Dec. 19, 1944. W. A. BADOWSKI 2,365,445

AUTOMATIC MEANS FOR OPENING PARACHUTES

Filed March 19, 1942 2 Sheets-Sheet 1

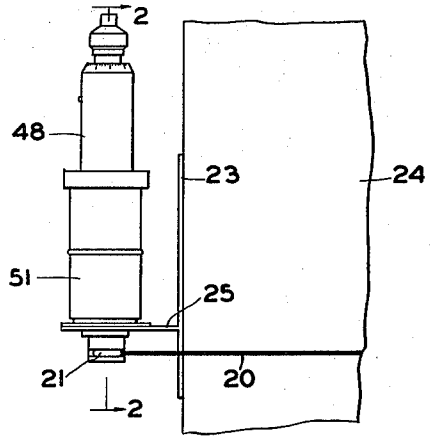


FIG.-1

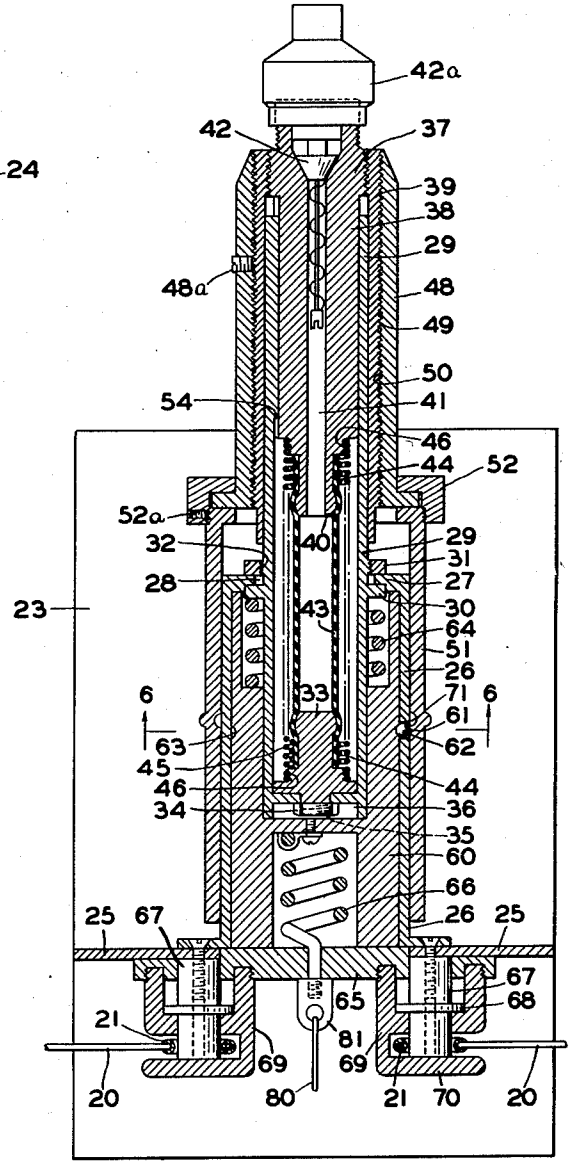
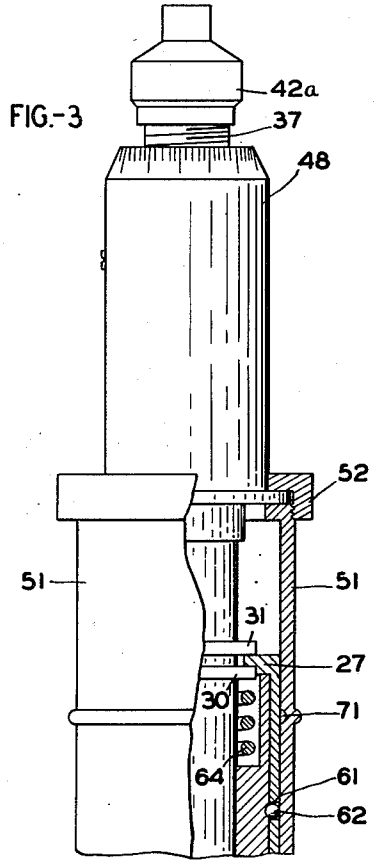


