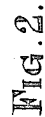


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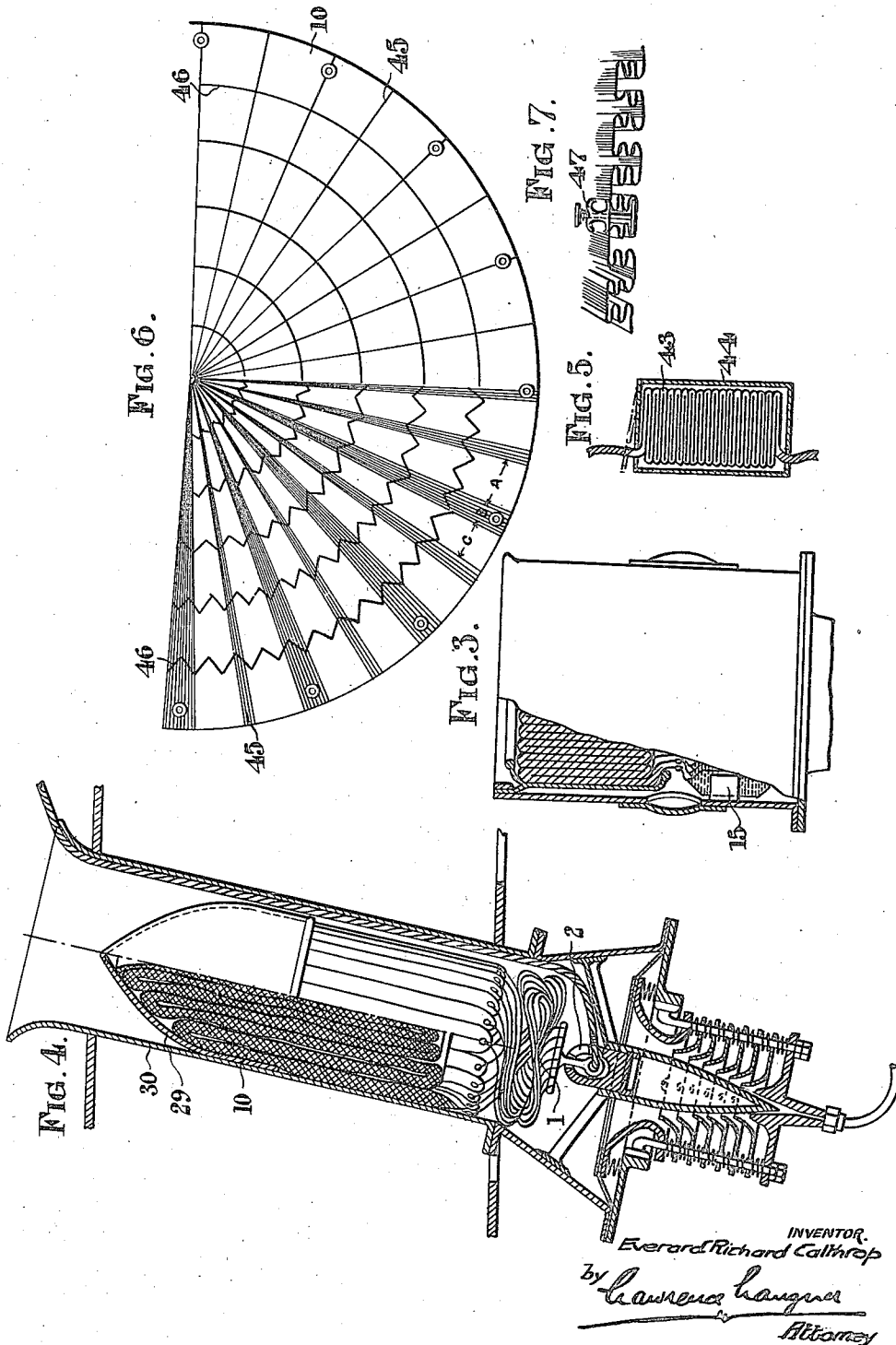
4 SHEETS—SHEET 1.



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Patented Dec. 28, 1915.  
4 SHEETS—SHEET 2.

