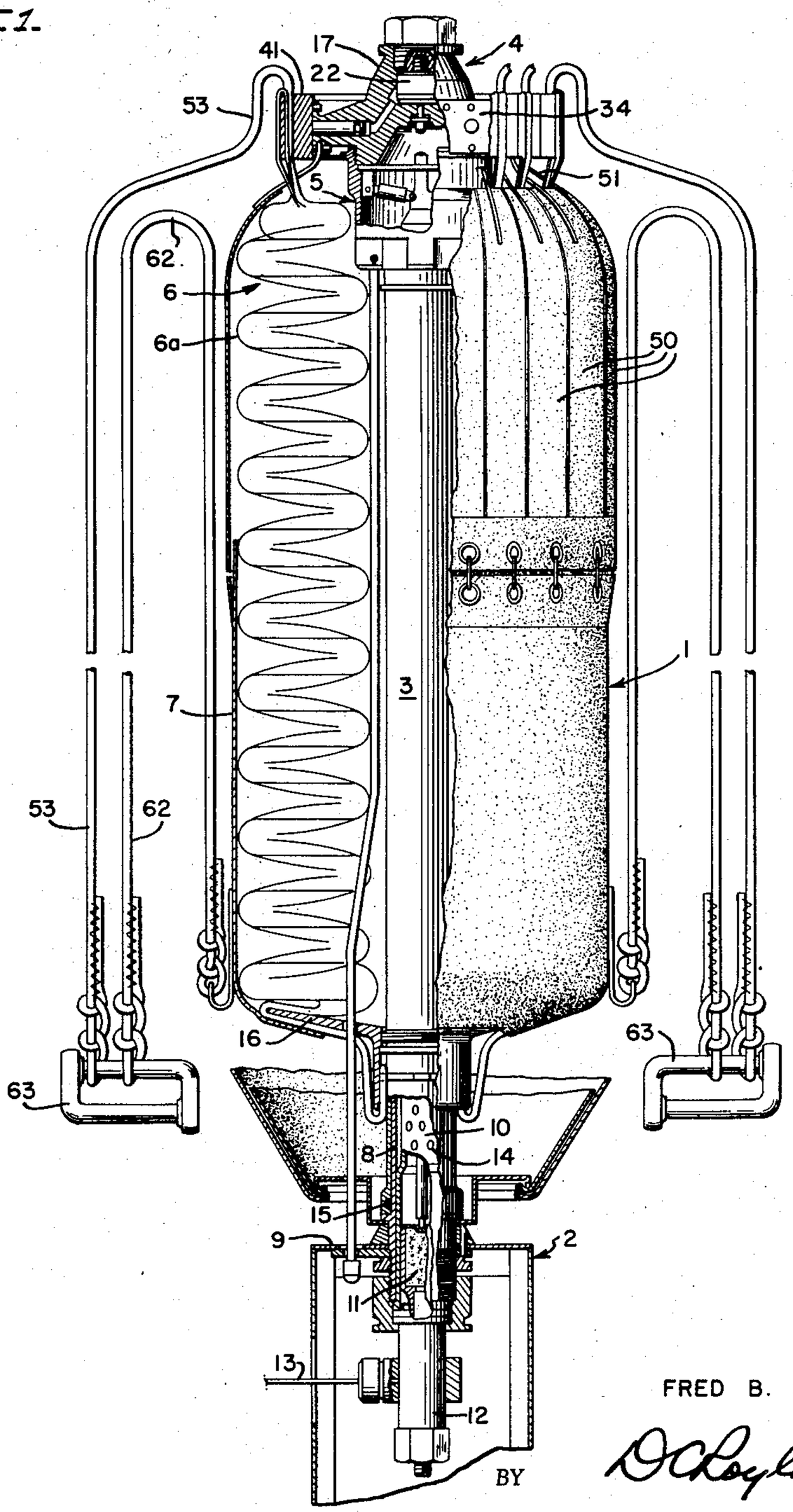
Sept. 20, 1960 F. B. STENCEL 2,953,333

FAST-ACTING PARACHUTES

Filed Feb. 28, 1958 3 Sheets-Sheet 1

Fig. 1.