FIG.-2

FIG.-3



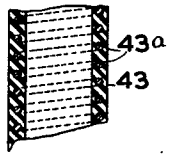


FIG.-2a

INVENTOR
WITOLD A. BADOWSKI
BY Hyde and Mayo
ATTORNEYS

Dec. 19, 1944. W. A. BADOWSKI 2,365,445

AUTOMATIC MEANS FOR OPENING PARACHUTES

Filed March 19, 1942 2 Sheets-Sheet 2

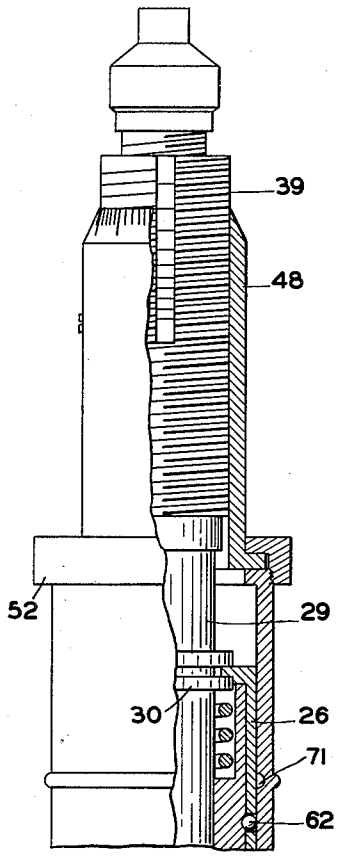


FIG.-4

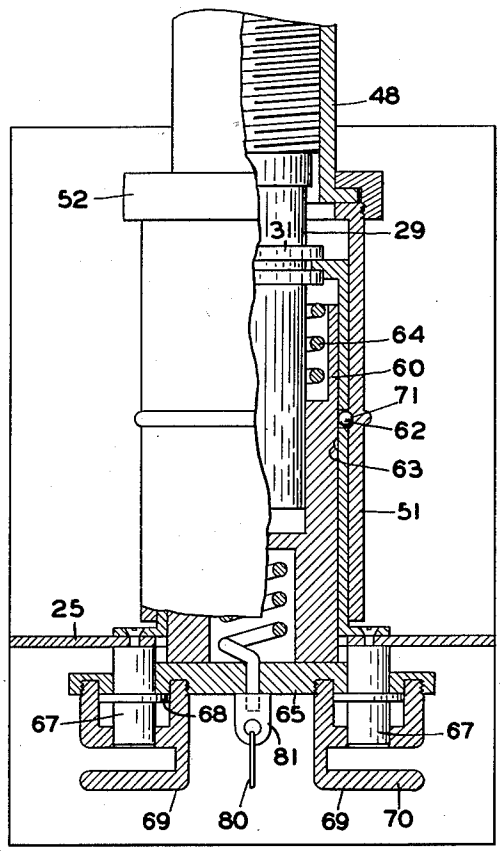


FIG.-5

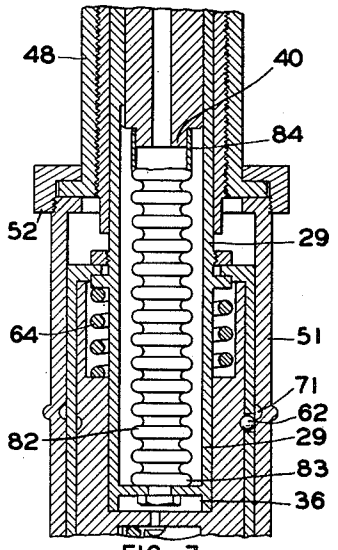


FIG.-7

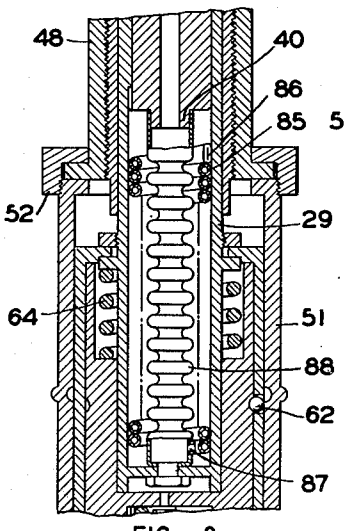


FIG.-8

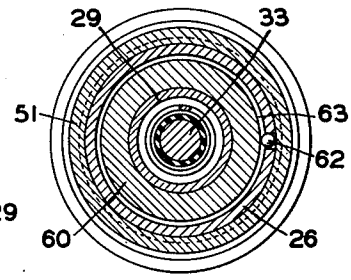


FIG.-6

INVENTOR
WITOLD A. BADOWSKI
BY Hyde and Mazer
ATTORNEYS

Patented Dec. 19, 1944 2,365,445

UNITED STATES PATENT OFFICE

2,365,445

AUTOMATIC MEANS FOR OPENING PARACHUTES

Witold A. Badowski, Cleveland, Ohio

Application March 19, 1942, Serial No. 435,257

11 Claims. (Cl. 244—150)

The invention relates to automatic means for causing a parachute to open within a predetermined elevation zone, and it is particularly directed to a control means for effecting this purpose, which means is responsive to variations in atmospheric pressure resulting from change in altitude above sea level or ground level.

As is well known to those skilled in the art of aerial navigation there are a number of occasions, in both civilian and military air travel, when it is extremely desirable that some means be provided for automatically opening a parachute at some approximate definite level above the ground. It might, for instance, be an occasion when an aviator intends to drop a package of food, or medicine, or ammunition, or other commodity, and when it is undesirable that he descend to a low altitude, either because of enemy fire or because of the loss of time and the fuel consumption required to again reach his previous flying level. It is nevertheless a fact that if the package be dropped from a high level, with parachute open, or in condition to open immediately after release from the airship, the accuracy with which the package can be dispatched to its objective may be very materially affected both by the initial velocity and direction of air currents, and by frequent shifts in such velocity and direction at various altitude levels. From this brief discussion it is obvious that it would be most desirable that the package descend as far as is safely convenient while the parachute is still closed, since in this way it is at least liable to be responsive to the disturbing effect of air currents. Such a procedure obviously requires some device for opening the parachute at a minimum but safe level.

