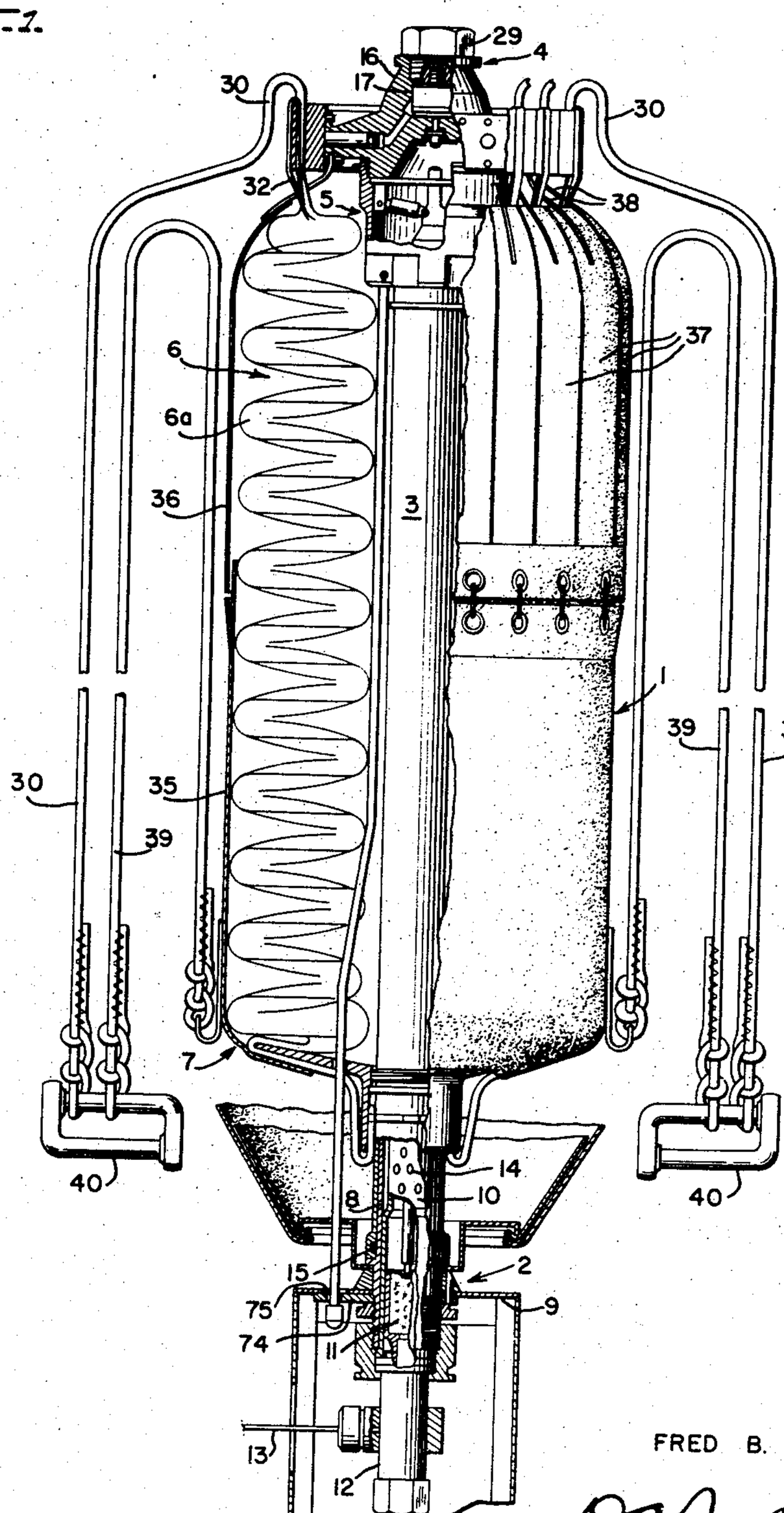
Sept. 20, 1960 F. B. STENCEL 2,953,334

FAST-ACTING PARACHUTES

Filed Feb. 28, 1958 3 Sheets-Sheet 1

Fig-1.