INVENTOR

FRED B. STENCEL

BY D C Loyhance

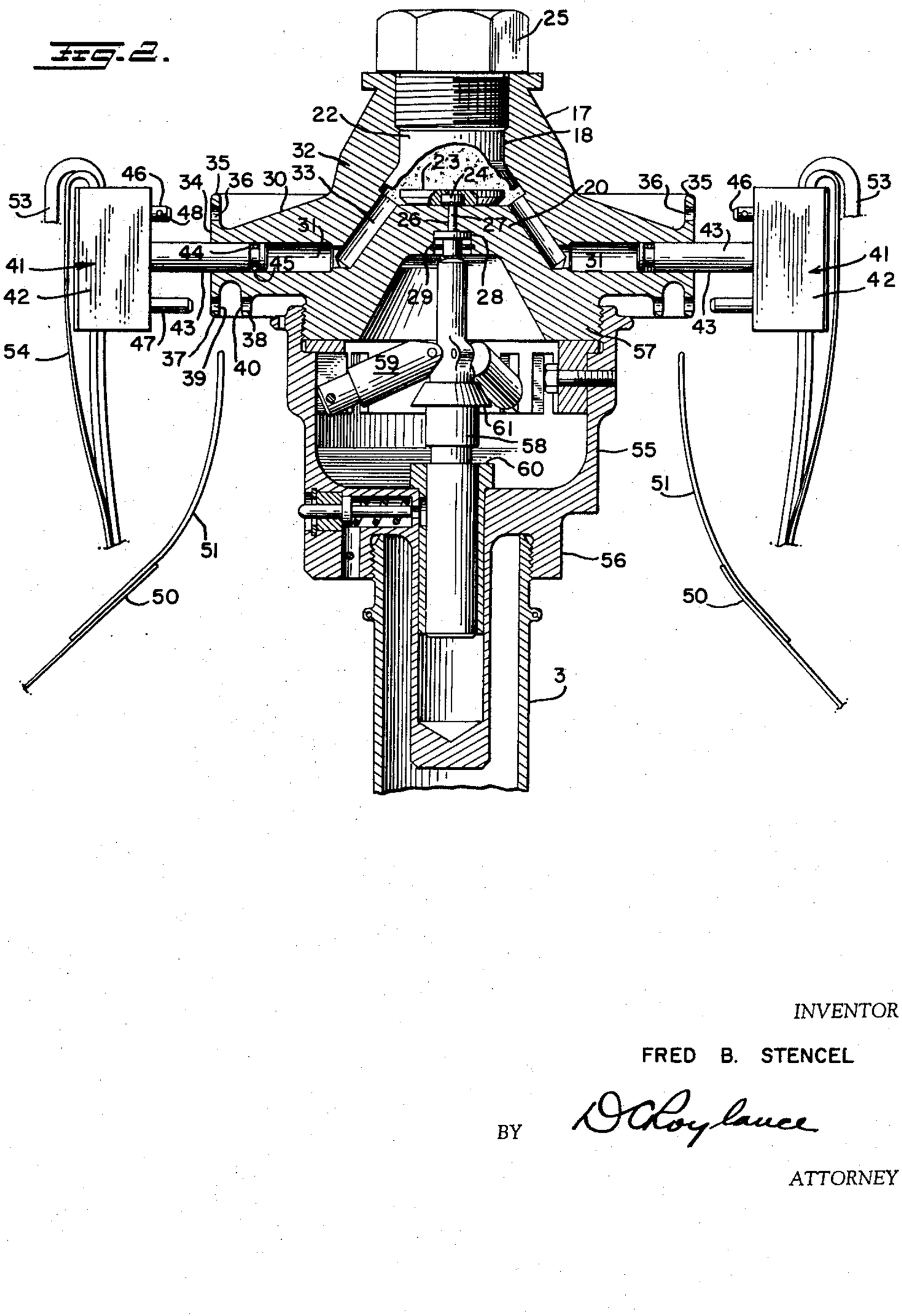
ATTORNEY

Sept. 20, 1960 F. B. STENCEL 2,953,333

FAST-ACTING PARACHUTES

Filed Feb. 28, 1958 3 Sheets-Sheet 2

Fig. 2.