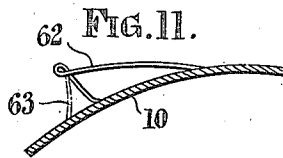
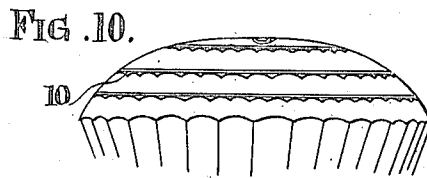
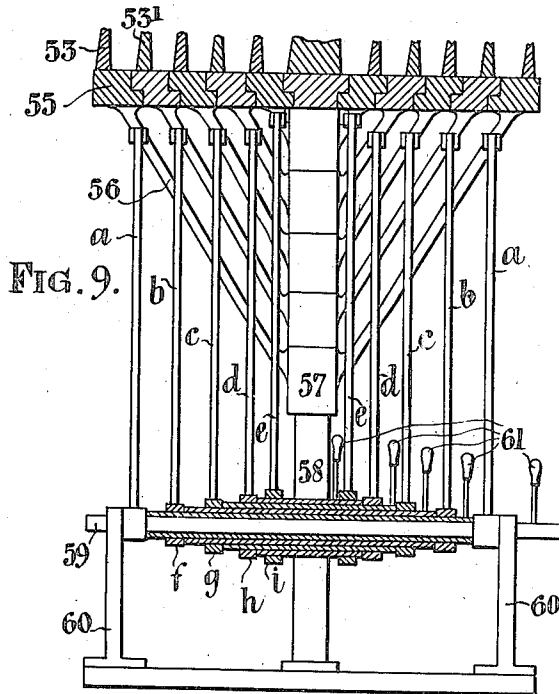
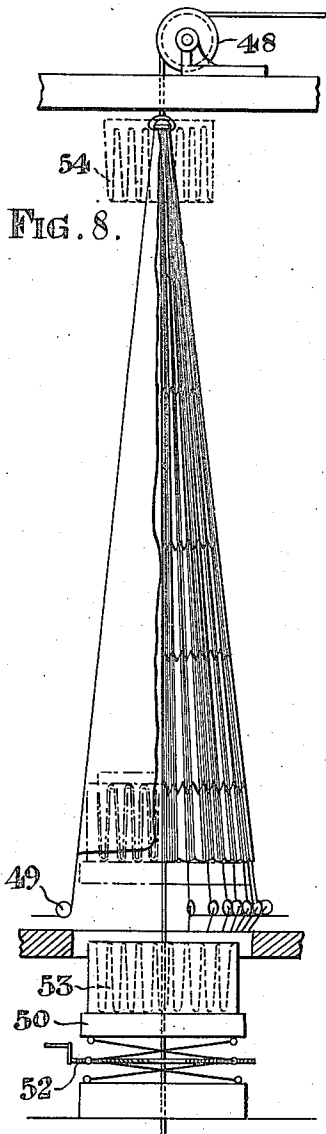


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PARACHUTE  
APPLICATION FILED SEPT. 4, 1915.

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4 SHEETS—SHEET 3.



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4 SHEETS—SHEET 4.

FIG. 12.