INVENTOR

FRED B. STENCEL

BY D C Loyless

ATTORNEY

Sept. 20, 1960

F. B. STENCEL

2,953,334

FAST-ACTING PARACHUTES

Filed Feb. 28, 1958

3 Sheets-Sheet 2

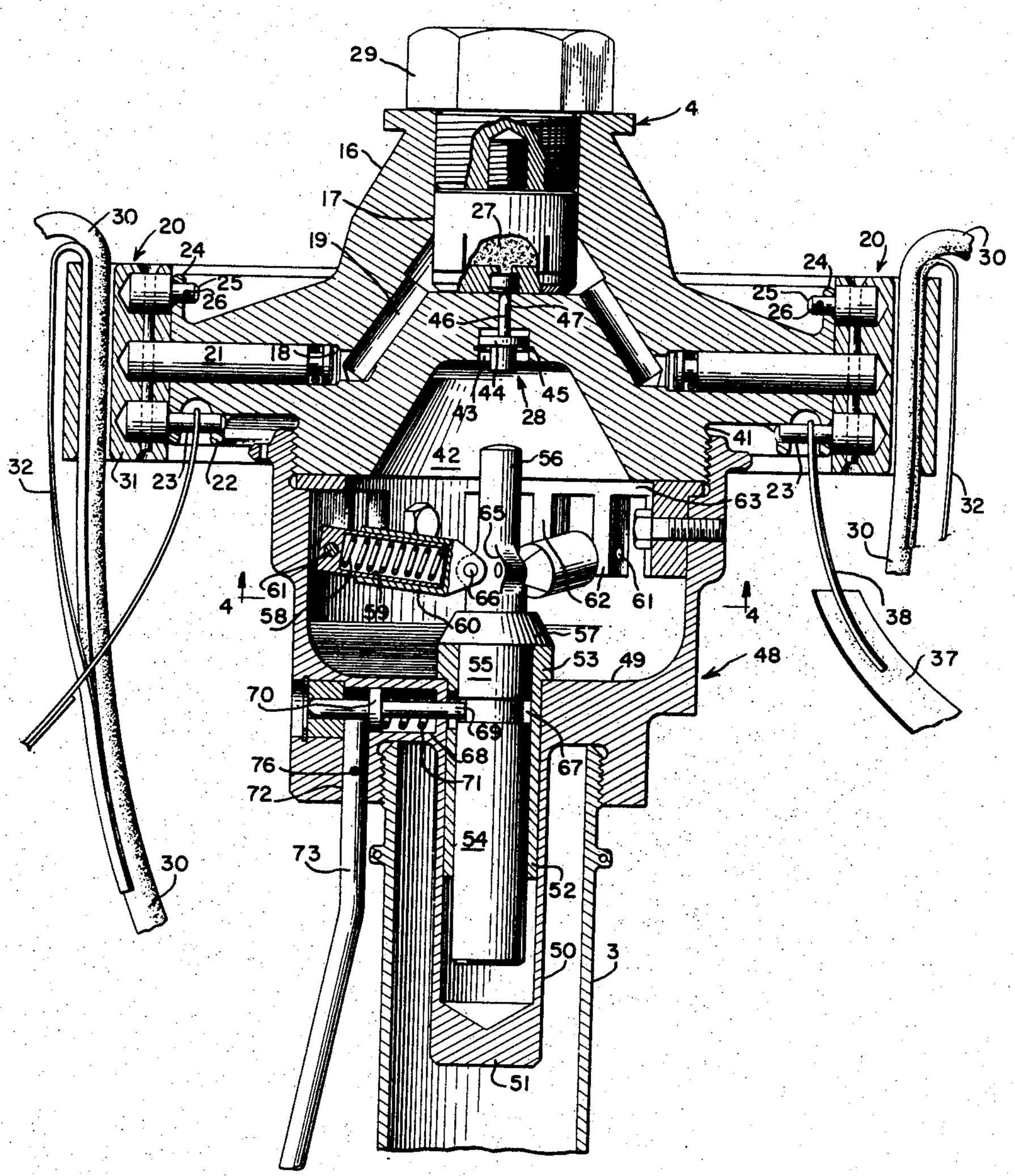


Fig. 2.

INVENTOR

FRED B. STENCEL

BY D C Loyless

ATTORNEY

Sept. 20, 1960

F. B. STENCEL

2,953,334

FAST-ACTING PARACHUTES

Filed Feb. 28, 1958

3 Sheets-Sheet 3

Fig. 3.

