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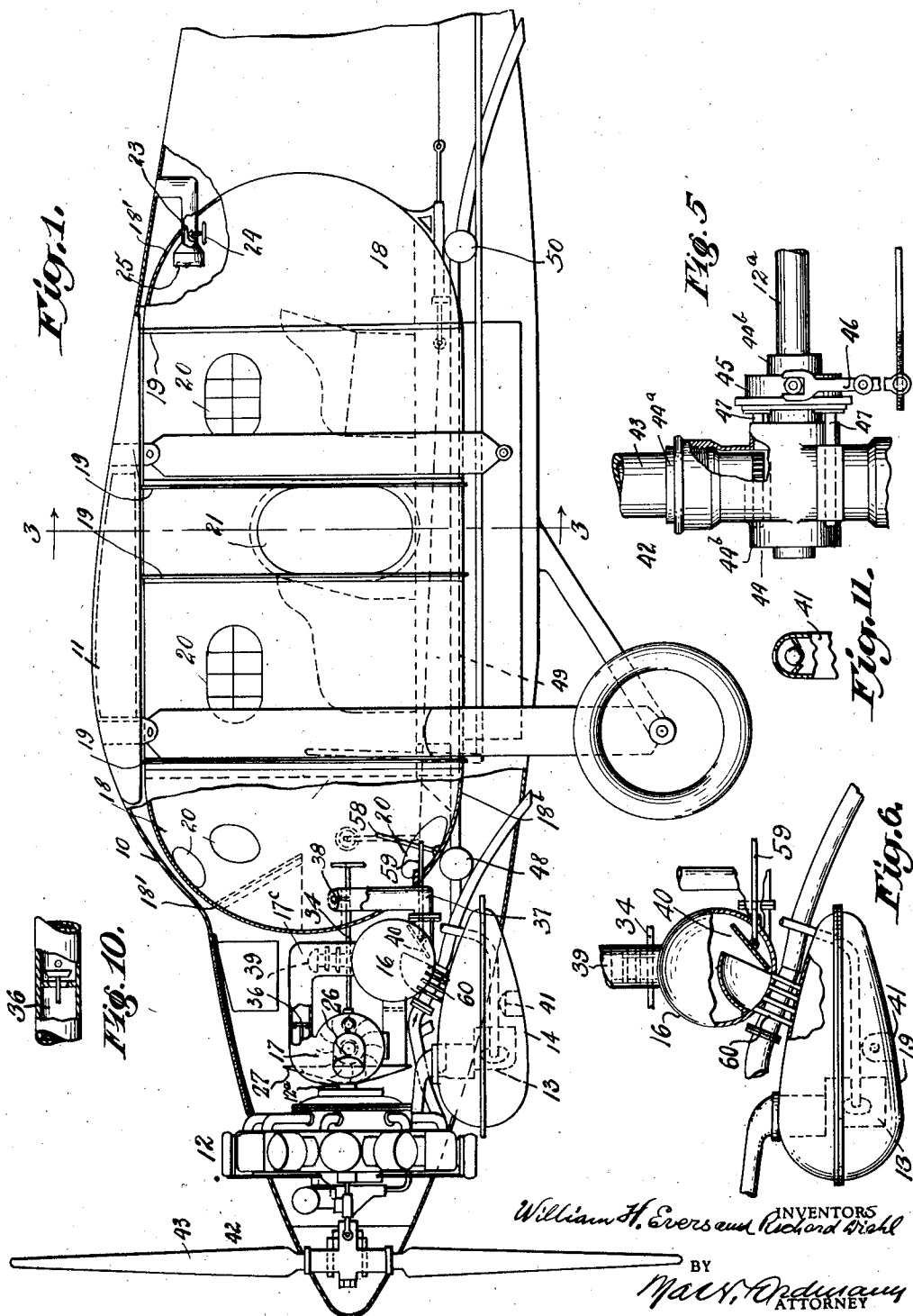
W. H. EVERS ET AL

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ENDURANCE HIGH ALTITUDE FLYING MACHINE