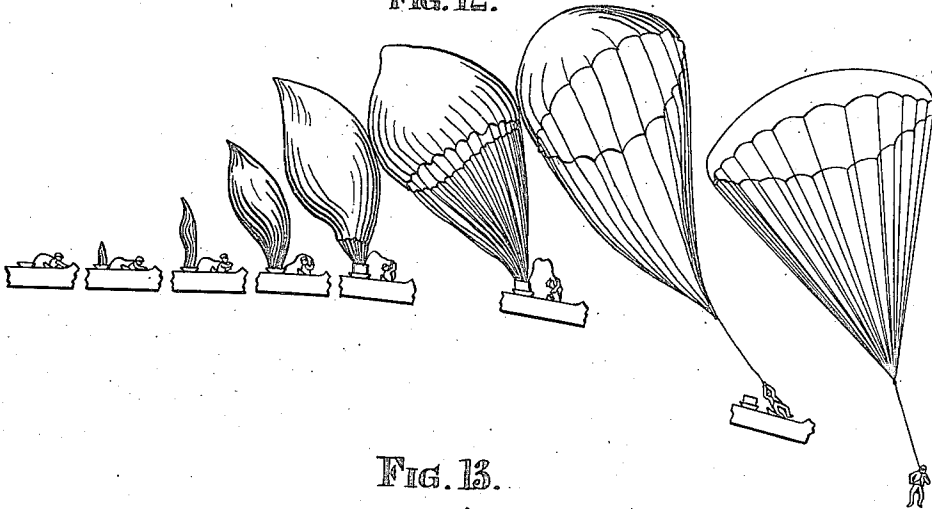
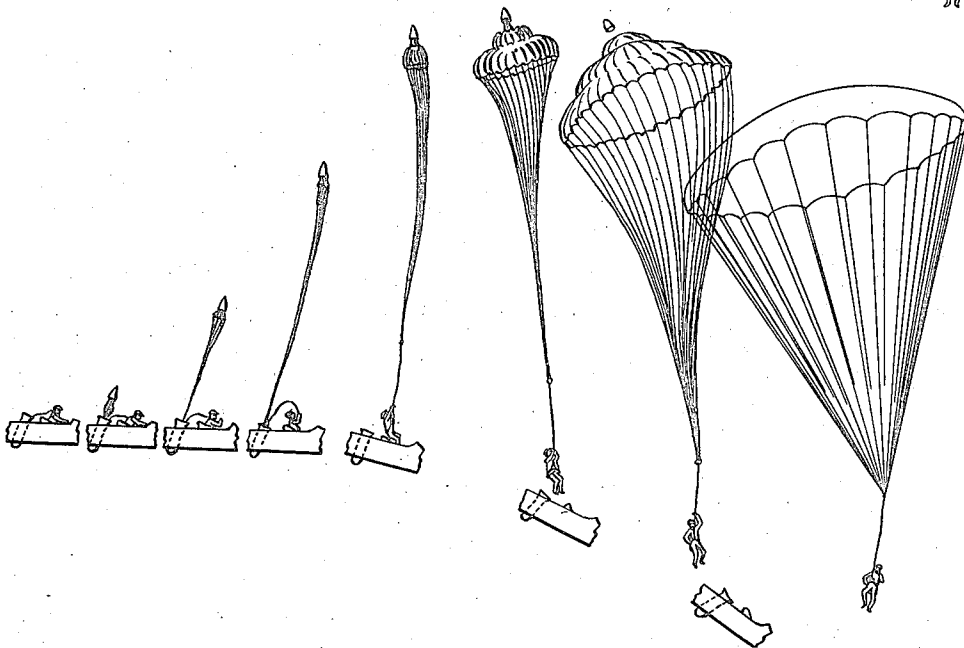


FIG. 13.



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# UNITED STATES PATENT OFFICE.

EVERARD RICHARD CALTHROP, OF LONDON, ENGLAND.

## PARACHUTE.

1,165,846.

Specification of Letters Patent.

Patented Dec. 28, 1915.

Application filed September 4, 1915. Serial No. 49,110.

*To all whom it may concern:*

Be it known that I, EVERARD RICHARD CALTHROP, a subject of the King of Great Britain, residing at London, in the county of Middlesex, England, have invented new and useful Improvements in and Relating to Parachutes, of which the following is a specification.

This invention has reference to parachutes of the kind described in the specification of my copending application No. 831785. In this prior specification I have described the construction of parachutes adapted for use with aeroplanes whereby the pilot may in case of emergency cause the parachute to be projected from a nest box or container clear of the aeroplane and by its aid descend safely to the ground.

Now my present invention contemplates improvements in parachutes of this kind whereby they may be rendered more certain in action and generally more efficient to the ends in view.

I will now proceed to describe my present improvements in detail for which purpose reference should be had to the accompanying drawings in which:

Figure 1 represents in section the arrangement of a parachute for use with aeroplanes and also illustrates an air injector device as applied thereto. Fig. 2 illustrates a modified form of air injector device. Fig. 3 is a detail view of a somewhat modified form of the means employed for retaining the parachute in a nest box or container. Fig. 4 is a view of a modification under this invention wherein the parachute is projected into the air and prevented from expanding until it has reached its limit of ascent. Fig. 5 is a detail view of the preferred means for packing or nesting the guy cords or rigging to prevent entanglement thereof when a parachute is ejected from a nest box or container. Fig. 6 illustrates a parachute cover having markings thereon to facilitate plaiting and folding as will be hereinafter explained. Fig. 7 is a detail view. Figs. 8 and 9 illustrate the construction of an apparatus for plaiting and folding a parachute cover. Figs. 10 and 11 are detail views illustrating means for utilizing aerial friction for the purpose of facilitating expansion of a parachute cover when ejected from a nest box or container and for minimizing oscillation when descending. Figs. 12 and 13 are a series of

diagrams illustrating the action of parachutes for use with aeroplanes under this invention.