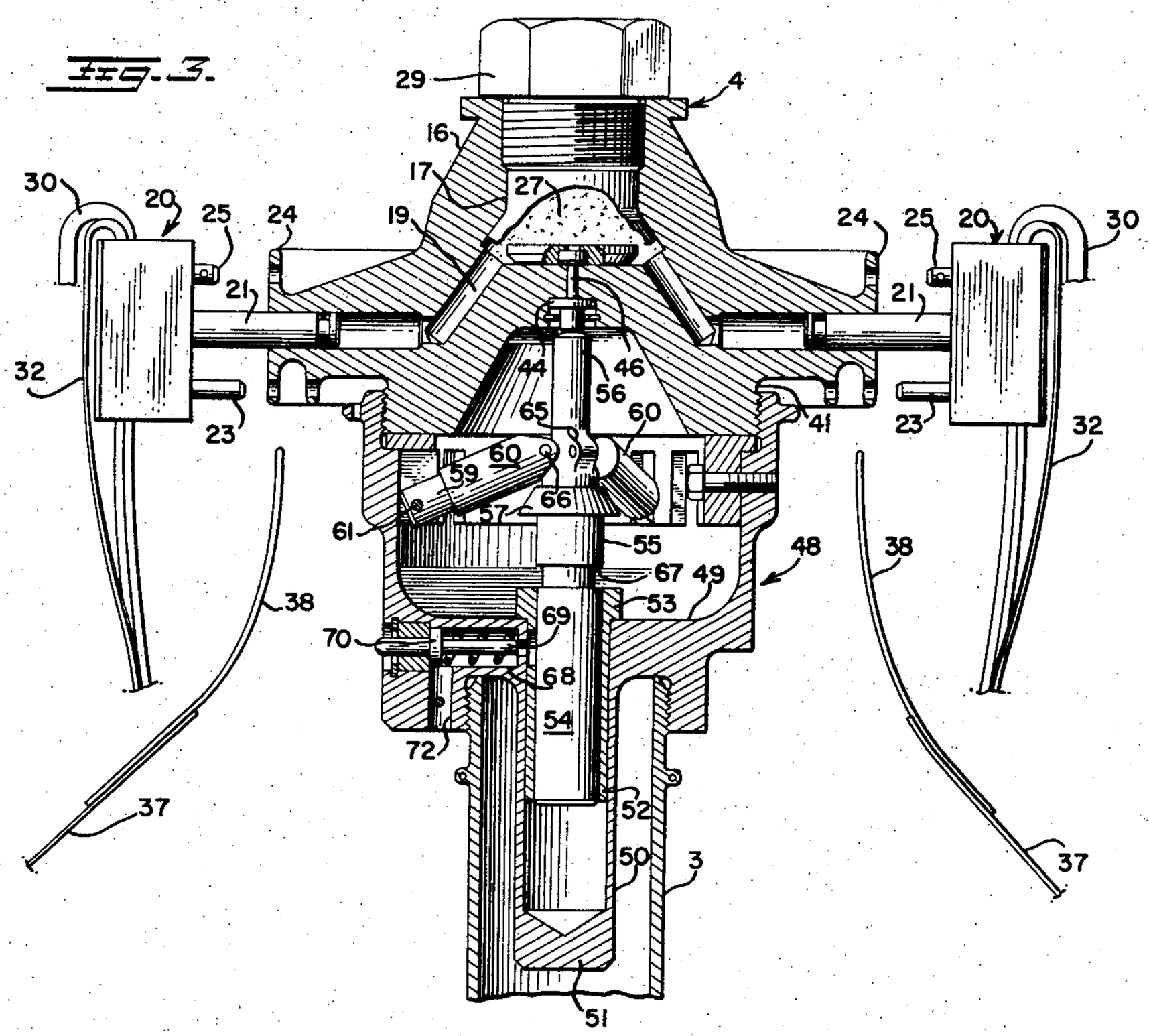
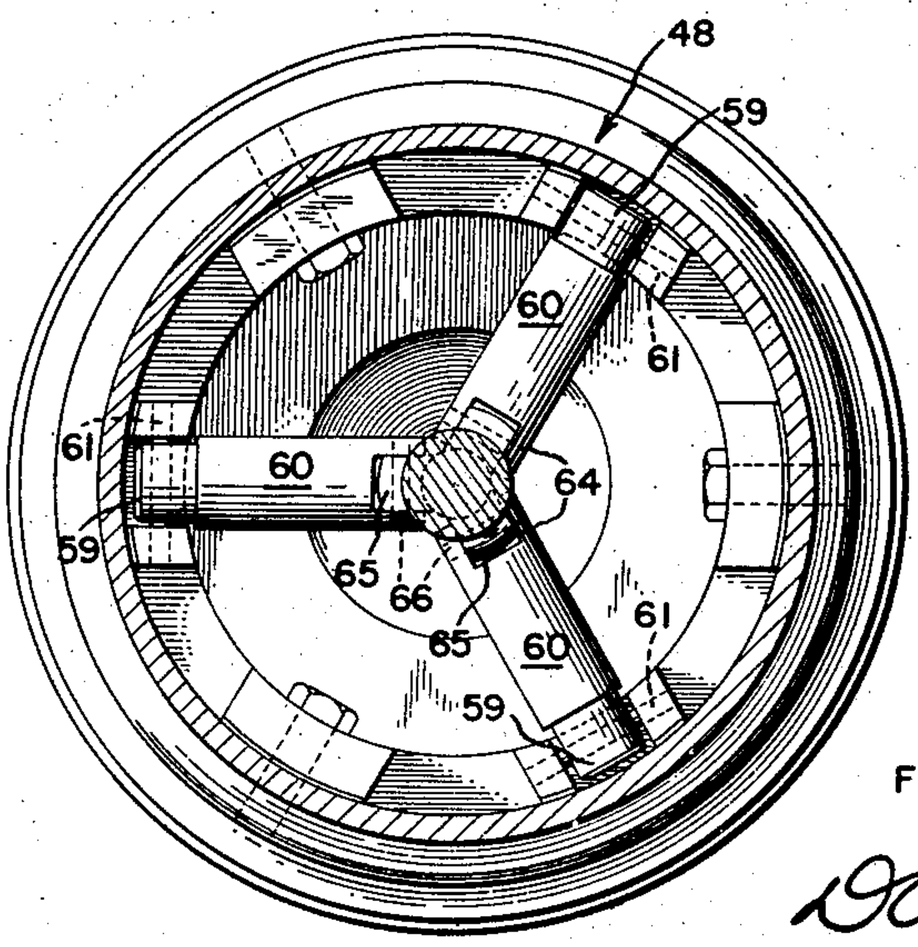