It is further well known that aviators are sometimes required to leave their ship at a considerable altitude, either voluntarily or involuntarily, yet, by reason of shock, wounds, or other causes, they are incapable of manipulating the ordinary parachute controls. In this instance also some form of automatic control is desirable. Other instances suggesting or requiring the use of automatic parachute control will probably occur to those skilled in the art.

An aviator equipped with such a device should nevertheless be enabled to exercise a personal control of his parachute, if some valid reason for such control should occur to him while dropping so that it is further desirable that a manual control be provided to supersede the automatic control at any time prior to the operation of said automatic control.

One object of the invention therefore is to provide an automatic device, operative at a predetermined height, for opening a parachute which is being used to lower packages or similar inanimate objects from airships.

Another object is to provide a device of this nature for a parachute carried by an air traveler, which device can be set before leaving the airship, and which will operate to permit opening of the parachute even if the jumper is wounded, or unconscious, or otherwise incapable of manipulating the parachute controls in the ordinary way.

Another object is to provide a device such as is mentioned in the last preceding paragraph, which is provided, in addition to said automatic control, with another control responsive to manual operation, whereby the jumper may cause the parachute to open at any desired point in his fall, prior to arrival at the level at which the automatic control operates.

Other objects and advantages will be apparent to those skilled in the art on consideration of the following description, in conjunction with the attached drawings in which

Fig. 1 is a side elevation of a parachute pack equipped with an automatic control such as herein described.

Fig. 2 is a vertical section through the control apparatus, taken on the line 2—2 of Fig. 1, showing the relationship of the various elements thereof approximately as they appear at ground level.

Fig. 2a is a fragmentary view in section, and somewhat enlarged, of a part of the apparatus shown in Fig. 2, slightly modified.

Fig. 3 is a fragmentary front elevation, partly broken away to show, in section the relationship of certain of the control parts at a substantial height above ground level.

Fig. 4 is a view similar to Fig. 3, but showing the parts reset for automatic operation.

Fig. 5 is a view showing the relationship of certain control parts when the atmospheric pressure reaches the preset value at which the control functions to permit parachute opening.

Fig. 6 is a section taken on the line 6—6 of Fig. 2.

Figs. 7 and 8 show, respectively, two additional embodiments of a pressure sensitive chamber.