It will be obvious that to obtain the maximum efficiency and smoothness of operation of a parachute packed in a container as above referred to it is essential that the danger attending entanglement or displacement of the guy ropes or cords should as far as possible be eliminated and that means should be provided for insuring that the parachute should be ejected from its container in such a manner as to obtain the maximum "expansive" effect upon the parachute cover of the air introduced under pressure into the nest box.

With these ends in view the ring 1 (Fig. 1) to which the guy ropes of the parachute cover are secured is held vertically within the nest box or container by means of a cradle 2 preferably of rubber or other resilient material and secured to the wall of the box is an annular sleeve 3 wholly or partly of rubber or other resilient material having a plurality of slots 4 on one edge. Said sleeve 3 is so mounted as to frictionally engage the ring 1 and the guy ropes either coiled individually and inclosed in elastic envelops 5 or arranged spirally in bulk are arranged in the space between the sleeve 3 and the wall of the nest box. The portions of the guy ropes between the aforesaid elastic envelops 5 and the ring 1 are then slipped into the slots 4 in the sleeve 3 thus holding them in spaced relation to each other. By this construction not only will the compressed air admitted to the nest box pass directly upward through the annular sleeve 3 to the parachute thus obviating the danger of the air blast disarranging or entangling the guy ropes but it will be directed more positively toward the center of the folded parachute to eject the folds rapidly but progressively from the center toward the periphery as shown by the dotted position of the cover indicated in Fig. 1 thereby obtaining the maximum "extending" effect of the compressed air before the final folds of the parachute cover are released.

Various methods may be adopted for retaining the final folds of the parachute until the maximum effect of the compressed air is exerted upon the cover. In Fig. 1 I have shown a sleeve 6 preferably of rubber having a thickened edge or lip 7 to which is attached a sleeve or lining 8 provided with

a thickened edge 9. The plaited and folded cover is thus held between the two thickened edges which with the intervening sleeve exert a restrictive pressure on the cover. With such a construction when the air is admitted it increases the restrictive pressure due to the elasticity of the sleeve 6 and enters between said sleeve and the sleeve or lining 8 pressing the latter against the parachute cover 10 and maintaining a tight frictional joint as the interior folds of the parachute cover are projected the inner sleeve or lining 8 following upward and being finally peeled off during this operation. The nest box may be provided with apertures 11 having appropriate covers 12 whereby the various spooled cords may be arranged by hand in the correct position.

In order to prevent the compressed air prematurely escaping upward through the central fold of the parachute and out through the air hole 13 with which most parachutes are usually provided at or near the apex, I may temporarily secure the base of the first fold of the cover such as by inclosing it in a cap 14 of suitable material and retain said cap in position by a rubber ring thereby preventing escape of compressed fluid. As the cover expands said cap 14 will be automatically stripped off.

Fig. 3 shows an alternative form of lining so arranged that the compressed air admitted to the nest box enters between the lining and the wall of the nest box so causing the air pressure to assist in frictionally engaging the parachute cover said lining peeling off from the outside fold of the cover as it is ejected. Appropriate clips 15 preferably of rubber may be provided to hold the spooled guy cords in correct position.

It will be apparent that when a parachute is folded or nested in a box or casing carried by an aeroplane and is adapted to be rapidly expelled or projected from said nest box by the admission thereto of a fluid under pressure the greater the quantity of air and the more rapidly it is introduced the sooner will the parachute be projected from its nest and if use can be made of the external air the weight of the compressed air and the vessel containing it can be greatly reduced. In accordance with my present improvements therefore I provide an injector device in connection with the pipe supplying the fluid under high pressure to the nest box or container and to the interior of the cover of the parachute whereby as said fluid is admitted atmospheric air will be drawn in so that a large quantity of air will be introduced into the nest box or container this instantaneously projecting the parachute clear of said nest or container. One such construction is shown in Fig. 1 the injector there illustrated comprising a nozzle 16 adapted to be connected to the pipe for