Fig. 4.



INVENTOR

FRED B. STENCEL

ATTORNEY

United States Patent Office

2,953,334

Patented Sept. 20, 1960

2,953,334

FAST-ACTING PARACHUTES

Fred B. Stencel, Asheville, N.C., assignor to Amcel Propulsion, Inc.

Filed Feb. 28, 1958, Ser. No. 718,349

7 Claims. (Cl. 244—147)

This invention relates to parachutes and more particularly to a novel construction especially applicable to ballistic parachutes, that is, parachutes which are explosively projected and deployed. The present invention embraces certain improvements over that disclosed and claimed in my co-pending application Serial Number 581,535, filed April 30, 1956.

Parachutes of the type referred to include a projected assembly comprising the parachute canopy disposed in specially folded condition on a support member, explosive means mounted on the support member for deploying the canopy after the parachute has been projected, and means for actuating the deployment means at the proper time during the projected flight of the assembly. The present invention is directed particularly to an improved means for actuating the explosive deployment means at the proper time.

An object of the present invention is to provide, in an explosively projected and deployed parachute, a particularly effective means for initiating the deployment explosion, and a novel mechanism for actuating the same when the projected parachute assembly has reached a given point in its flight.

Another object is to provide novel inertia-operated means for accomplishing initiation of the deployment explosion, the inertia-operated means being so constructed that actuation of the same can be predetermined to occur at a definite deceleration value.

A further object is to provide, in combination in a parachute of the type described, a novel inertia-operated means for initiating the deployment explosion, such inertia-operated means being positively maintained in inactive position at all times prior to occurrence of a predetermined deceleration of the projected parachute assembly.