INVENTOR

FRED B. STENCEL

BY D. C. Loyd Lance

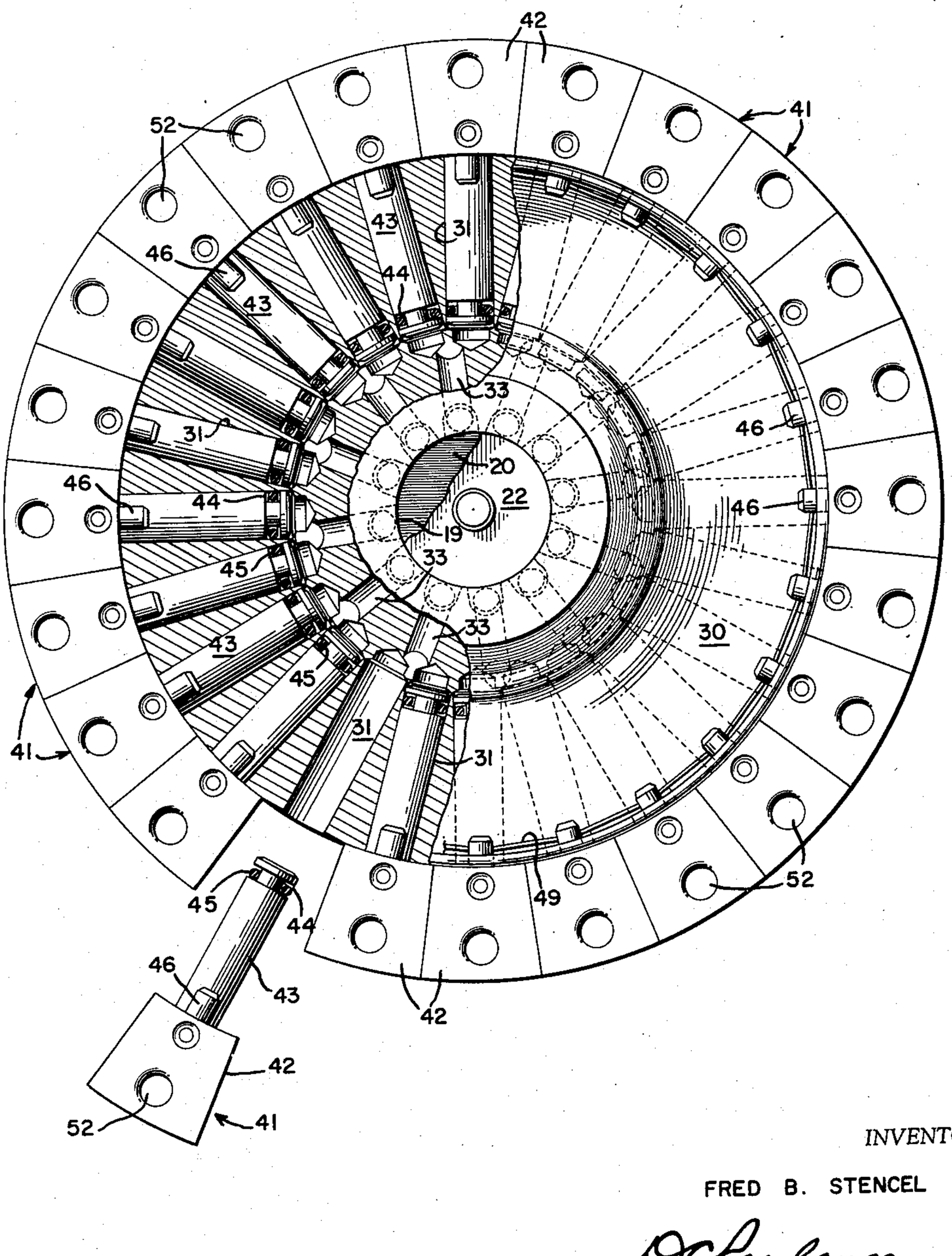
ATTORNEY

Sept. 20, 1960 F. B. STENCEL 2,953,333

FAST-ACTING PARACHUTES

Filed Feb. 28, 1958 3 Sheets-Sheet 3

Fig. 3.