Filed Dec. 7, 1927

3 Sheets-Sheet 1



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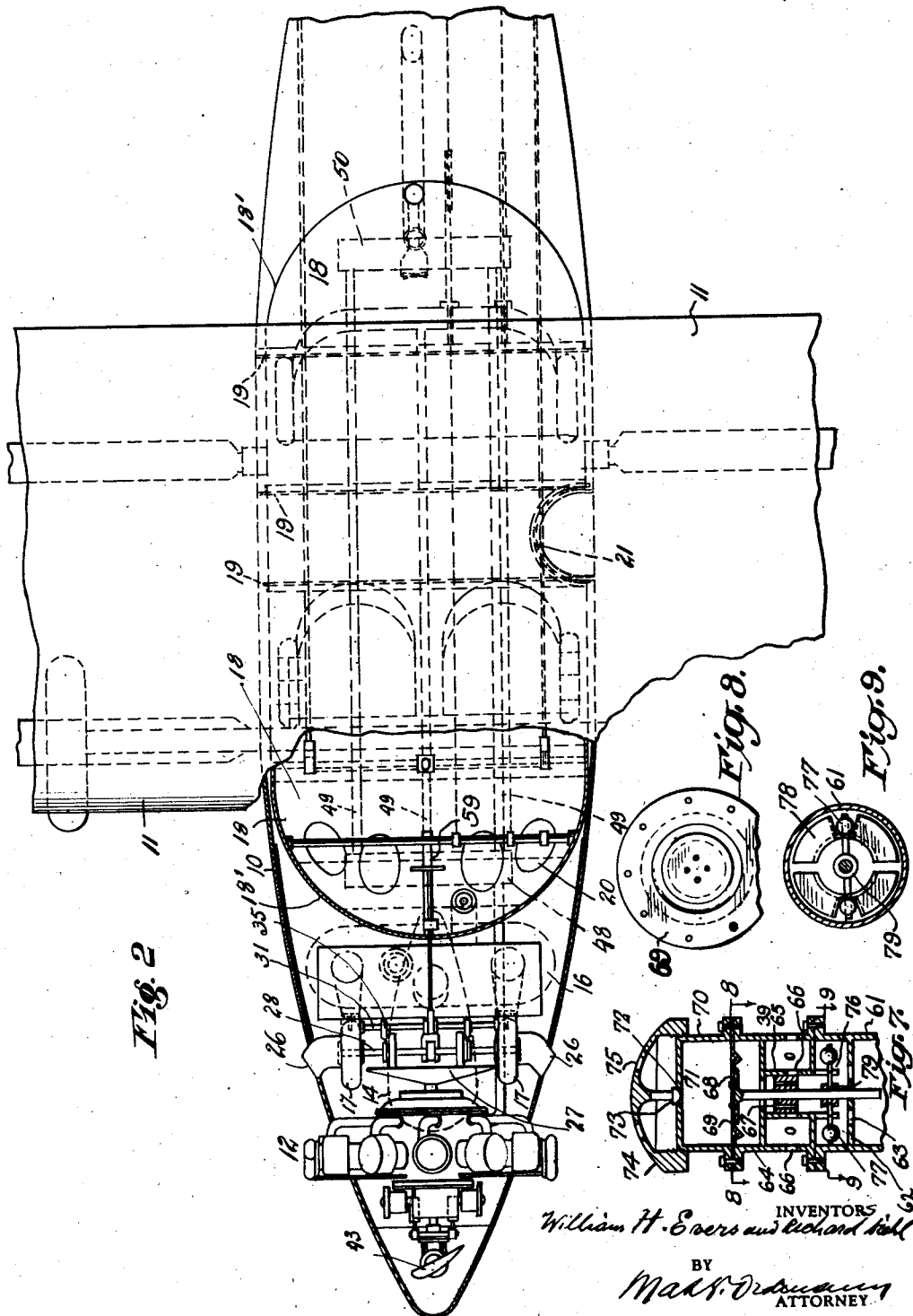
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