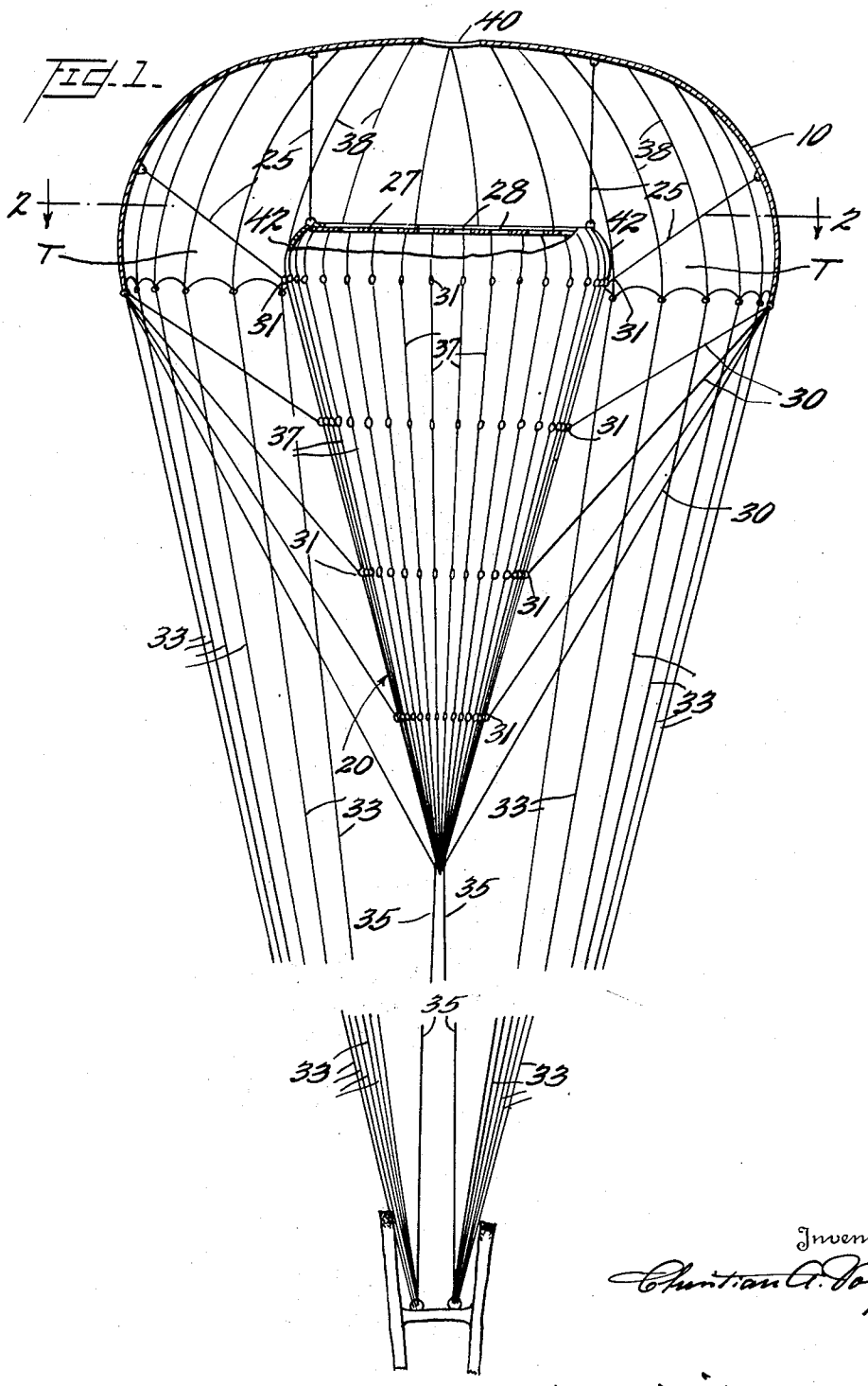
Feb. 22, 1944. C. A. VOLF 2,342,384

PARACHUTE

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FIG. 1.