INVENTOR

FRED B. STENCEL

BY D. C. Laylance

ATTORNEY

United States Patent Office

2,953,333

Patented Sept. 20, 1960

2,953,333

FAST-ACTING PARACHUTES

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

Filed Feb. 28, 1958, Ser. No. 718,363

10 Claims. (Cl. 244—147)

This invention relates to parachutes and more particularly to fast-acting parachutes which are power-projected and power-deployed. The invention embraces certain improvements over that disclosed and claimed in my co-pending application Serial Number 581,535, filed April 30, 1956.

The general object of the present invention is to devise an improved, exceedingly fast-acting explosive deployment means for parachutes.

Another object is to provide improved parachute deployment means of the type referred to particularly adapted for top mounting, that is, for mounting at the lead or nose end of the projected parachute assembly.

A further object is to provide novel explosive deployment means for parachutes, such means allowing a distinct saving in weight while maintaining the relatively high strength necessary in such an explosive device.

Yet another object is to provide explosive deployment means including a novel construction assuring abrupt application of the explosion gases to the deployment projectiles.

A still further object of the invention is to provide such deployment means especially adapted to assure release of certain of the parts of the associated projected parachute assembly at the instant of firing of the deployment projectiles.

In order that the manner in which these and other objects are achieved 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 view in vertical sectional view, partly in elevation and with some parts broken away for clarity, of a parachute assembly constructed in accordance with one embodiment of the invention;

Fig. 2 is a vertical sectional view of a portion of the assembly of Fig. 1, on enlarged scale, illustrating the relationship of various parts of the device in the instant following firing of the deployment means, and

Fig. 3 is a view, partly in plan elevation and partly in transverse section, of the assembly of Fig. 2, on enlarged scale.

Referring now to the drawings in detail, it will be seen that the embodiment of the invention here illustrated comprises a projected assembly indicated generally at **1** and a mounting and projecting assembly indicated generally at **2**. The projected assembly comprises a centrally disposed projectile or supporting tube **3**, the novel deployment means indicated at **4**, an inertia-operated actuator **5** for firing the deployment means, the parachute canopy **6** and the canopy retaining bag **7**.

The mounting and projecting assembly **2** includes the projecting tube **8** carried by a mounting plate **9** and enclosing, at its lower end, a combustion chamber **10**. The combustion chamber **10** carries in its lower portion an explosive projecting charge **11**. Operatively associated with the charge **11** is a firing pin actuator unit indicated generally at **12** and constructed to be triggered by the

Bowden wire **13**. At its upper end, the combustion chamber **10** is provided with perforations **14** communicating between the interior of the combustion chamber and the interior of projecting tube **8**. Accordingly, when the Bowden wire **13** is withdrawn from the firing pin actuator unit **12**, the actuator unit fires the projecting charge **11**, so generating explosion gases within the combustion chamber **10**, which gases pass through perforations **14** into the interior of projecting tube **8**. The projectile tube **3**, forming part of the parachute assembly to be projected, is telescopically disposed over tube **8**, an O-ring seal being provided at **15** to prevent escape of the explosion gases from between the two tubes. The expanding explosion gases thus are effective to project the tube **3**, and its associated components, away from the tube **8**.

The canopy **6** is folded in accordance with my co-pending application Serial Number 581,764, filed April 30, 1956. Thus, the canopy is disposed in a stacked series of generally toroidal folds **6a**, with the periphery of the canopy adjacent deployment means **4** and with the apex of the canopy disposed a substantial distance below the deployment means at plate **16** secured to and extending transversely of the projectile tube **3**. The apex of the canopy is secured to the tube **3** in any suitable fashion, advantageously in the manner described in my co-pending application Serial Number 718,362, filed concurrently herewith.