In order that the manner in which these and other objects are accomplished in accordance with the invention can be understood in detail reference is had to the accompanying drawings which form a part of this specification and wherein:

Fig. 1 is a vertical sectional view, with some parts shown in elevation and others broken away for clarity, of a parachute constructed in accordance with one embodiment of the invention;

Fig. 2 is a vertical sectional view of a portion of the apparatus of Fig. 1 but on a larger scale, illustrating the novel deployment means actuator of the invention in unactuated position;

Fig. 3 is a view similar to Fig. 2, on somewhat smaller scale than Fig. 2, illustrating the deployment means and its actuator immediately after actuation of the latter, and

Fig. 4 is a transverse sectional view on line 4—4, Fig. 2.

As seen in Fig. 1, this embodiment of the invention combines a projected assembly indicated generally at **1** and a mounting and projecting assembly indicated generally at **2**. Projected assembly **1** comprises a projectile or supporting tube **3**, canopy deploying means **4**, the inertia-operated actuator for the deployment means, indicated at **5**, the specially folded canopy **6** and the canopy retaining bag **7**. The mounting and projecting assembly is constructed in accordance with my co-pending application Serial Number 718,364, filed concurrently herewith, and comprises a projecting tube **8** secured to a transversely extending mounting plate **9**, by which the parachute is mounted on any suitable supporting structure before projection and deployment. Disposed within projecting tube **8** is a tubular combustion chamber **10** containing an explosive projection charge **11**. A firing pin actuator unit **12** is operatively associated with charge **11** and adapted to be triggered by a Bowden wire **13**, as fully explained in the aforementioned co-pending application.

The projectile or supporting tube **3** of the projected assembly **1** telescopically embraces the projecting tube **8**. The combustion chamber **10** is perforated, as indicated at **14**, so that the explosion gases generated by charge **11** escape through the perforations **14** into the tube **8** and are effective to act against means closing the upper end of tube **3**, so that the assembly **1** is projected away from the mounting and projecting assembly when charge **11** is ignited in response to operation of Bowden wire **13**. Advantageously, the lower end portion of tube **3** is provided with a transverse internal groove in which is disposed a sealing ring **15** to accomplish a substantially fluid-tight seal between tubes **3** and **8**.

The canopy **6** is folded in accordance with my co-pending application Serial Number 581,764, filed April 30, 1956, and comprises a stacked series of generally toroidal folds 6^a, tube **3** extending through the centers of the folds 6^a. The canopy is disposed with its periphery adjacent the deployment means **4** and with its apex disposed considerably therebelow and attached to tube **3**. Attachment of the apex of the canopy to tube **3** may be accomplished in any suitable fashion, the means described in my co-pending application Serial Number 718,362, filed concurrently herewith, being particularly advantageous.

Deployment means **4** is constructed in accordance with my co-pending application Serial Number 718,363, filed concurrently herewith, and comprises a main body **16** having a centrally disposed, upwardly opening deployment charge chamber **17**. Body **16** is provided with a plurality of radially directed bores **18**, and suitable connecting conduits **19** communicate between the bores **18** and the charge chamber **17**. For each suspension line of the parachute, there is provided a projectile **20** equipped with a cylindrical stem **21** inserted in one of the radial bores **18**. At the bottom thereof, the body **16** is provided with two radially spaced, concentric, dependent flanges **22** having radially aligned openings. Each projectile **20** includes a pin **23** disposed in one such opening when the projectile stem is inserted to its bore **18**. At its top, the body **16** is provided with a peripheral flange **24** having radially directed openings equal in number to the bores **18**. Each deployment projectile **20** is equipped with a pin **25** extending through one of such openings in the upper flange **24**. A single, circularly extending shear wire **26** runs through transverse bores in all of the upper pins **25**, to retain the projectiles **20** in their initial position.

Within charge chamber **17**, there is mounted an explosive charge **27** having a primer operatively disposed with respect to a firing pin **28** centrally located in body **16**. The charge **27** is retained in place by a cap screw **29**, threaded downwardly into chamber **17**.

Each suspension line **30** of the parachute extends from the periphery of the canopy upwardly through a bore in

the main body portion 31 of one of the projectiles 20. The projectile is secured with respect to the suspension line in any suitable fashion, as by means of a loop of cord or fabric 32 extending through the main body 31, along with the suspension line, and having its ends attached either to the suspension line or to the periphery of the canopy. From the projectiles 20, the suspension lines extend downwardly, are grouped together into two bundles, and each bundle is stowed in a different one of two series of pockets in a line storage sleeve (not shown) which has an open top and is secured to the mounting means from which the parachute is projected.

