The piston 46 continues to move forward until it abuts the remote side 52 of slot 26 which serves as an anvil. The annular portion 49 of the piston 46 is of a sufficient depth to contain the core 51 of lanyard and tubing without impairing the progress of the piston toward the anvil. The wall thickness of the tubing 32 serves to hold the cross section of lanyard inwardly from the surfaces of the bushing 30 and slot base 31 whereby it is assured that the knife edge 50 will completely sever the lanyard. The knife edge 50 is of a larger diameter than the lanyard but smaller than the tubing 32. The fact that a small wall thickness of the tubing 32 remains unsevered by knife 50 is unimportant since the lanyard is released and slips from the tubing, as shown in FIGURE 4. This function of the tubing of spacing the lanyard from the side walls eliminates the necessity of a precision fit between the knife piston 46 and the space between the bushing 30 and slot base 31.

Thus it may be seen that by the mechanism 25 the lanyard 15 is completely and automatically disconnected from the projectile 14 after a predetermined lapse of time following the ignition of the drogue gun charge 19 which fires the projectile. The duration of the time lapse can readily be fixed by the delay fuse 44 to just allow complete deployment of the main parachute 12 from the parachute pack 11 whereby the projectile separates from the parachute to avoid entanglement or damage. It has been found that a time delay of about 300 to 500 milliseconds by fuse 44 is acceptable with one system but of course the preferred time delay in a given system will depend upon the velocity with which the projectile 14 is fired and the small inherent time delays in other portions of the mechanism 25 such as between the shearing of pin 42 and shearing of pin 20. By this arrangement it may be seen that a disconnect mechanism is provided which operates completely automatically upon firing of the drogue gun and is contained completely within the projectile which may be of otherwise conventional configuration. Thus no change is required in the drogue gun or lanyard to provide this self-disconnecting projectile.

Having fully described our invention in connetcion with a single preferred embodiment it is to be understood that our invention is not limited to the details shown in the drawings or set forth in the above description but rather our invention is of the full scope of the appended claims.

We claim:

1. An automatic disconnect projectile for deploying and then disconnecting from a parachute, comprising a projectile body having a lanyard connected therefrom to the parachute, a cutting member mounted in the projectile body and movable from a first position to a second position to sever the lanyard from the projectile, and force producing means mounted in said projectile body for causing said lanyard severing movement of said member and having means initiated upon ballistic discharge of the projectile to produce a predetermined time delay between such discharge and production of the force to move said cutting member.

2. The device of claim 1 wherein said force producing means includes a pyrotechnic charge for causing said cutting member movement and a time delay fuse for igniting said charge.

3. The device of claim 1 wherein said cutting member comprises an annular knife edge of a width greater than the width of the lanyard to cut out a section of the lanyard.

4. The device of claim 3 wherein said cutting member is a movable piston with the annular knife edge on one end for allowing the piston to be rotated to any position without changing the position of the knife edge.

5. An automatic disconnect projectile for deploying and then disconnecting form a parachute, comprising a projectile body having a lanyard connected therefrom to the parachute, means confining the lanyard to a given space within the projectile, a piston movably mounted in the projectile body and having a knife edge confronting and movable into said space to sever the lanyard upon movement of said piston, and force producing means mounted in said projectile body for causing said lanyard severing movement of said piston and having means initiated upon ballistic discharge of the projectile to produce a predetermined time delay between such discharge and production of the force to move said piston.

6. The device of claim 5 wherein said lanyard confining means comprises a short length of a soft tubular element encircling the lanyard and fitting the said given space.

7. The device of claim 5 wherein said knife edge is an annular shape aligned with the piston and wider than the

lanyard for cutting and removing a section of the lanyard without regard for the orientation of the piston.

8. The device of claim 5 wherein said force producing means includes pyrotechnic charge and a delay fuse for igniting the charge to produce pressure on said piston for causing said severing movement.

9. The device of claim 8 wherein said knife edge is annular and concentric with the axis of the piston.

10. A projectile for ballistically deploying a parachute and then disconnecting from the lanyard connected therebetween comprising; a projectile body having a lateral passageway therein near one end through which the lanyard passes and is retained, said body having a central longitudinal bore intersecting said passageway, a firing pin mounted within the bore and secured in a first position by frangible means, said firing pin moved from said first position toward said one end to a second position upon ballistic firing of the projectile, a primer cap mounted within the bore at said second position and for being struck by said firing pin moving to said second position, a delay fuse mounted within the bore adjacent said primer cap and ignited by said primer cap, a gas-generating explosive charge mounted within the bore adjacent said delay fuse, said delay fuse igniting said charge a predetermined time after said ignition of the fuse for allowing complete deployment of the parachute, a piston releasably mounted within the bore and having one end exposed to said charge and the other end confronting the said lateral passageway and the lanyard, said other end of the piston having a large central bore and an annular knife edge formed on the extremity confronting the lanyard, a plastic tubular member encircling the lanyard in said passageway and confining a cross-section of the

lanyard to a space smaller than the diameter of said annular knife edge of the piston, and the ignition of said explosive charge urging said piston into said passageway and severing the lanyard to disconnect the projectile from the parachute.

11. The projectile of claim 10 wherein an elongated case is removably mounted in said bore of the projectile and said case contains said firing pin, said primer cap, said delay fuse, said explosive charge and said piston.

12. The projectile of claim 10 wherein said predetermined time lapse caused by said delay fuse is approximately 300 to 500 milliseconds.

13. The projectile of claim 10 wherein said projectile is fired from a gun by an explosive charge, said firing pin having a piston portion exposed to the pressure produced by the ignition of said gun charge to cause the movement to the second position, and a second frangible means connecting the projectile body to the gun and requiring a greater force to break than the first said frangible means.

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