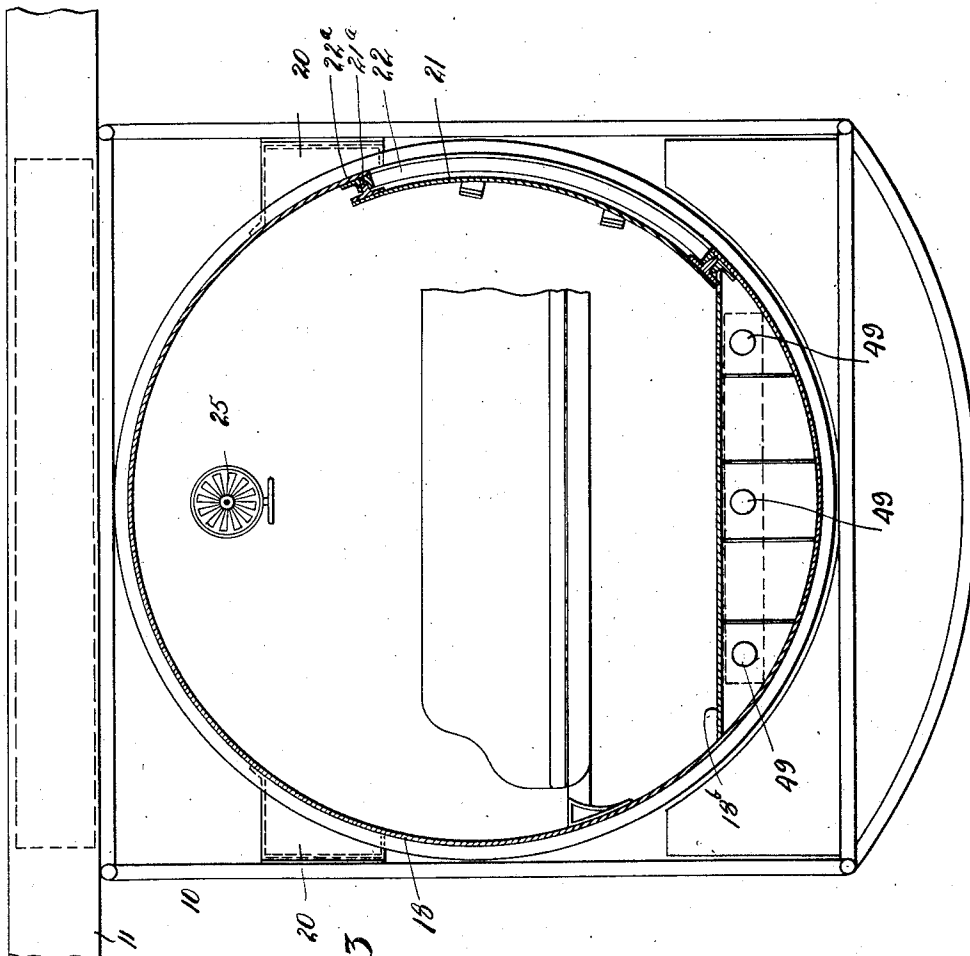
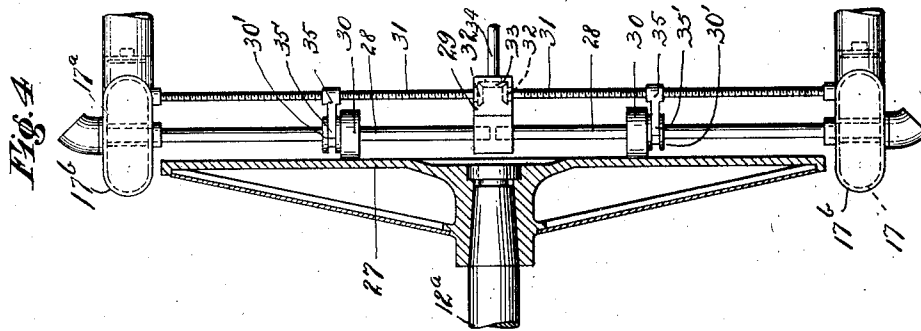
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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