the supply of the compressed air and having a flange 17 upon which are supported by means of the guide rods 18 a plurality of annular members 19 maintained in spaced relation to each other by the springs 20. Mounted in the interior of the injector device is a preferably conical member 21 serving to evenly direct the air under pressure issuing from the nozzle 16 and to facilitate the injection of the external air drawn in through the spaces between the aforesaid annular members 19. The uppermost annular member 22 is so mounted as to project within the nest box or container 23 and is provided with a flange 24 supported by springs 25 from the bottom of the nest box said flange 24 being connected to the bottom of the box by an annular flange 26 of rubber or leather so as to constitute an air tight diaphragm. By constructing the injector in the manner above described it will be seen that in the event of the nested cover of the parachute offering any considerable resistance to projection the accumulated pressure of the air within the box will be exerted upon the aforesaid annular member 22 depressing it against the resistance of its springs 25 and as said member moves downward the spaces between the other annular members 19 will be reduced or altogether closed until the high pressure air issuing from the nozzle overcomes the resistance of the parachute cover when the pressure within the box being suddenly reduced the parts will be automatically returned to their normal position and the injector again become operative.

In Fig. 2 I have illustrated a modified form of injector device comprising a Venturi pipe 27 into which the nozzle 16 projects a non-return valve 28 being provided to close the air intake aperture in the event of the parachute offering any considerable resistance to projection.

The injector device may be appropriately secured to the nest box as shown or I may attach it to a tube leading into a folded parachute as shown in Figs. 3 and 4 of my aforesaid prior specification or to the ring to which the guy ropes of the folded parachute are secured in which case the compressed air or other fluid will be introduced directly into the interior of the parachute to positively expand it.

In a further modification of my invention I so arrange that the parachute may be projected in a solid mass from a cylindrical casing and in contradistinction to the arrangement illustrated in Fig. 1 take precautions to eliminate as far as possible frictional contact between the casing and the parachute and I also provide means for preventing the parachute cover expanding in its passage through the air until projected to a sufficient height above the aeroplane.

Referring now to Fig. 4 which illustrates this form of my invention the parachute 10 is plaited and folded to a more or less elongated or "projectile" form and a light cap 29 which may be of elastic material is provided to envelop the head or nose thereof being retained in position thereon by friction. The parachute thus arranged is placed in the cylindrical container 30 the guy ropes being suitably coiled or otherwise disposed as to avoid entanglement when the parachute is projected and the ring 1 mounted in the cradle 2 as described with reference to Fig. 1. The bottom of the container 30 is preferably provided with an air injector device but as such device has been described in detail with reference to Figs. 1 and 2 further explanation thereof will be unnecessary.

Upon admission of the compressed air the parachute 10 will be rapidly ejected from its container 30 the cap 29 remaining in position until the parachute cover which in mass is arrested by the sudden strain exerted through the guy ropes by the resistance of the weight of the aviator to whom of course the rope of the parachute is attached. As the parachute will be retained in its plaited and folded condition until such sudden strain is exerted on it the whole of the guy ropes and rigging will be in tension at that moment with the consequence that the cap 29 will be thrown off and the parachute cover will "break" and expand to enable the aviator to descend safely to the ground.

A cap similar to the cap or cover 29 may be provided to inclose the lower portion of the folded and plaited parachute and the guy cords or stated another way the cover guy cords and associated parts may be inclosed in a two part shell or casing of suitable light material and projected as above described. When the guy ropes reach their limit of movement the two-part shell or envelop will separate and the plaited and folded cover will be pulled from within the upper cap and expanded by the air in momentum following the projectile.

Referring again to Fig. 1 it will be seen that the parachute rope 31 provided with arm slings 32 is attached to a stirrup piece 33 the cross piece of which is so constructed as to fit into and form part of the main seat 34 of the aeroplane being retained in position by a locking rod 35 passing through a depending lug on the cross piece adapted to be actuated when the lever 36 for admitting the compressed air to the nest box is operated as is fully explained in my prior specification hereinbefore referred to. This cross piece, of course, constitutes a seat device when the parachute only is in operation as shown in Figs. 12 and 13.

The progressive operation of a parachute for use with aeroplanes constructed and op-

erating as hereinbefore described with reference to Figs. 1 and 2 will be readily understood by an inspection of the various diagrams constituting Figs. 12 and 13.