Before proceeding to a detailed description, it may be of assistance in a comprehension of the invention to state that the automatic control herein involved is based on the volumetric changes of a hollow or otherwise chambered device responsive to variations in atmospheric pressure on an external surface of said device. It is well known

that atmospheric pressure gradually and continuously drops at respectively higher altitudes and the present invention takes advantage of this phenomenon by means of its effect on a gas filled, leakproof, expansible chamber which volumetrically responds to such variations in external pressure.

Since the average atmospheric pressure at sea level, under standard temperature conditions, is about 14.7 pounds per square inch, and at a height of 18,000 feet is still about 7.3 pounds per square inch, it is apparent that a device sensitive enough to be controllable within fractional increments of altitude, represented by corresponding changes in fractions of a pound of pressure, must be constructed with considerable accuracy and must be sensitive to minute pressure changes. It is desirable that a control device of the desired sensitivity should not be required to produce, from its own inherent power, sufficient energy to perform operations requiring substantial mechanical effort. My automatic parachute control is accordingly characterized by the use of this pressure sensitive device as a trip or trigger to energize or touch off a relay device deriving increased energy from an additional source, such as a heavy spring or otherwise, said relay device having ample power to unlatch, or otherwise operate, means whereby a parachute is normally restrained from opening.

Since atmospheric pressure may vary from day to day, or hour to hour, even at the same altitude level (and even at sea level) depending on various meteorological factors not necessary to be detailed herein, such variation being within recognized average limits, I will speak herein of the setting of the device to operate within a certain altitude zone, the precision of the control being amply sufficient to provide a margin of safety despite pressure variations which even in extreme cases, represent a spread of less than 10 per cent of the total pressure at any level.

In the use of the control which constitutes the present invention, therefore, a parachute is provided with means normally tending to initiate opening movement thereof. Restraining means is provided for preventing such opening movement until said restraining means is tripped or unlatched by a relay of ample power. The relay is itself operatively associated with a sensitive device which is responsive to variations in atmospheric pressure and which is provided with a movable trigger or trip means sensitive enough to respond to small positional variations, and which initiates action by the relay at a predetermined pressure value. Finally manually operative means is provided for assuming control of the opening of the parachute at any time previous to its operation by the automatic control.

As will appear in the following description of the invention, in conjunction with the accompanying drawings, I have shown several embodiments of a pressure sensitive control device which may be used to trip the more powerful relay. Each such embodiment includes a gas-tight, expansible, hollow device, and for specific examples I show and describe a valved chamber walled in part with rubber (Figs. 2 and 2*a*), a Sylphon bellows type of expansible chamber (Fig. 7), and a chamber which is for the most part relatively rigid, but has a Sylphon bellows extension thereon (Fig. 8). It is to be understood of course that any device responsive to changes in atmospheric pressure, and capable of producing motion external thereto as a result of such response, may be adapted to cooperate with the additional elements herein shown.

Fig. 1 indicates, without attempt to illustrate conventional apparatus in detail, a fragmentary portion of a parachute pack, it being understood that the parachute includes conventional internal means, spring impelled or otherwise, producing a normal tendency to open a portion of the cover means and release a pilot parachute, or miniature parachute which in turn frees the main parachute. This normal tendency is restrained by certain binding cords which in turn are customarily released by a rip cord which is manually operated. In the device here shown the release tendency is restrained by a securing cord **20**, its ends being maintained in position by means of a latching stud passing through eyelets **21** on the ends of the cord (Figs. 1 and 2). Release of eyelets **21** in a manner soon to be described, permits cords **20** to respond to the tension thereon, freeing the pilot parachute and thereby permitting opening of the main parachute.

The pressure sensitive control and its manner of operation will first be described. A plate **23** is attached by any convenient method to the pack cover **24** which carries the parachute assembly. A bracket **25** is attached to the plate, and said bracket carries fixedly attached thereto a cylindrical member **26** provided at its upper end with an inturned flange **27** which defines a centrally disposed opening **28**. Another tubular member **29** is disposed partially within the cylinder **26** and is fixedly attached to flange **27** in any convenient manner. I have here shown the tube **29** fitted with an annular flange **30** which slides upwardly into a machined seat in flange **27**, and is retained thereon by means of a threaded collar **31** assembled on a threaded portion **32** integral with tube **29**. Rigidly attached to the lower end of tube **29** is an imperforate plug **33**, held in place in any convenient manner, such as by a nut **34** threaded on a projection **35** of plug **33**, said projection passing through an inset bottom portion **36** of the tube **29**. The base bracket **25**, and the concentric cylindrical members **26** and **29** form an immovable foundation for the several movable elements now to be described.