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ENDURANCE HIGH-ALTITUDE FLYING MACHINE

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This invention relates to flying machines, particularly to aeroplanes, and has for its principal object to provide an air going vessel of this type which may be safely used
 5 for endurance high altitude flights.

There are several conditions under which endurance high altitude flights can be carried out satisfactorily:

- First, there must be the necessary air
 10 pressure for respiration by the occupants when reaching altitudes where the atmospheric conditions affect an aviator in normal health. Second, the efficiency of the motor must remain constant at all altitudes.
 15 It has been found that the efficiency of the driving motor tends to decrease in approximate proportion to the decrease of the air density. It is for this reason that aeroplanes with motors whose driving power varies cannot be used for carrying heavy loads at high
 20 altitudes, especially for long distances. Yet high altitude flights are very desirable and preferable to those of low altitude because of the more favorable meteorological conditions, the possibility of avoiding rain, hail,
 25 etc., and because of the reduced resistance there encountered.

To solve the problem our invention consists in the provision of means for proper respiration at high altitudes, which means include
 30 a pressure cabin for the crew and passengers of the aeroplane through which air at the required pressure will be circulated. By providing such a cabin and insuring respiration under the necessary pressure irrespective of the altitude, persons in normal health could undertake high altitude endurance flight without having to undergo such medical tests as now necessary with the known
 40 aeroplane construction and respiration equipments.

Another object is to provide means whereby the air pressure supplied to the combustion mixture of the driving motor will remain
 45 constant and furthermore to so construct said means that both the cabin and motor will be supplied with the compressed air from a single source.

A further object is to provide a compression element for raising the rarefied atmos-

phere to the desired density and means for operating the said compression element from the driving motor.

Our invention also consists in the particular construction of the pressure cabin whereby, in a comparatively simple manner and without waste of material it will be made sufficiently strong to effectively resist the inner pressure and at the same time will not materially add to the weight of the machine.
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When using a motor whose driving power is to remain constant, the pitch of the propellers must be adjustable in order that it may be varied to suit the requirements as the aeroplane ascends to higher altitudes, for it is obvious that in endurance flights it would be impractical to keep on increasing the speed of the motor, as this would, not only put an undue stress on the material, but would also permit the propeller blades to assume such velocities as would soon destroy the parts. We therefor provide propellers with blades adjustable to different pitch and with means for controlling this adjustment from the pilot's seat.
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Other objects or features of our invention will appear in the following detailed description.

In the accompanying drawings which constitute part of this specification and in which similar reference characters denote corresponding parts, Fig. 1 is a sectional side elevation of our new aeroplane; Fig. 2 a sectional top plan view thereof; Fig. 3 an enlarged cross section on line 3—3 of Fig. 1.
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 Fig. 4 is an enlarged sectional view of the motion transmitting means between the compressor and the motor. Fig. 5 is an enlarged fragmentary view of the propeller adjusting mechanism. Fig. 6 is an enlarged fragmentary view of the carburetor chamber and is broken away to disclose pipes which connect it with the pressure distributing chamber. Fig. 7 is an enlarged vertical section of the automatic pressure control valve. Fig. 8 is a section taken over the top of the diaphragm and on the line 8—8 of Figure 7. Fig. 9 is a cross section on the line 9—9 of Figure 7. Fig. 10 is an enlarged detail view of a check valve in a compressor connecting

pipe. Fig. 11 is a check valve in the air chamber which encloses the carburetor.

Referring to the drawings more in detail 10 denotes the fuselage of the aeroplane which is suitably shaped for the most favorable aerodynamic effect, 11 denotes the supporting planes or wings of conventional shape according to the type of aeroplane used and 12 denotes a motor of suitable design.

13 denotes the carburetor which for the purpose of maintaining the constant motor efficiency is mounted in a special chamber 14. This chamber communicates with a second chamber 16 which in the following is termed "the pressure distributing chamber" and which in its turn is adapted to communicate with a compressor element 17 of any suitable construction. 18 denotes a chamber which serves as cabin for the crew and passengers. This cabin is arranged intermediate the ends of the fuselage and consists of a substantially cylindrical chamber whose end walls 18' are semi-spherically shaped. To effectively resist the inner pressure two or more reinforcing hoops 19 are provided around the outer circumference of the chamber.

The chamber 18 is provided with a plurality of windows 20 of any suitable shape according to their location, and a door 21 adapted to open inwardly. The frame 22 of the door is grooved as 22^a to receive an annular flange 21^a provided around the door, suitable packing being provided in said groove to produce an hermetic closure.