The canopy bag 7 is made up of a lower portion 35 and an upper portion 36 connected by lacing. Upper portion 36 consists of a plurality of upwardly extending tapes 37 so connected at their lower ends as to be in sidewise overlapping relationship. At its top, each tape 37 has attached thereto a loop 38 of cord or the like extending upwardly to the deployment means. Each of the projectile pins 23 extends through a different one of the loops 38. Thus, the combination of pins 23 and loops 38 maintains the expansible top mouth of the upper bag portion 36 closed prior to deployment of the parachute canopy.

The parachute is equipped with four arresting lines 39, each having one end attached to the canopy bag at the bottom of lower bag portion 35. From their points of attachment to the canopy bag, the arresting lines extend upwardly between the canopy bag and line storing sleeve (not shown) and are separated into two pairs, each pair of arresting lines being joined with one of the two bundles of suspension lines and thus also stowed, along with the suspension lines, in the pockets of the sleeve, as fully described in the aforementioned application Serial Number 718,362. Where they emerge from the last of the pockets in the storing sleeve, the suspension lines and the arresting lines of each bundle are all attached to a different one of two buckles 40. Also attached to the buckles 40 are two riser extension straps, not shown, which extend to, and are attached to, the body or load to be recovered by the parachute during operation thereof.

Thus, the arresting lines have one end attached to the load to be recovered and the other end attached to the lower portion of the canopy bag, it being understood that the canopy bag is a part of the projected assembly. All of the suspension lines similarly have one end attached to the load to be recovered, the other ends thereof being attached to the periphery of the parachute canopy and connected to the deployment projectiles. The arresting lines are made effectively shorter than the suspension lines. That is, the length of the arresting line plus the distance between the point of attachment thereof to the canopy bag and the deployment means is materially shorter than the length of the suspension line extending from the deployment means to the buckle 40. It will thus be understood that, when the parachute is projected as a result of explosion of the projection charge 11, the suspension and arresting lines then paying out of their storage pockets, the arresting lines will become taut at a time when the suspension lines are still slack.

At its bottom, and concentrically inwardly of lower flange 22, the body 16 includes a dependent flange 41 defining a cavity 42 in the top wall of which is provided the firing pin retaining bore 43. The firing pin 28 includes an annular transverse shoulder 44 slidably engaging the cylindrical wall of bore 43, the firing pin being retained in the bore by a snap ring 45 located beneath shoulder 44. The primer-engaging head 46 of the firing pin extends through a smaller bore 47 communicating with the cavity in which charge 27 is mounted.

The outer surface of dependent flange 41 is provided with screw threads engaged by matching, internal threads on the upper end portion of a cup-shaped housing 48. Housing 48 has a transversely extending bottom wall 49

disposed across and in contact with the upper end of projectile tube 3. At its center, bottom wall 49 of the housing is provided with a dependent, cylindrical extension disposed within the upper end portion of tube 3 and aligned co-axially with that tube, the bottom of extension 50 being closed by a wall as indicated at 51. Thus, the extension 50 defines a cylindrical chamber opening upwardly into the interior of housing 48.

Mounted within extension 50 is a cylindrical bushing 52 having, at its upper end, a shoulder 53 engaged over the top surface of bottom wall 49 of housing 48. Slidably disposed within bushing 52 is the lower shank portion 54 of a firing pin actuating plunger 55. The plunger includes an upper striking head 56 aligned with firing pin 28. Between portions 54 and 56, the plunger 55 includes an outwardly directed annular shoulder 57 disposed above the top shoulder 53 of bushing 52.

The firing pin actuating plunger 55 is arranged to actuate the firing pin in response to deceleration of the projected parachute, but is initially biased to an inactive position by a plurality of radially disposed compression springs 58. Each spring 58 is enclosed within a telescopically engaged pair of tubes 59, 60. Each smaller tube 59 has its outer end pivoted on a pin 61 extending through suitably spaced, vertically extending flanges 62. The flanges 62 are made integral with and depend from an annular plate 63 clamped between the top of housing 48 and the bottom of flange 41 of deployment body 16. At their ends adjacent the plunger 55, the larger tubes 60 are each provided with a bifurcated portion embracing a radially directed boss 65 on plunger 55 above shoulder 57 and pivoted to such boss by a pin 66. Thus, the combination of tubes 59 and 60 constitutes means for enclosing the springs 58 and maintaining the same in radial positions with respect to the plunger 55.