Telescopingly slidable into the open upper end of tube **29** is a plunger **37** which is in sliding contact with both the inner and outer cylindrical peripheries of tube **29**, and which, though at all times moving as a unit, may conveniently be assembled from two concentric plunger parts **38** and **39**. A nipple **40** is carried on the lower end of the plunger **37**. Extending axially of the nipple and plunger is an orifice **41** which is sealed by means of a pneumatic valve **42** of conventional type. The plunger carries a dust cap **42***a*. A tubular member **43** of resilient material is attached at one end to plug **33**, for instance by wire binding **44**, and similarly united at its other end to nipple **40**. The tube **43** may be of any convenient material of sufficient rigidity for the function soon to appear. If desired a coil spring **43***a* may be incorporated in the wall of tube **43** during fabrication thereof, as shown in Fig. 2*a*. A spiral spring **45** is assembled on threads **46** on the nipple and the plug. Since plunger **37** is in floating contact with tube **29** (except in so far as it is resiliently restrained by tube **43** and spring **45**) it is apparent that if resilient tube **43** be filled with gas at any suitable pressure, and

the amount of said gas is maintained constant by the normal sealing effect of valve 42, variations in external pressure will result in corresponding inverse variations within tube 43, resulting in axial movement of said plunger within tube 29.

An upper sleeve 48 carries an internal thread 49 which matches a thread 50 on the plunger exterior. A lower sleeve 51 of cylindrical contour depends from upper sleeve 48 and maintains sliding contact with the fixed cylinder 26. The upper and lower sleeves 48 and 51 are maintained in fixed juxtaposition by a threaded collar 52 having set screw retaining means 52a, but if desired the collar 52 may be fitted loosely enough to permit sleeve 48 to be moved axially with respect to the plunger (by peripheral relative movement of threads 49 and 50) without rotation of sleeve 51 in which case sleeve 51 would respond by direct endwise movement to the micrometer thread advance of sleeve 48. When desired the variable relationship of plunger 37 and sleeve 48 may be fixed by means of a set screw 48a.

It is now apparent that in its floating movement, responsive to external pressure, for instance to atmospheric pressure, the plunger 37 carries in its axial movement the upper sleeve 48 and lower sleeve 51, and that said sleeves, movabel endwise as a unit, may be adjusted to a predetermined position with respect to the plunger by rotating the upper sleeve 48. Rotation of the plunger is prevented by a key and groove relationship 54 between the plunger and fixed tube 239.

The floating assembly just described constitutes a control means sensitive to atmospheric pressure, and responsive thereto whereby a more powerful relay is energized. Said relay will now be described and thereafter its operation will be explained.

An ejector member 60 is normally retained within cylinder 26. Cylinder 26 is provided with a perforation 61, within which is loosely positioned a ball 62 which is slightly oversize with respect to the thickness of the wall of cylinder 26. Ejector 60 is provided with a depression 63, and when ball 62 is retained in such a way that it is partially seated in the depression the ejector is retained in the position shown in Fig. 2. A compression spring 64 is interposed between fixed flange 27 and ejector 60 and its normal tendency (except as restrained by the position of ball 62) is to expel the ejector 60 from its position within cylinder 26. An ejector extension 65 is normally retained in contact with ejector 60 by means of a retaining spring 66.

A pair of studs 67 provided with stop flanges 68 are fixedly attached to base bracket 25 in any convenient manner, and serve to limit endwise movement of ejector 60 and the extension 65 carried thereby. Extension 65 carries a pair of eyelet retaining brackets 69, the eyelets 21 being retained in place by normal abutment of the flange 70 of retaining bracket 69 against the end of stud 67. It is apparent that if the ejector 60 is permitted to move outwardly under the pressure of spring 64, the ejector extension 70 also moves outwardly carrying with it the eyelet retaining brackets 69, thereby freeing the eyelets from the end of studs 67 and releasing the parachute restraining cords 20 as already explained.

The ejector assembly and its motivating spring 64 constitute the relay means which may be suitably tripped by the pressure sensitive control through the influence of ball key 62. As already described, the ball normally is in the position shown in Fig. 2, and motion of the ejector is thereby prevented. The pressure of spring 64 communicated through ejector 60 and against ball 62, produces a constant tendency to expel the ball from depression 63, which tendency is normally prevented by the position of lower sleeve 51.