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PARACHUTE

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FIG. 2.

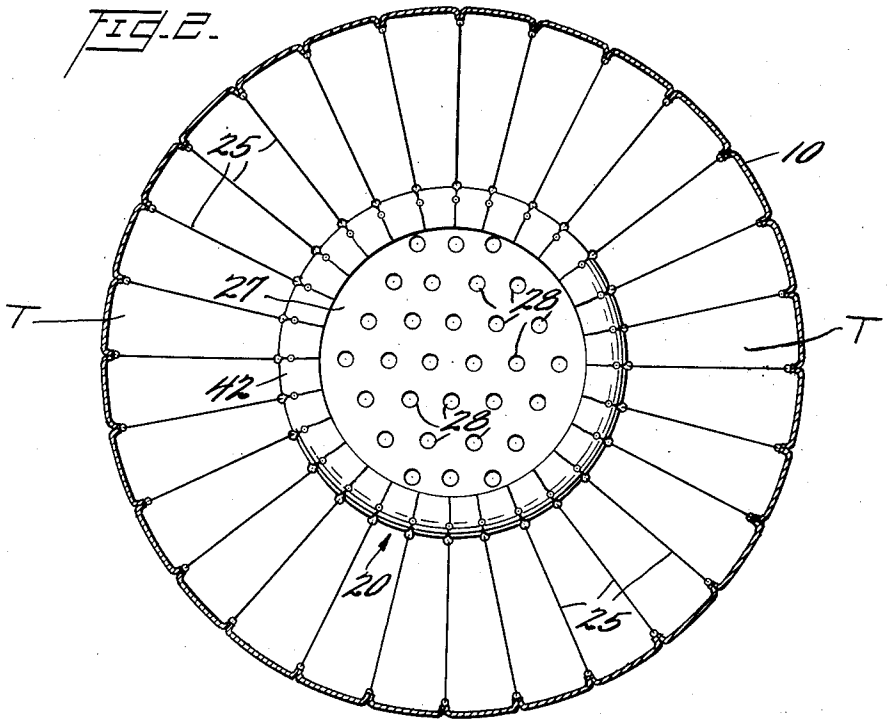
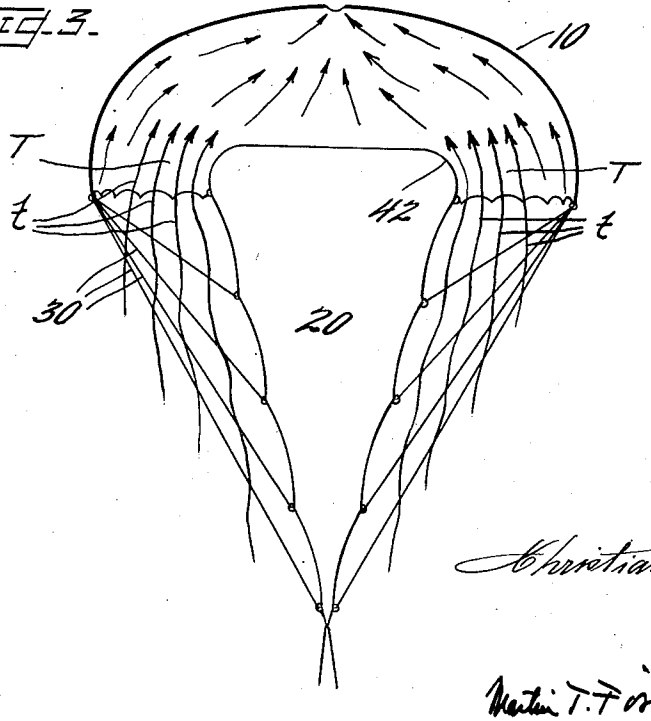


FIG. 3.