The vertical spacing between the bottom of shoulder 57 and pins 66 is such that, when shoulder 57 is engaged with the bushing 52, pins 66 are disposed in a transverse plane located below that plane in which pivot pins 61 are located. See Fig. 2. Springs 58 always being maintained in compression by the telescopic tubes 59 and 60, the springs are effective to bias the plunger 55 into the position just mentioned. However, when the arresting lines 39 become taut during the projected flight of the parachute assembly, the projected assembly is abruptly decelerated. This deceleration causes actuating plunger 55 to move upwardly, against the biasing force of springs 58. When the deceleration is of a pre-selected value, the force with which plunger 55 moves upwardly is sufficient to compress springs 58 to an extent such that pins 66 are brought just above pins 61. When this occurs, the springs 58 are no longer effective to bias the plunger away from the firing pin, and the plunger accordingly snaps upwardly into engagement with the firing pin and so explodes the primer for deployment charge 27. See Fig. 3. As a result of explosion of charge 27, the deployment projectiles 21 are thrown radially outward, substantially instantaneously deploying the canopy 6 in the manner fully described in the aforesaid co-pending application Serial Number 718,362.

The inertia-operated firing pin actuating mechanism just described is particularly advantageous in several respects. First, it will be clear that this mechanism can be easily designed to operate in response to any deceleration which exceeds a specifically predetermined value. This value is determined by the amount of energy required to compress the springs 58 sufficiently to bring pins 66 just above pins 61. For all decelerations less than such predetermined value, it will be clear that the springs 58 serve to hold the plunger 55 positively in inactive position, so preventing premature firing of the deployment charge during the projection flight of the parachute assembly.

It will also be noted that the inertia-operated firing pin actuating means is one which is particularly adapted

to light weight construction in such fashion that the housing for the mechanism will serve to close the upper end of the projectile tube 3, so cooperating with that tube to confine the explosion gases generated by the projection charge 11. Thus, the tube 3, the housing for the inertia-operated firing pin actuator, and the main body of the deployment means are all arranged serially, with the actuator housing closing the tube and with the body of the deployment means closing the actuator housing.

Referring particularly to Fig. 1, it will be clear that the construction of this embodiment of the invention aids in concentrating most of the heavier metal parts toward the upper or leading end of the assembly, so that the center of gravity of the projected assembly can be made to lie at a point disposed approximately at bottom wall 49 of the housing 48. With such an arrangement, greater certainty of steady projected flight of the assembly is attained.

The inertia-operated firing pin actuator of the invention is also particularly adapted for combination with positive latching means operative to preclude accidental firing of the deployment charge during handling of the assembly or while the parachute is still retained on its mount. Thus, at a point within bushing 52, the plunger 55 is provided with an outwardly directed, transverse notch or groove 67. Laterally aligned with this groove is a bore 68 in bottom wall 49 of housing 48. A slidable latch pin is disposed in bore 68 and provided with a transverse shoulder 70, a compression spring 71 being positioned between shoulder 70 and the inner end of bore 68, so as to urge the latch pin radially outward. Communicating with bore 68 is a downwardly extending bore 72 in which is engaged, prior to projection of the parachute, the upper end portion of a latch rod 73. Thus, the upper end of latch rod 73 is engageable with the outer surface of shoulder 70, so holding the latch pin 69 in an inward position, with the tip of pin 69 engaged in groove 67 and preventing upward movement of plunger 55.