Lower sleeve 51 is similarly provided with a depression 71 which, by motion of the said sleeve, may be brought into registry with aperture 61 under proper atmospheric pressure conditions as will appear. In such a case the parts assume the relationship shown in Fig. 5, the ball is expelled into partial registry with depression 71, the ejector assembly 60, 65, 69 moves outwardly and the eyelets are released.

A complete sequence of operations will now be described, with reference to Figs. 1 to 6.

Before leaving the ground the air within chambered tube 43 is permitted to assume ground level pressure, for instance by depressing momentarily the stem of valve 42 in familiar manner. Under these conditions, the parts are assumed to be in the position shown in Fig. 2. The parachute retaining eyelets are retained in position by studs 67. As the airship ascends the atmospheric pressure drops and as a consequence the internal pressure relatively increases, so that plunger 37 moves outwardly, carrying sleeves 48 and 51 therewith, the position of the parts being indicated in Fig. 3 for a height of say 10,000 feet above ground level. Assuming that at this point it is desired to set the controls for opening at, say, 2000 feet, the upper sleeve 48 is rotated and moves downwardly with relation to plunger part 39 which latter part may, for convenience in setting, be provided externally with longitudinal graduations of the micrometer type (Fig. 4) marked for each thousand feet and fractions thereof. Such setting moves the depression 71 closer to ball 62 by a predetermined amount, the preset position being shown in Fig. 4. If now the parachute pack and control, carried either on a package or by an aviator, be dropped from the airship, the resulting constant increase in atmospheric pressure causes a shrinkage in chambered tube 43, aided by the retractive effect of spring 45, and when the parts reach the position shown in Fig. 5 the parachute is released as previously explained.

If the parachute is carried by an aviator, and he desires to open the parachute prior to its automatic release, he may pull cord 80 (Figs. 2 and 5) attached to the projecting end 81 of spring 66 which causes downward movement of ejector extension 65, independently of ejector 60, and the eyelets 21 are released thereby.

In resetting the device for the normal ground level position shown in Fig. 2, the ejector assembly is manually forced upwards until its top portion abuts flange 27, in which position ball 61 may be caused to fall by gravity into depression 63, clearing the depression in lower sleeve 51, which sleeve is thereby permitted to assume the position shown in Fig. 2. This operation is facilitated by tipping the whole control so that the ball region is on top. The ejector 60 being thereby held in place, the ejector extension 65 may be pulled downwardly in the manner explained for manual release, after which the eyelets 21 are placed under the studs 67 and the ejector extension is allowed to snap back into place.

Fig. 7 illustrates a somewhat modified embodiment of the pressure sensitive, chambered device.

In this embodiment I use a Sylphon bellows **82** as a substitute for the tubular member **43** shown in Fig. 2. The lower end **83** is sealed, and maintained in fixed relationship to the inset bottom portion **36** of tube **29**. The upper end **84** is welded, or otherwise attached in leakproof relationship, to nipple **40** of the control plunger. As is well known to those skilled in mechanical arts, a bellows of this type is characterized by an ability to expand or contract longitudinally, responsive to variations in internal fluid pressure. Its wearing qualities are probably superior to those of rubber alone, as shown in Fig. 2, or rubber with coil spring reinforcement such as is illustrated in Fig. 2*a*.

Fig. 8 illustrates yet another example of a pressure sensitive chamber adapted for use with my invention. In this embodiment I have provided an air space of considerably increased length for the purpose of increasing, if desired, the total travel of the plunger between ground level and any attainable altitude, thereby permitting a widening of the scale interval for increments of height and pressure, and consequently affording a more sensitive control with respect to pressure variations or height adjustments. The air chamber comprises both a relatively rigid portion, and a resilient, expansible portion. The rigid portion is shown as a coiled tube **85**, contained within cylindrical housing tube **29**, and sealed at its upper end **86**. At its lower end **87** it is in communication with a Sylphon bellows **88**, which bellows is welded to nipple **40** as in the embodiment shown in Fig. 7. By this arrangement both the air or gas in the Sylphon bellows and in tube **85** is sensitive to external changes in pressure and responsive thereto to produce changes in position of the plunger.