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PARACHUTE

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Application March 11, 1941, Serial No. 382,795

5 Claims. (Cl. 244—142)

This invention relates to parachutes hereinafter sometimes referred to as "chutes."

Among the objects of the invention is to modify the conventional canopy-type parachute whereby the buoyancy afforded by the chute will be materially increased, and whereby a much smaller chute may be used to permit the same load to descend through the air at substantially the same speed as that afforded by the present conventional chute. Further objects are to provide greater stability in descending; to ease the shock of opening of the chute on the chutist; and to save material in manufacturing the chute; and to provide a chute that will open with certainty when it is supposed to open.

The invention comprises the combination of a canopy-type parachute with an air deflecting member, preferably a cone-shaped element, suitably attached to said canopy-type parachute whereby the beneficial features of the cone and the canopy are compounded to produce a parachute, which size for size is superior to the conventional canopy-type chute for reasons explained in the following.

It is known that a cone in descending through the air, point foremost, offers a resistance equal to the resistance of a flat plate of a diameter equal to the diameter of the base of the cone and therefore serves as a parachute. The canopy-type parachute and its properties are well known. However, the applicant has discovered that the combination of a cone-type chute with a canopy-type chute produces highly beneficial and unexpected results, whereby a far greater sustaining force is produced as compared with the canopy chute by itself when a cone of the proper size is combined with a canopy-type chute of usual size. The diameter of the canopy chutes in use today varies from 22 to 28 feet in most instances, a commonly used size being about 24 feet. Such a chute will readily sustain a body up to about 200 pounds and permit descent through the air at the rate of about 10 miles per hour. Greater speed results in too severe a shock in landing. By using the combination of a cone similar to that illustrated, with a canopy arranged over the mouth of the cone, the canopy may be only about one-half, or less, the diameter of the conventional present day canopy chutes intended to sustain a single person and the new chute will not descend any more rapidly than said present day chute.

Furthermore, the present canopy-type chute upon opening and billowing outwardly to operative position results in a terrific shock to the chutist and checks descent abruptly. In contradistinction to this, the improved chute herein described and illustrated has the further advantage of easing and decreasing the effect of the shock of opening due to the gradual building up of pressure due to air particles moving upwardly along the surface of the cone.

Due to the aerodynamic characteristics of the cone, the parachute of this invention will descend much more nearly vertical, with much less lateral drift than the conventional canopy-type chute.

It is a known fact that, for a given load, the velocity of descent depends on the size and shape of the canopy or sail. The present invention has utilized a materially changed shape in the aggregate to produce the advantages set forth.

In the drawings, which form a part of the present application:

Figure 1 illustrates a fragmentary side elevation, partly in section, of the improved chute in expanded position;

Figure 2 is a sectional view on the line 2—2 of Fig. 1; and

Figure 3 is a view similar to Fig. 1, showing the theoretical air flow.

In the preferred embodiment of the invention as illustrated in Figure 1, a canopy-type chute is provided, which in the position of operation assumes substantially the shape shown, which, in cross section is substantially circular. The air deflecting member **20** shown in the present preferred embodiment is substantially a cone, preferably substantially circular in cross section. The cone is connected to the canopy by suitable shroud lines **25** affixed to the upper portion of the member **20**. The canopy **10** is shown in section whereas the air deflecting member **20** is shown in full side elevation with the upper portion partly in section; a closure member **27** is affixed to the upper portion of member **20**, said closure member being provided with apertures **28** for equalizing the air pressure on the opposite sides of the member **27**. These apertures also permit inflow of air to the interior of member **20** upon the same becoming opened from folded position.