The novel deployment means **4** of the invention comprises an integral main body **17**, advantageously machined from aluminum or like light metal. The body **17** is formed to define a centrally located, upwardly opening, generally cup-shaped explosion chamber **18** having annular side walls **19** and a horizontally disposed, transverse bottom wall **20**. At its bottom end, the chamber **18** is outwardly and downwardly flared, as indicated at **21**. Disposed within chamber **18** is a generally cylindrical explosive charge retainer **22** in the shape of an inverted cup with thin metal side walls and a flat transverse top wall. The bottom of the charge retainer is closed by a closure plate **23** which carries the usual primer **24** at the center thereof. The top portion of side wall **19** of chamber **18** is threaded to receive a cap screw **25** which directly engages the top of the charge retainer **22** to hold the charge in place.

Bottom wall **20** is provided at its center with a vertically disposed bore **26** in which is slidably mounted a firing pin **27** aligned with primer **24**. Bore **26** has an upper portion of smaller diameter and a lower portion of larger diameter. Firing pin **27** is provided with an annular transverse shoulder **28** slidably engaging the cylindrical wall of the lower portion of bore **26**. A snap ring **29**, seated in an annular groove in such lower portion, is situated below shoulder **28** to retain the firing pin.

Outwardly of explosion chamber **18**, body **17** is provided with an annular portion **30**, which portion has a plurality of outwardly opening bores **31** extending radially with respect to tube **3**. The inner ends of bores **31** are spaced along a circular line concentric with the axis of tube **3** and, as seen in Fig. 3, such inner ends are disposed very close together. Body **17** also has an intermediate portion **32** provided with a plurality of ducts **33** communicating between the inner ends of portion **31** and the lower portion of explosion chamber **18**. Thus, ducts **33** lead directly into that portion of the explosion chamber defined by the outwardly and downwardly flared part of side wall **19**.

As will be seen from Fig. 3, in this embodiment of the invention the deployment means includes twenty-four of the bores **31** and only twelve ducts **33**, each duct **33** opening into two adjacent ones of the bores **31**. The outer annular portion **30** of body **17** is displaced from the explosion chamber, in a direction rearwardly with

respect to the line of flight of the projected assembly 1. Thus, all of the bores 31 are disposed in a transverse plane approximately aligned with the lower face of bottom wall 20. Accordingly, the ducts 33 can be said to slant downwardly and outwardly from the lower portion of explosion chamber 18. This arrangement is particularly advantageous since it assures that all portions of bores 31 and ducts 33 will be surrounded by a substantial thickness of the metal from which body 17 is made, so providing the necessary strength to withstand the explosion forces to which the body would be subjected.

The top surface of outer, annular body portion 30 slants downwardly and outwardly. Portion 30 has a plain cylindrical peripheral face 34 and is provided at its periphery with an upwardly directed cylindrical flange 35 concentric with tube 3 and constituting an extension of peripheral face 34. Flange 35 is provided with a plurality of radially directed openings 36, Fig. 2.

On its bottom surface, portion 30 is provided with two dependent cylindrical flanges 37 and 38 concentric with tube 3, outer flange 37 being aligned with upper flange 35. Flanges 37 and 38 are each provided with a plurality of radially directed openings, as indicated at 39 and 40, respectively, Fig. 2. Openings 36 in flange 35 are equal in number to and aligned respectively above bores 31. Each set of openings 39 and 40 is also equal in number to bores 31 and aligned therebelow.