A pressure sensitive control device constructed as herein described may be calibrated in a pressure chamber for the purpose of determining the positioning of the scale divisions in accordance with known atmospheric pressure for different levels. All succeeding instruments of the same type and identical construction may of course be manufactured in quantity without further calibration.

It may of course be here mentioned, although immediately apparent on consideration of the above detailed description, that in passing over sections of the country which are several thousand feet above base level, or sea level, this fact must be borne in mind in setting the control. It should obviously be set for a safe distance above local ground level, and not above sea level.

It is further apparent that while I have shown a ball key as a convenient and sensitive means for releasing the ejector assembly, other sensitive trigger or trip means may be employed and accommodated to suit particular design factors in specific cases.

What I claim is:

1. Automatic means for causing a parachute to open in a predetermined elevation zone, comprising a support, a chambered gas-tight device capable of expansion and contraction responsive to variations in atmospheric pressure, said device having a part movable with relation to said support, means for preadjusting the position of the movable part independently of atmospheric pressure, a parachute, movable parachute release means carried by said support, and means operatively associated with the movable part of said device for automatically actuating said release means within said predetermined elevation zone.

2. Automatic means for causing a parachute to open in a predetermined elevation zone, comprising a support, a chambered gas-tight device capable of expansion and contraction responsive to variations in atmospheric pressure, said device having one part fixed and one part movable with relation to said support, means for adjusting the position of said movable part with respect to said fixed part independently of atmospheric pressure, a parachute, parachute release means detachably carried by said support, and means operatively associated with the movable part of said device for automatically actuating said release means within said predetermined elevation zone.

3. Automatic means for causing a parachute to open in a predetermined elevation zone comprising a support, a gas-tight device provided with a chamber capable of expansion and contraction responsive to variations in atmospheric pressure, means for varying the pressure within said chamber, said device having one part fixed and one part movable with relation to said support, means for adjusting the position of said movable part with respect to said fixed part independently of atmospheric pressure, a parachute, parachute release means carried by said support, and means operatively associated with the movable part of said device for automatically actuating said release means within said predetermined elevation zone.

4. Automatic means for causing a parachute to open in a predetermined elevation zone, comprising a support, a chambered gas-tight device capable of expansion and contraction responsive to variations in atmospheric pressure, said device having a part movable with relation to said support, means for preadjusting the position of the movable part independently of atmospheric pressure, a parachute, movable parachute release means carried by said support, means operatively associated with the movable part of said device for automatically actuating said release means within said predetermined elevation zone, and additional means, operatively associated with said release means, for manually actuating said release means at any desired elevation.

5. Automatic means for causing a parachute to open in a predetermined elevation zone, comprising a support, a chambered gas-tight device capable of expansion and contraction responsive to variations in atmospheric pressure, said chambered device having a rigid wall portion and a flexible wall portion, means for preadjusting the position of said flexible wall portion with respect to said fixed wall portion independently of atmospheric pressure, said flexible wall portion being movable with respect to said support, a parachute, movable parachute release means carried by said support and means operatively associated with the movable part of said device for automatically actuating said release means within said predetermined elevation zone.

6. Automatic means for causing a parachute to open in a predetermined elevation zone, comprising a support, a gas-tight chamber having a predetermined molecular content of gas therein, said chamber having a wall portion movable in response to variations in atmospheric pressure, a parachute, parachute release means detachably carried by said support, means operatively associated with the movable wall portion of said chamber for actuating said release means at said predetermined elevation zone, and means for preadjusting the position of said operatively associated means independently of the movement

responsive to that of the movable wall portion, and independently of atmospheric pressure.

7. Automatic means for causing a parachute to open in a predetermined elevation zone comprising releasable restraining means normally preventing opening of the parachute, latch means for releasing said restraining means, energizable relay means operatively associated with said latch whereby to operate said latch when energized, means comprising a gas-tight chamber having a predetermined molecular content of gas therein, said chamber having a resilient wall portion of rubberlike material movable in response to variations in atmospheric pressure, sensitive trip means interposed between said movable wall portion and said relay means whereby said relay means is energized when the atmospheric pressure attains a predetermined value, and means for preadjusting said sensitive trip means, so as to vary its position relative to said movable wall portion independently of atmospheric pressure.