The pressure cabin in which, as above stated, crew and passengers are accommodated, has the object to afford respiration at normal pressure when the aeroplane is flying at high altitudes. The air pressure in the cabin 18 which is supplied from the compressors, as will be hereinafter explained, is held constant by means of a discharge valve 23. This valve is controllable, either by the hand wheel, or other suitable means.

To enable the pilot at all times to be sure that there is proper circulation of air in the cabin, a fan 25 is provided in front of the valve 23, which will revolve as long as air passes out. Suitable optical or electrical indicating means (not shown) may be provided in front of the pilot's seat to enable him to observe the working of said fan.

The quantity of air necessary for respiration is about 120 cubic meters per hour for four persons, in which case its humidity in the cabin will not rise beyond 70% of complete saturation, and the carbon dioxide will not be higher than 1/1000 of the entire amount of air in the cabin.

The air is drawn into the compressors 17 through intake ducts 26 arranged in the pressure zone of the fuselage as seen in Figure 2. The compressors then drive the air under pressure into the distributing chamber 16, from which it passes through the pipe 37 into

the cabin 18. Air under pressure may also pass into the carburetor chamber 14 through the pipes 60 thus ensuring a proper gas mixture for the motor when in a high altitude. The compressors are adapted to be suitably cooled, so that their inner temperature will not rise beyond 0° centigrade. If possible the cooling of the compressors should be such that when the outer temperature is about 50° centigrade the temperature of the air compressed to 1 atmosphere does not exceed -10° to 50° centigrade.

The compressors 17 may be driven from the motor 12 or by any suitable means. We prefer however to use the mechanism as illustrated in Figure 4 of the drawing. On the motor shaft 12^a is fixed a friction disk 27. Extending diametrically across the surface of the disk are two shafts 28, whose inner or adjacent ends bear in a suitable common central bearing 29 and whose outer ends actuate the compressors 17. Intermediate the compressors 17 and the central bearing 29 we provide friction disks 30 keyed on the shafts 28 so as to revolve with the latter and be displaceable longitudinally thereto, i. e., radially relative to said disk 27. To this end we provide two threaded spindles 31 extending parallel and also diametrically relative to said disk 27 and whose outer ends are rotatively supported in the casings 17^b of the compressors 17 and whose inner ends are rotatively supported in the central bearing 29. These inner ends carry bevel gears 32 which mesh with a common bevel gear 33 carried by a spindle 34 adapted to be suitably manipulated from the pilot's seat. On the threaded portions of said spindles 31 are mounted levers 35 formed with forked portions 35' which engage around collars 30' provided on the friction disks 30. By turning the spindles 31 in one or the other direction the friction wheels 30 will be caused to move closer to or farther away from the centre of the disk 27, whereby the speed of the compressors will be correspondingly increased or decreased.

The compressors 17 draw in the air through the intake ducts 26 and compress the same. The compressed air is passed into the pressure distributing chamber 16 through a back stroke valve 36 provided in the passage 17^c, connecting the compressor plant to said chamber 16. From this chamber 16 a part of the air passes into the pressure cabin 18 through pipe 37 provided with a back stroke valve 38.

The pressure distributing chamber 16 is provided with an automatic pressure control valve 39 whereby the pressure is maintained constant at normal atmospheric density. Means may be provided, if desired, for manual control of the pressure in the chamber 16. A valve 40 is also provided in the said chamber whereby communication between the latter and the carburetor chamber 14 can be cut off at will by means of the lever 58 and the

rod 59, and when this is done, air is taken into the said chamber 14 by means of the valve 41.