Latch rod 73 extends downwardly beside tube 3 and through a suitable opening in mounting plate 9. Secured to the lower surface of mounting plate 9 is a latch plate 74 having a key slot 75 therein. At its bottom end, the latch rod 73 is provided with a notch engaged in the key slot 75, so that the latch rod is retained by the mounting means when the parachute assembly is projected. Thus, upon projection of the parachute, the upper end of the latch rod is necessarily withdrawn from its bore 72, so that spring 71 then forces latch pin 69 outwardly, disengaging the inner tip thereof from notch or groove 67 and leaving the plunger 55 free for upward movement when the projected assembly is caused to decelerate by tautening of the arresting lines at the end of the projected flight. Advantageously, a shear pin 76 extends through the upper end portion of latch rod 73 into the material of housing 48 which defines bore 72, shear pin 76 being ruptured as a result of projection of the parachute assembly.

Attention is called to co-pending application Serial Number 718,361, filed concurrently herewith, in which the latch mechanism just described is claimed.

I claim:

1. In a fast acting, power projected parachute, the combination of a projected assembly comprising a support member, a parachute canopy disposed in folded relation on said member, impact-actuated deployment means mounted on said member and operatively associated with said canopy to deploy the same, an actuating member for said deployment means, said actuating member having a material mass, means attached to said support member and mounting said actuating member for movement generally in the direction of flight of said assembly in such fashion that upon deceleration of said assembly the momentum of said actuating member will urge the same toward said deployment means, and snap-acting resilient means mounted on said support member and connected to said actuating member and operative to bias the same away from said deployment means; a mounting and projection assembly operatively associated with said projected assembly to project the same; and arresting line means attached to said projected assembly and operative to decelerate the same to effect operation of said actuating member.

2. A parachute in accordance with claim 1 and wherein said projected assembly further comprises a stop member fixedly mounted with respect to said support member at a point rearwardly of said resilient means with respect to the direction of flight of the projected assembly, said actuating member including a stop surface disposed to be urged against said stop member by the biasing action of said resilient means.

3. In a parachute of the type described, the combination of an elongated projectile tube having a leading and a trailing end; a housing mounted on the leading end of said tube and defining a chamber; deployment means mounted on said housing and spaced from the leading end of said tube, said deployment means comprising a centrally disposed explosive deployment charge, a firing pin for said charge, a plurality of radially directed deployment projectiles, and means effective to apply the explosion gases from said charge to project said deployment projectiles; a firing pin actuating plunger disposed in said chamber in alignment with said firing pin; means mounting said plunger on said housing for movement toward and away from said firing pin; resilient means connected between said housing and said plunger and disposed to bias said plunger away from said firing pin; a folded parachute canopy disposed about said tube, said deployment projectiles being operatively connected with said canopy to deploy the same upon explosion of said charge; a projection assembly operatively associated with said projectile tube to project the same; and arresting line means operatively connected to decelerate said projectile tube and the parts carried thereby during projected flight thereof.

4. A parachute in accordance with claim 3 and wherein the means mounting said plunger comprises a plurality of telescopic assemblies disposed radially of said plunger and each pivoted at one end to said plunger and at the other end to means disposed outwardly of the plunger and fixedly carried by said projectile tube, and said resilient means comprises a plurality of compression springs each disposed within a different one of said telescopic assemblies.

5. A parachute in accordance with claim 4 and wherein said means disposed outwardly of the plunger and fixedly carried by the projectile tube is a unitary annular member mounted on said housing and surrounding said plunger.

6. A parachute in accordance with claim 4 and including stop means fixed with respect to said tube, said telescopic assemblies being disposed between said stop means and said deployment means, said plunger having a stop surface disposed to engage said stop means.

7. In a parachute of the type wherein the parachute canopy is embodied in a projected assembly including impact-actuated explosive means effective to deploy the canopy from the projected assembly during its flight, the combination with such projected assembly of a projectile tube having a leading and a trailing end; a generally cup-shaped housing secured at its bottom to the leading end of said tube and closing the same, the deployment means of the projected assembly being mounted on the top of said housing to close the housing; an impact actuator disposed in the housing and operatively associated with the deployment means, said actuator being mounted for movement toward and away from the deployment means

generally in the direction of flight of the projected assembly; stop means carried by said housing and spaced from the deployment means; snap-action resilient means disposed between said stop means and the deployment means and connected to said actuator to bias the same against said stop means; and arresting line means connected to the projected assembly and effective to decelerate the same to cause the force of inertia of said actuator to overcome the biasing action of said resilient means.

References Cited in the file of this patent

FOREIGN PATENTS

133,924	Austria	June 26, 1933
436,529	France	Jan. 25, 1912