Referring particularly to Figs. 2 and 3, it will be seen that deployment means 4 comprises a plurality of deployment projectiles 41 equal in number to bores 31. Each projectile 41 comprises a main body portion 42 and a stem 43. Each stem 43 is slidably disposed in a different one of the bores 31 and is provided with an annular transverse groove 44 in which is disposed an O-ring 45 effecting a relatively fluid-tight seal with the wall of the corresponding bore 31. Each projectile 41 also has an upper pin 46 extending parallel to stem 43, and a lower, longer pin 47 also extending parallel to stem 43. Each pin 46 extends radially inward through a different one of the openings 36 in upper flange 35 and is provided, at a point which will lie inwardly of flange 35, with a transverse opening 48, Fig. 2. As seen in Fig. 3, a single shear wire 49 extends through all the openings 48. The lower pin 47 of each projectile 41 extends through a different aligned pair of the openings 39 and 40 of flanges 37 and 38. As seen in Fig. 1, the upper portion of canopy bag 7 is made up of a plurality of tapes 50 to each of which is attached a loop of cord or the like 51. Each such loop 51 extends between flanges 37 and 38. Each pin 47 extends through a different one of the loops 51. It will thus be seen that the pins 47, cooperating with the flanges 37, 38, comprise means operative to retain the upper portion of canopy bag 7 in closed position until such time as the deployment means 4 is actuated.

The body 42 of each projectile 41 is provided with a bore 52, Fig. 3, extending parallel to the axis of tube 3. Canopy 6 is provided, in the usual fashion, with twenty-four suspension lines 53, each extending through a different one of the bores 52. For each suspension line, a length of cord or the like 54, Fig. 2, is run through the corresponding bore 52 and has its ends stitched or otherwise secured to the suspension line to secure the corresponding deployment projectile 41 to the suspension line. Thus the deployment projectiles are operatively connected to the parachute canopy in such fashion that the canopy will be properly deployed when the projectiles 41 are thrown radially outward.

The actuator 5 comprises a generally cup-shaped housing 55 having a dependent annular portion 56 threaded to and closing the leading end of tube 3. At its top, housing 55 is threaded to an annular dependent portion 57 of body 17. Thus, the housing 55 is secured directly to and closes tube 3, and the body 17 is secured directly to and closes housing 55.

Within housing 55 is an actuating plunger 58 mounted in alignment with firing pin 27 for movement toward and away from the firing pin generally in the direction of the line of flight of the projected assembly. As fully described in my copending application Serial Number 718,349, filed concurrently herewith, a plurality of radially extending telescopic spring housing assemblies 59 are provided, each pivoted at one end to the plunger 58 and at the other end to means carried by housing 55. In each such telescopic assembly there is enclosed a compression spring. As seen in Fig. 2, the housing 55 encloses stop means 60 disposed below the assembly 59 and plunger 58 is equipped with cooperating stop means 61. Thus, the compression springs in assemblies 59 are effective to resiliently bias the plunger downwardly to bring means 61 into engagement with means 60. However, when the projected assembly 1 is decelerated in its flight, to a predetermined extent, the movement of plunger 58 is sufficient to overcome the biasing action of the springs, allowing the plunger to snap upwardly against the firing pin and so actuate the deployment means.

Deceleration of the projected assembly is accomplished, in the manner fully described in my co-pending application Serial Number 718,362, filed concurrently herewith, by means of arresting lines 62, each having one end attached to the lower portion of canopy bag 7 and the other end attached to one of the buckles 63 employed to connect the suspension lines to the load to be recovered by the parachute.

Upon explosion of primer 24, resulting from actuation of firing pin 27 by plunger 58 when the projected assembly is decelerated, the charge contained within charge retainer 22 is ignited, and the pressure within retainer 22 increases. Slightly after such ignition, the explosion gases produce a pressure sufficient to deform the walls of retainer 22 outwardly against outwardly and downwardly flared portion 21 of the walls of the explosion chamber 18. Such deformation allows the explosion gases to escape suddenly via ducts 33 and into bores 31, applying pressure against the tips of stems 43. Shear wire 49 is ruptured, releasing deployment projectiles 41, and the projectiles are thus thrown outwardly at very high speed.

As the projectiles 41 begin to move outwardly, pins 47 are withdrawn from holes 39, 40, and loops 51 are freed, thus allowing the top of canopy retaining bag 7 to open. Thus, as the projectiles 41 continue their flight, the canopy 6 is now free for deployment.