In descending, the canopy will be billowed outwardly as illustrated. In the preferred embodiment, the member **20** may be formed of material similar to that of the canopy, such as the popularly used fabrics of today, such as silk, cotton, pongee and "nylon" or any other suitable material. However, either the canopy or the cone, or both, could be made of rigid material if de-

sired. It will thus be seen that in descending, the member **20**, being formed of readily flexible material in the preferred embodiment, would have a tendency to collapse due to air pressure exerted against the outer sides. Accordingly, supplementary shroud lines **30** are attached at various points on the cone, and to the edge of the canopy, whereby air pressure exerted against the canopy and holding the same in billowed position will hold the sides of the member **20** substantially in the expanded position as shown. The shroud lines **30** may be secured to the member **20** by suitable loops **31** or reinforcing patches and the air pressure in acting against the sides of the member **20** will probably tend to curve the sides inwardly particularly between the loops **31**, whereby the configuration of the member **20** will assume somewhat the shape illustrated in Figure 3 in side elevation, that is, the sides between the rows of loops **31** will be curved inwardly.

The load imposed on the composite chute is partially suspended by conventional shroud lines **33**, shown in Figure 1, the load not being illustrated since it is merely the conventional load carried by a chute. Shroud lines **33** are fastened to the harness fixed to the load. To hold the downward end of the member **20** in proper position, and also to partially sustain the load, supplementary shroud lines **35** are fixed to said end and extend downwardly to be fixed also to the harness carried by the load. For purposes of clearer illustration the shroud lines **25**, **30** and **35** are shown on the drawings to illustrate one complete set only arranged on opposite sides of the assembly and are those which would appear on any vertical section through the middle of the said chute assembly. It is to be understood that a similar set of shrouds is affixed to each seam **37** joining together the various sections forming the member **20**. Furthermore, in the preferred embodiment, the number of sections forming the member **20** correspond to the number of conventional sections forming the canopy **10**. Therefore, the number of seams **37** in the member **20** will correspond to the number of seams **38** in the canopy **10** and each pair of seams **37** and **38** will preferably have a set of shroud lines, similar to **25**, **30**, and **35** as shown in Fig. 1, connected therebetween. It is to be understood, however, that a fewer number of pairs of seams **37** and **38** may also be connected by the shroud lines within the scope of this invention.

Furthermore, additional supporting lines to assist in maintaining the proper shape of member **20** may be added between the connecting loops or patches **31** and the shroud lines **33** for example, by arranging them more or less perpendicularly to the lines **33** when drawn taut.

The canopy is provided with an air exit opening **40** preferably substantially in the center of the top thereof, this opening being much smaller than the base of cone **20**.

The air deflecting member **20** is arranged with its base or upper edge extending somewhat above the horizontal plane defined by the lower edge of the canopy **10** when in operative position, as clearly shown in the figures. If the diameter of the canopy is 24 feet, the base of the cone extends above such plane about one foot. This distance would vary somewhat for different sized canopies. Furthermore, in the preferred embodiment, the upper end of the air deflecting member **20** is curved inwardly as shown at **42** to facilitate the passage of air around said upper edge. The outer edge of the base of cone **20**, and the lower edge of canopy **10**, define between them an annular air inlet throat T, at about the level of the outer edge of the canopy, into which air is forced or crowded by the deflecting effect of the cone, thereby increasing the air pressure and consequently its velocity. The cone having substantially straight sides, this high velocity air, passing through throat T, as indicated by the arrows *t*, Fig. 3, flows smoothly and rapidly upwardly toward the underside of the canopy, pressing against the canopy and being deflected thereby inwardly and toward the air exit opening **40**.

The standard parachute used today is designed to withstand the shock incurred by opening with a 200 pound load while traveling at a speed of 300 miles per hour. It is also designed to permit the descent of said load with a landing speed of approximately 10 miles per hour or, roughly, 18 feet per second. When the applicant's chute is descending at a vertical speed of substantially 10 miles per hour, the still air mass, due to the cone **20** moving through it, is caused to move upwardly and outwardly into and through annular throat T at far greater velocity than the velocity of descent of the cone **20**, whereby when the air reaches the upper end of the cone **20**, and is forced thereby into annular throat T this upward velocity will be several times that of the velocity of descent. This rapidly and upwardly moving air exerts a buoyant force on the canopy. Upon reaching the upper part of the deflecting member **20**, the air, as a result of the shape of the canopy **10**, is deflected around the curved portion **42** of the member **20** and is directed generally toward the air exit opening **40** in the canopy.