The automatic pressure control valve 39 is illustrated in detail in Figures 7, 8 and 9. The construction is as follows: The base element 61 has a transverse wall 62 and apertures 63. The mid section 64 is mounted on the said base element and has a central cylinder 65 in which are openings 66. A piston 67 is positioned within the said cylinder and this is perforated vertically as shown. A plate 68 on the upper end of the piston rod is secured to a sensitive diaphragm 69. The casing 70 encloses the compression chamber 71 which has a vent 72, which vent is normally closed by the valve 73. The cap 74 is screwed down on the upper element and has vents 75. In the lower section, levers 76 are provided with adjustable weight balls 77 and on these levers are fan blades 78. These fans together with the weight balls act to stabilize the piston through the collar 79. The action is as follows: At no altitude, or sea level, the cap 74 is opened up and air at ground level pressure, approximately 15 lbs., is taken into the chamber 71. The cap is then screwed down to close the valve 73. When, at a higher altitude, air is forced into the pressure distributing chamber 16, it will bear upward against the piston and will be met with resistance by the diaphragm 69 which is backed by the normal atmospheric pressure attained at the ground level. If the pressure in the chamber 16 rises above that required, viz., 15 lbs. approximately, the piston will rise slightly and air will escape through the vents 66 thus bringing the distributing chamber pressure back to normal.

In addition to the provision of the pressure chamber 18 and the means for maintaining constant the efficiency of the motor, endurance flights at high altitudes can be carried out safely only when the propeller blades are adjustable to different pitch, so as to maintain an approximately constant draft irrespective of the altitude. As already stated, with motors whose efficiency remains constant the pitch of the propellers must be variable.

The propeller adjusting means illustrated in Figure 5 is as follows: the propeller 42 is provided with blades 43 borne in an adjustable section 44^a of the propeller hub 44. This adjustable section may be actuated from the pilot's seat through any suitable means, as for instance by a member 45 slidably mounted on the stationary section 44^b of the propeller hub 44 and operated by the lever 46 or the like from the pilot's seat. The member 45 may be provided with racks 47 meshing with a toothed portion of the adjustable section 44^a.

The cabin may not only accommodate the crew and passengers but may also contain the

motors in which case the special chamber 14 enclosing the carbureter can be eliminated. The exhaust gases from the motor may be utilized for heating the cabin at high altitudes. To this end the same may be discharged from the motor into a vessel 48 arranged below the bottom 18^b of the cabin and which may be connected to radiator pipes 49 arranged in the latter. From the radiator pipes the discharge gases pass into another vessel 50 from which they are allowed to pass out into the atmosphere.

It is obvious that various modifications may be made in the construction without departing from the spirit of our invention and for this reason we do not wish to limit ourselves to the details described and shown.

What we claim is:

1. In an air going vessel of the character described, a cabin having pressure retaining walls, a compressor element and a pressure distributing chamber adapted to force air into the said cabin, and a pressure control valve having a compression chamber therein, which chamber is normally closed to the outer air and has a diaphragm attached to a piston element and adapted to resist the raising of the same up to the point where the force exerted against the said diaphragm is greater than the internal pressure of the said compression chamber.

2. In an air going vessel of the character described, a cabin having pressure retaining walls, a compressor element and a pressure distributing chamber communicating with the said cabin, and a pressure control valve in the line of the said communication, which valve is constructed as follows, a compression chamber normally closed to the outer air, a diaphragm transverse to the said chamber, a piston rod connected to the said diaphragm, a piston on the said rod and a cylinder enclosing the same, and perforations in the walls of the said cylinder which are adapted to be opened by the raising of the said piston.

3. In an air going vessel of the character described, a pressure retaining cabin, air compression means adjacent thereto and means to deliver air from the said compression means to the said cabin, and a pressure control valve in the air delivery line of the said compression means, and the said valve constructed as follows, a compression chamber normally closed to the outer air, means to admit air thereto and to again seal the said chamber, a sensitive diaphragm forming the base of the said chamber, a piston connected to the said diaphragm, a cylinder about the said piston and openings therein which are normally closed by the said piston, perforations in the said piston communicating with a chamber below the diaphragm, and a chamber below the said piston and a stabilizing mechanism therein which comprises balanced

weights and fan elements which act upon the rod of the said piston.

4. In combination with an air ship of the character described, a pressure retaining cabin of cylindrical form and having convex end walls, reinforcing hoops about the cylindrical portion thereof and a door provided with a flange which engages a marginal groove on the cabin wall, and communicating with the said cabin, air compressing means, and in the line of said compressing means a pressure control valve having a compression chamber, a diaphragm thereunder, and a piston acting against the said diaphragm and controlling vents in the valve walls adjacent thereto.

In testimony whereof we affix our signatures.

WILLIAM H. EVERS.
RICHARD DIEHL.