I claim:

1. In a fast-acting parachute apparatus of the type comprising a projected assembly, including the parachute canopy, and power means operatively associated with the projected assembly to project the same in such fashion that the projected assembly follows a line of projected flight away from the load to be recovered by the apparatus, the combination in said projected assembly of a support member upon which the canopy is disposed in folded relation; deployment means mounted on said member and comprising an integral body having a central portion defining a generally cup-shaped explosion chamber having a bottom wall, said body also having an outer annular portion and an intermediate portion connecting said outer and central portions, said outer portion being provided with a plurality of radially extending outwardly opening bores the inner ends of which are spaced generally circularly along a line displaced from said bottom wall in a direction axially of said chamber, said intermediate portion being provided with a plurality of ducts communicating between the inner ends of said bores and the portion of said chamber adjacent said bottom wall, a plurality of deployment

projectiles each having a stem slidably disposed in a different one of said bores, said projectiles being operatively connected to the parachute canopy, and explosive means disposed in said chamber; the parachute apparatus including means operative to ignite said explosive means during the projected flight of the projected assembly.

2. A parachute apparatus in accordance with claim 1 and including an even number of said bores, the inner ends of said bores being closely adjacent to each other, and each of said ducts communicating with two of said bores.

3. A parachute apparatus in accordance with claim 1 and wherein said explosive means comprises a charge container having deformable side wall means disposed in the portion of said chamber adjacent said bottom wall, said chamber portion having outwardly displaced wall portions disposed to allow outward deformation of said deformable side wall means upon explosion of said explosive means.

4. A parachute apparatus in accordance with claim 3 and wherein said chamber has a generally cylindrical side wall flared outwardly adjacent said bottom wall, said ducts communicating with the space surrounded by such outwardly flared wall portion, and said charge container includes a generally cylindrical wall nested against the side wall of said chamber and extending toward said bottom wall to terminate in a cylindrical tip spaced inwardly from the outwardly flared portion of the side wall of said chamber.

5. A parachute apparatus in accordance with claim 1 and wherein said outer annular portion of said body is provided with an annular flange concentric with said central portion and having a plurality of radial openings, each of said deployment projectiles being provided with a retaining pin extending through a different one of said openings, said apparatus further comprising shear means carried by said body of said deployment means and engaged with said pins.

6. A parachute apparatus in accordance with claim 5 and wherein said pins extend radially inward beyond said flange, said apparatus further comprising a single shear member extending transversely through said pins inward of said flange.

7. In a fast-acting parachute apparatus of the type comprising a projected assembly, including the parachute

canopy, and means for projecting said assembly, the combination in said projected assembly of an elongated support member having leading and trailing end portions, the parachute canopy being disposed in a series of annular folds extending about said member with the periphery of the canopy adjacent the leading end portion thereof; a housing mounted on said leading end portion and extending therefrom longitudinally of said member; an integral, rigid body mounted on said housing, said body having a central portion defining a cup-shaped explosion chamber having its bottom wall adjacent said housing, said body further including an outer annular portion and an intermediate portion, said outer portion being provided with a plurality of bores extending radially of said member and opening outwardly, said intermediate portion having a plurality of ducts communicating between said bores and said explosion chamber; a plurality of deployment projectiles each having a stem slidably disposed in a different one of said bores, said projectiles being operatively connected to the parachute canopy; explosive means disposed in said chamber, and means mounted in said housing operative to actuate said explosive means.

8. A parachute apparatus in accordance with claim 7 and wherein said bores are disposed in a transverse plane spaced from the bottom wall of said chamber in the direction of the opposite end of said support member.

9. A parachute apparatus in accordance with claim 8 and wherein said intermediate portion of said body and said bottom wall of said chamber combined to define a concavity opening to the interior of said housing, said bottom wall being provided with a bore directed axially of said chamber, and a firing pin is slidably disposed in said bore.

10. A parachute apparatus in accordance with claim 7 and wherein said housing has a threaded annular end portion and said body includes a portion threaded to said end portion, said body thus closing said housing.

References Cited in the file of this patent

FOREIGN PATENTS

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