It is well known that a manila hempen or other rope or cord the strands of which are laid spirally as is usual in the manufacture thereof is very liable to develop kinks when unwound after being coiled and as it is of primary importance that the danger attendant upon the kinking or entanglement of any ropes or cords employed in a parachute should be obviated I contemplate employing woven or plaited flat tapes for the rigging and all other purposes where cords or ropes are indicated and throughout this specification where the term "cord" or "ropes" is employed it is to be understood that "tapes" is included in that expression. By the employment of flat tapes not only are the disadvantages just pointed out obviated but they lend themselves readily to being spooled or packed into a relatively small space. Fig. 5 illustrates a convenient method of arranging such tapes wherein they are shown as being laid in folds and inclosed in a waterproof paper or light cardboard box 44.

A further and important feature of my invention consists in the method of preparing the parachute cover for insertion in the nest box described with reference to Fig. 1 or the cylindrical casing illustrated in Fig. 2 for it will be apparent that to obtain certainty of expansion of the parachute under these conditions the cover must be very carefully folded and plaited before it is placed in the nest box or cylinder in order that there may be no frictional or other obstacles in the way of its rapid expansion at the proper moment. To facilitate such symmetrical plaiting and folding I provide the cover 10 with appropriate indicating marks such as shown at the right or the left hand portions of Fig. 6 the right hand portion being marked with straight radial lines and concentric circles while the left hand portion indicates an alternative form of marking consisting of zig-zag concentric markings and broad radial markings. By gathering up the material of the cover between such marks it may be plaited and folded with great accuracy. Such indicating marks preferably consist of radial lines 45 and concentric markings 46 on the cover in a suitable color or colors. The cover thus marked is plaited by gathering up the parts A—B—C making one plait the parts A and C being sub-plaited and housed under the portion B. This operation is repeated for the whole circumference of the parachute appropriate spring clips 47 as shown in Fig. 7 (which shows a slightly different form of fold) being inserted lengthwise between the plaits and then turned crosswise and released so as to hold

the plaits in position until the plaited cover is ready for folding which latter operation is performed by the aid of the concentric markings 46.

5 It will be appreciated that to effect such aforementioned plaiting and folding of a parachute cover of any size by hand would be a more or less lengthy and difficult operation and I therefore provide apparatus  
10 whereby this may be expeditiously and efficiently performed.

Referring now to Fig. 8 the parachute cover 10 is suspended by a rope or cord passing over a pulley 48 whereby it may be progressively lowered as the folding proceeds and the guy ropes of the cover are stretched tightly such as by passing under pulleys 49 and being then secured in any suitable manner. Beneath the cover a platform 50 is arranged adapted to be raised or lowered such as by a "lazy-tongs" contrivance 51 operated by the screwed spindle 52. The platform 50 is provided with a plurality of annular concentrically arranged walls 53 and above the  
25 parachute and adapted to be lowered and raised such as by cords passing over suitable pulleys I provide a plurality of annular concentrically arranged forming members 54 adapted to be lowered one by one to force  
30 the material of the parachute cover into the spaces between the walls 53 of the platform 50.

In Fig. 9 I have shown a modified form of platform comprising concentric portions 55 each carrying an annular wall 53. Each annular portion 55 constituting the platform is connected by means of arms 56 with a collar 57 adapted to slide upon a central pillar 58 and each pair of supporting arms 56 is connected by a pair of rods *a, b c d e* by means of intervening laterally extending crank arms (not shown) with tubular shafts mounted upon a spindle 59 supported by appropriate standards 60. The pair of levers for the arms *a* are keyed directly to the spindle 59 which is provided with a handle 61 whereby the spindle 59 may be partially rotated thus lowering the outermost annular portion 51 of the platform. Each of the remaining pairs of rods *b c d e* are connected by levers similar to those operating the arms *a* said levers being keyed to the tubular shafts *f, g, h, i*, mounted on the spindle 59 and each tubular shaft is provided with a handle similar to 61.  
55

The operation of a device constructed as illustrated in Fig. 9 is as follows: The parachute cover being suspended above the platform 55 and the annular concentrically arranged forming members 54 being also arranged as in the construction shown in Fig. 8, the cover is plaited radially and then the outermost of said members 54 is lowered to force the material of the cover 10 into the space between the walls 53 and 53' of the  
60 65

platform 55. The portion of the platform 55 carrying wall 53 is then lowered by operating the handle 61 and the fold of the parachute lightly secured such as by tying a thread around it. The succeeding forming member 54 is then lowered to form another fold and so on in like manner until folding of the cover is completed.