The sustaining force of a cone is substantially equal to the flat plate resistance corresponding to the area of the base of the cone. It will thus be seen in the present embodiment that this sustaining force is utilized as well as the enhanced sustaining force of the canopy **10**. The air rushing past the sides and mouth of the cone **20** with a velocity of that of descent multiplied several times, produces a distinct and positive upward drag of air directed toward the canopy. This force is utilized in addition to the foregoing two forces whereby the resulting combined sustaining force of the entire chute assembly is a summation of these three factors.

This phenomenon is illustrated in Fig. 3 wherein the paths of the air currents are shown by the arrows as moving past the surface of the air deflecting member **20** which, in the present preferred embodiment, has been illustrated as a circular cone. Compound wind pressures produced by the sides of the cone **20** form air currents of relatively high velocity at the mouth of the cone directed toward the top of the canopy and produce a lifting effect over the cone in the direction of the canopy. The cone causes the air to build up from zero to a velocity several times the speed of descent of the chute, while the canopy compresses this rapidly moving air directed toward it from the sides and upper edge of the cone and breaks down this air speed so that in effect the canopy may be said to act as a resistor and concentrator for the air deflected toward it, not only by the cone **20** but also the still air naturally encountered by the canopy upon descent.

A cone tends toward a straight downward de-

scent. A conventional chute drifts laterally rather too readily. While perhaps some lateral drift would take place with a horizontal wind, this lateral drift is greatly lessened with applicant's chute, as compared with a conventional chute. By the present combination of the air deflecting and resisting member **20**, shown as a cone, and the canopy **10**, there is produced a chute which will descend more nearly vertically, with much less lateral drift, than with the conventional chute. This is due mainly to the fact that when horizontally moving air encounters a downwardly descending cone, there is a tendency for the air to curve around the cone and not materially affect the vertical travel of the same.

While in the preferred embodiment of the invention the air deflecting member **20** is shown to be cone-shaped, it is within the contemplation of the invention to use other air deflecting members that will have a similar function, namely, that of deflecting air diagonally upwardly and outwardly toward the canopy.

As a modified construction the air deflecting member **20** may be open at the top, thus eliminating the closure member **27**.

While the invention here involved is not limited to particular proportions of parts, nevertheless, in the present preferred embodiment of the invention the vertical height of the cone is about equal to the diameter of the canopy when in expanded position. Furthermore, the diameter of the base of the cone is about half the diameter of the canopy when in expanded position and is about equal to the distance between a horizontal plane tangent to the top of the canopy and a horizontal plane defined by the lower edge of the canopy, when it is in expanded position.

However, it should be distinctly understood that the invention is not limited to the proportions just set forth, the invention being in the combination of structural features, rather than in particular proportions of parts. Furthermore, statements of wind velocities, etc., are given to the best of applicant's knowledge and belief, but are illustrative and not restrictive of the invention.

The main advantages derived from the present construction reside in the production of a far greater sustaining force, area for area, than that present in the conventional canopy type chute. Thus, where the standard chute is of a diameter from 22 to 28 feet to permit the proper descent of a chutist of load of 200 pounds at a vertical speed not to exceed 10 miles an hour, a chute of half the diameter of less than that of the conventional chute may be used to permit the descent of the same size load under equivalent conditions. On the other hand, if a standard canopy type chute is modified to include the features of the present invention, loads of as much as three or four times the present permissible loads may be afforded satisfactory descent within the present regulations. As a corollary to these advantages, a saving in material is afforded in the construction of chutes made in accordance with the present invention as distinguished from the conventional canopy type chutes in considering equivalent total buoyant forces produced by the respective chutes.