8. Automatic means for causing a parachute to open in a predetermined elevation zone comprising a support, a gas-tight device provided with a chamber capable of expansion and contraction responsive to variations in atmospheric pressure, said device having a part movable with relation to said support, a fixed member carried by said support and provided with an aperture extending laterally therethrough, a key laterally freely movable within said aperture, and laterally slightly oversize with respect thereto, an ejector member in movable contact with one face of said fixed member and provided with a depression normally in registry with said aperture and adapted to receive a projecting portion of said key, thereby normally preventing motion of said ejector member, a control member operatively associated with the movable part of said device and provided with a depression and being movable along the other face of said fixed member, said last named depressions being normally out of registry with said aperture, means for urging said key out of said depression in said ejector member and into said depression in said control member whenever motion of said control member produces simultaneous registry of both depressions with said aperture, thereby permitting motion of said ejector member with respect to said support, a parachute, parachute release means carried by said support, and means interposed between said ejector member and said release means for automatically actuating said release means whenever motion of said movable part of said device produces such simultaneous registry.

9. Automatic means for causing a parachute to open in a predetermined elevation zone, comprising a support, a gas-tight device provided with a chamber capable of expansion and contraction responsive to variations in atmospheric pressure, said device being provided with a gas-tight chamber having a predetermined molecular content of gas therein, said chamber having a resilient wall portion movable in response to variations in atmospheric pressure, a fixed member carried by said support and provided with an aperture extending laterally therethrough, a key laterally freely movable within said aperture, and laterally slightly oversize with respect thereto, an ejector member in movable contact with one face of said fixed member and provided with a depression normally in registry with said aperture and adapted to receive a projecting portion of said key, thereby normally preventing motion of said ejector member, a control member operatively associated with the movable wall portion of said device and provided with a depression and being movable along the other face of said fixed member, said last named depression being normally out of registry with said aperture, means for urging said key out of said depression in said ejector member and into said depression in said control member whenever motion of said control member produces simultaneous registry of both depressions with said aperture, thereby permitting motion of said ejector member with respect to said support, a parachute, parachute release means carried by said support, and means interposed between said ejector member and said release means for automatically actuating said release means whenever motion of said movable part of said device produces such simultaneous registry.

10. Automatic means for causing a parachute to open in a predetermined elevation zone comprising a support, a gas-tight device provided with a chamber capable of expansion and contraction responsive to variations in atmospheric pressure, said device having a part movable with relation to said support, a fixed member carried by said support and provided with an aperture extending laterally therethrough, a key laterally freely movable within said aperture, and laterally slightly oversize with respect thereto, an ejector member in movable contact with one face of said fixed member and provided with a depression normally in registry with said aperture and adapted to receive a projecting portion of said key, thereby normally preventing motion of said ejector member, a control member operatively associated with the movable part of said device and provided with a depression and being movable along the other face of said fixed member, said last named depression being normally out of registry with said aperture, means for urging said key out of said depression in said ejector member and into said depression in said control member whenever motion of said control member produces simultaneous registry of both depressions with said aperture, thereby permitting motion of said ejector member with respect to said support, a parachute, parachute release means carried by said support, means interposed between said ejector member and said release means for automatically actuating said release means whenever motion of said movable part of said device produces such simultaneous registry, and additional ejector means for manually actuating said release means at any desired elevation.

11. Automatic means for causing a parachute to open in a predetermined elevation zone comprising a support, a gas-tight device of the Sylphon bellows type capable of expansion and contraction responsive to variations in atmospheric pressure, said device having a part movable with relation to said support, a fixed member carried by said support and provided with an aperture extending laterally therethrough, a ball key laterally freely movable within said aperture, and laterally slightly oversize with respect thereto, an ejector member in movable contact with one face of said fixed member and provided with a depression normally in registry with said aperture and adapted to receive a projecting portion of said key, thereby normally preventing motion of said ejector member, a control member operatively associated with said movable part of said

device and provided with a depression and being movable along the other face of said fixed member, said last named depression being normally out of registry with said aperture, means for urging said key out of said depression in said ejector member and into said depression in said control member whenever motion of said control member produces simultaneous registry of both depressions with said aperture, thereby permitting motion of said ejector member with respect to said support, a parachute, parachute release means carried by said support, and means interposed between said ejector member and said release means for automatically actuating said release means whenever motion of said movable part of said device produces such simultaneous registry.

WITOLD A. BADOWSKI.