A further feature of my invention consists in the provision of means whereby when 75 a parachute is projected from a nest box or container as hereinbefore described the ejection and opening thereof may be assisted by aerial friction and oscillation of the expanded parachute during descent lessened 80 as much as possible.

In Figs. 10 and 11 I have shown the cover 10 as being provided with a plurality of air pockets arranged in concentric circles or otherwise around the outer surface of the 85 cover. These pockets may be constituted by bands of canvas 62 stitched or otherwise secured to the cover 10 and retained by tapes 63 (Fig. 11) in such a manner that as the parachute is ejected from its nest box the 90 relatively rapidly moving current of air will enter such of the pockets as are successively uncovered thus increasing the speed of the projection into the air. These pockets also serve to diminish oscillation of the parachute for the reason that as the parachute 95 tilts to one side such pockets will be opened by the opposing current of air while those pockets on the opposite side of the cover will lie more or less flat thus producing increased resistance and leverage. 100

What I claim is:

1. In combination with a nesting parachute having radial and concentric foldings, a nest box, and an injector device attached 105 to said nest box provided with an automatic pressure regulator.

2. In combination with a folded parachute, an open ended nest box and an injector device attached to said nest box provided with an automatic pressure regulator. 110

3. In combination with a folded parachute, an open ended nest box and an injector device attached to said nest box provided with an automatic pressure regulator 115 said pressure regulator comprising a Venturi tube having at one end an annular seat attached to the casing of the nest box and at the other a spring engagement and an inlet annulus concentric with the venturi. 120

4. In combination with a nesting parachute cover, an open ended nest box, an air injector device attached to one end of the nest box, and a spaced sleeving attached to said nest box and encircling said nested parachute cover, adapted to be projected outward with the parachute on operation of the air injector device. 125

5. In combination with a nesting parachute cover, an open ended nest box, an air 130

injector device attached to one end of the nest box, and a spaced sleeving attached to said nest box and encircling said nested parachute cover, adapted to be projected outward with the parachute on operation of the air injector device, said sleeving having an enlarged beading at the axial extremes adapting it to hold the nested parachute within the casing or nest box.

6. In combination with a nested parachute a nest box for said parachute, nested guy ropes for said parachute, a holding annulus attached to the nest box and concentric therewith devices on the annulus for holding the guy rope ends in relation to the parachute, an air injector device, said holding annulus serving as an air shield or baffle for the guy ropes by having the nested guy ropes attached thereto out of line of the ejecting air.

7. In combination with a nesting parachute having radial and concentric foldings, a nest box, and an injector device attached to said nest box.

8. In combination with a nesting parachute, an open ended nest box for said parachute and an axially arranged injector associated with the nest box, said injector comprising an inlet for compressed air, an air spreader adapted to direct the air currents to the outer folds of the nested parachute, and inlets about the air spreader for air at atmospheric pressure.

9. In combination with a nesting parachute having radial and concentric foldings, a nest box, and an injector device attached to said nest box provided with an automatic pressure regulator and a cap device for cov-

ering the central portion of the folded parachute.

10. A parachute cover adapted to be folded radially and circumferentially having radial and concentric markings for indicating the foldings of said cover and concentrically arranged external air pockets having tapes to limit the possible opening of said pockets.

11. In combination with a nesting parachute an open ended nest box for said parachute and an axially arranged air injector comprising an air spreader device to direct the air to the outer folds of the nested or folded parachute within said nest box.

12. A parachute cover adapted to be folded radially and circumferentially having radial and concentric markings for indicating the foldings of said cover a rope attached to the parachute, arm supporting loops on said rope and a seat device attached to the farther end of the rope.

13. In combination with the fuselage of a flying machine, a nest box, a nested parachute within said nest box, an air injector device attached to the nest box having an automatic pressure regulator, a rope attached to the parachute having arm supporting loops, a fixed seat in the fuselage, a detachable seat in coöperation therewith and attached to the farther end of the parachute rope, and a manually operated detaching device for the detachable seat having means for simultaneously ejecting the parachute from the nest box.

E. R. CALTHROP.

Witness:

A. E. WHITE.