In operation, the canopy and the cone member **20** interact so that each tends to open the other. As the canopy starts to expand at the beginning of the descent it tightens the shroud lines so as to open the cone member; the cone member, as it opens, directs air upwardly and outwardly under the canopy and tends to billow it outwardly. In other words, the cone member acts somewhat as a pilot chute in opening the canopy and the canopy acts to open up the cone member.

A further advantage resides in the fact that when a smaller chute, made in accordance with this invention, is used to sustain the same size load as a larger chute of conventional construction, shorter shrouds may obviously be used with the corresponding lessening of danger of entanglement of the shrouds upon the chute opening.

The known desirable requirements of a parachute which should be retained or improved are:

1. Rapidity of opening;
2. Safe velocity of descent;
3. Minimum shock imposed upon the chutist by the opening of the chute;
4. Safety factor in construction; and
5. Stability.

The foregoing requirements are satisfactorily met by chutes constructed in accordance with this invention so that none of these requirements are impaired but, on the contrary, these requirements have been improved in a number of instances, particularly with respect to the increased safety and the minimizing of the shock of the opening of the chute as it affects the chutist.

While this invention has been described in connection with a chute of the canopy type, circular in cross section, it should also be understood that it may be applied to other types and shapes of canopy chutes, one example of which is the triangular chute.

The foregoing description of the present preferred embodiment of the invention is by way of illustration only, and it should be understood that the invention may be carried out in other ways.

I claim as my invention:

1. In combination, a parachute of the canopy type provided with an air exit opening substantially in the top thereof, and a substantially cone-shaped member having straight sides and being rounded inwardly and upwardly at the base, said cone shaped member being positioned and held under the canopy with its base below said opening and its apex pointing downwardly, the base of the cone being formed by a diaphragm member extending thereacross.

2. In combination, a parachute of the canopy type provided with an air exit opening substantially in the top thereof, and a substantially cone-shaped member having straight sides and being rounded inwardly and upwardly at the base, said cone shaped member being positioned and held under the canopy with its base below said opening and its apex pointing downwardly, the base of the cone being formed by a diaphragm member provided with air openings therein.

3. In combination, a parachute of the canopy type, provided with a centrally positioned air exit opening in the top thereof, a substantially cone-shaped air deflecting member having straight sides and positioned under said canopy with its apex pointing downwardly, the base of the cone extending upwardly a substantial distance into the canopy, the base of the cone being formed by a perforated diaphragm.

4. A parachute comprising a canopy having at the central top portion thereof a relatively small air exit opening, and a conically shaped air deflecting member having substantially straight sides, positioned centrally below said air exit opening with the apex of the cone pointing down-

wardly, the base of the cone member being within the canopy at about the level of the outer edge of the canopy when it is in expanded position, and being much larger than said air exit opening, the outer edge of the base of the cone and the outer edge of the canopy defining between them an annular air inlet throat into which air is forced by the cone at a velocity much greater than the velocity of descent of the parachute, the air flowing smoothly into said throat and being directed by the cone in an upward direction against the underside of the canopy, and being then directed by the canopy toward and out of said central air exit opening.

5. A parachute comprising a canopy having at the central top portion thereof a relatively small air exit opening, a conically shaped air deflecting member having substantially straight sides, positioned centrally below said air exit opening with the apex of the cone pointing downwardly, shroud lines interconnecting the base of the cone member and the underside of the canopy, between the outer edge of the canopy and the air exit opening, the base of the cone member being within the canopy at about the level of the outer edge of the canopy when it is in expanded position, and being much larger than said air exit opening, the outer edge of the base of the cone and the outer edge of the canopy defining between them an annular air inlet throat into which air is forced by the cone at a velocity much greater than the velocity of descent of the parachute, the air flowing smoothly into said throat and being directed by the cone in an upward direction against the underside of the canopy, and being then directed by the canopy toward and out of said central air exit opening.

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