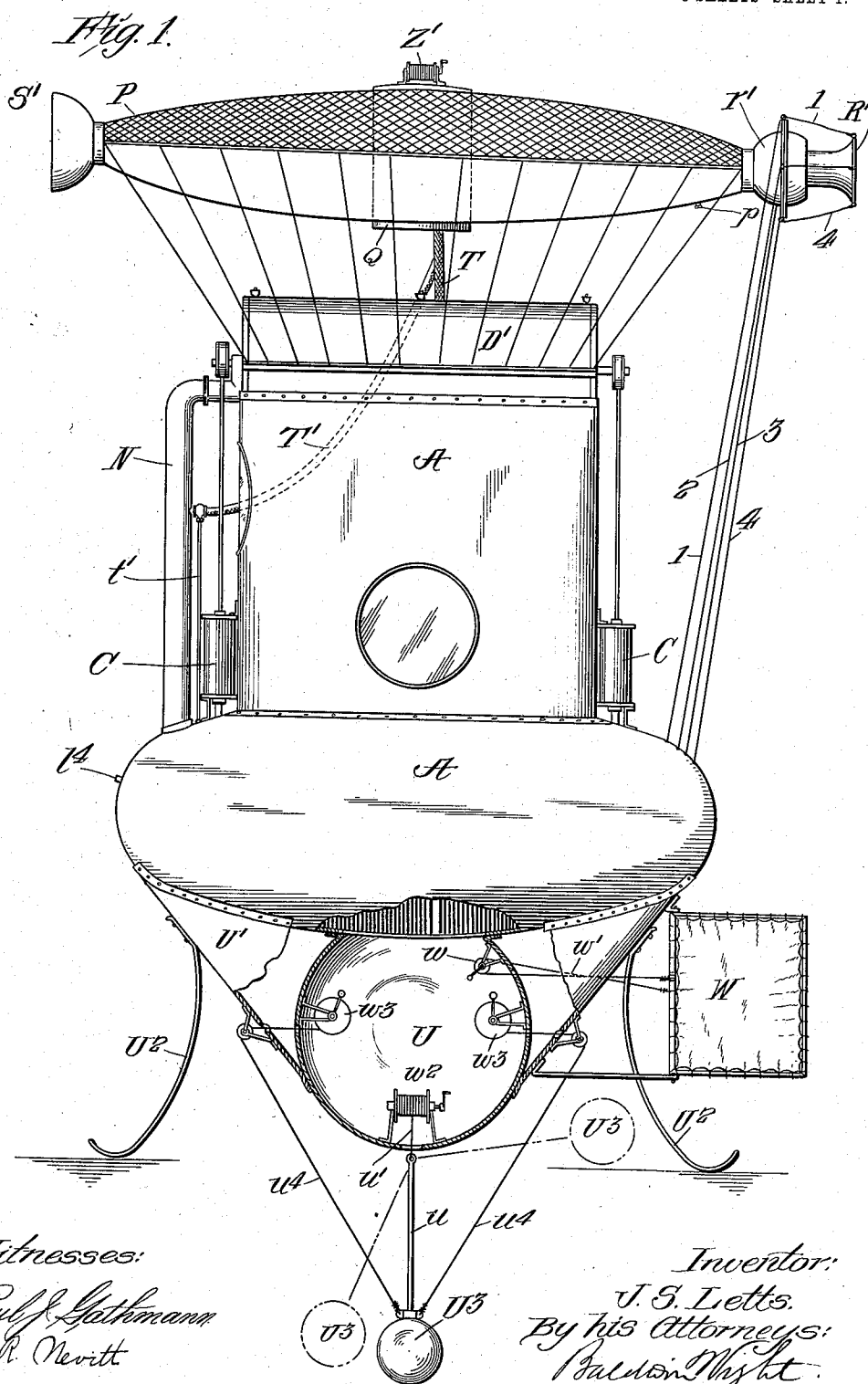


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APPLICATION FILED DEC. 28, 1908.

Patented Oct. 19, 1909.

5 SHEETS—SHEET 1.

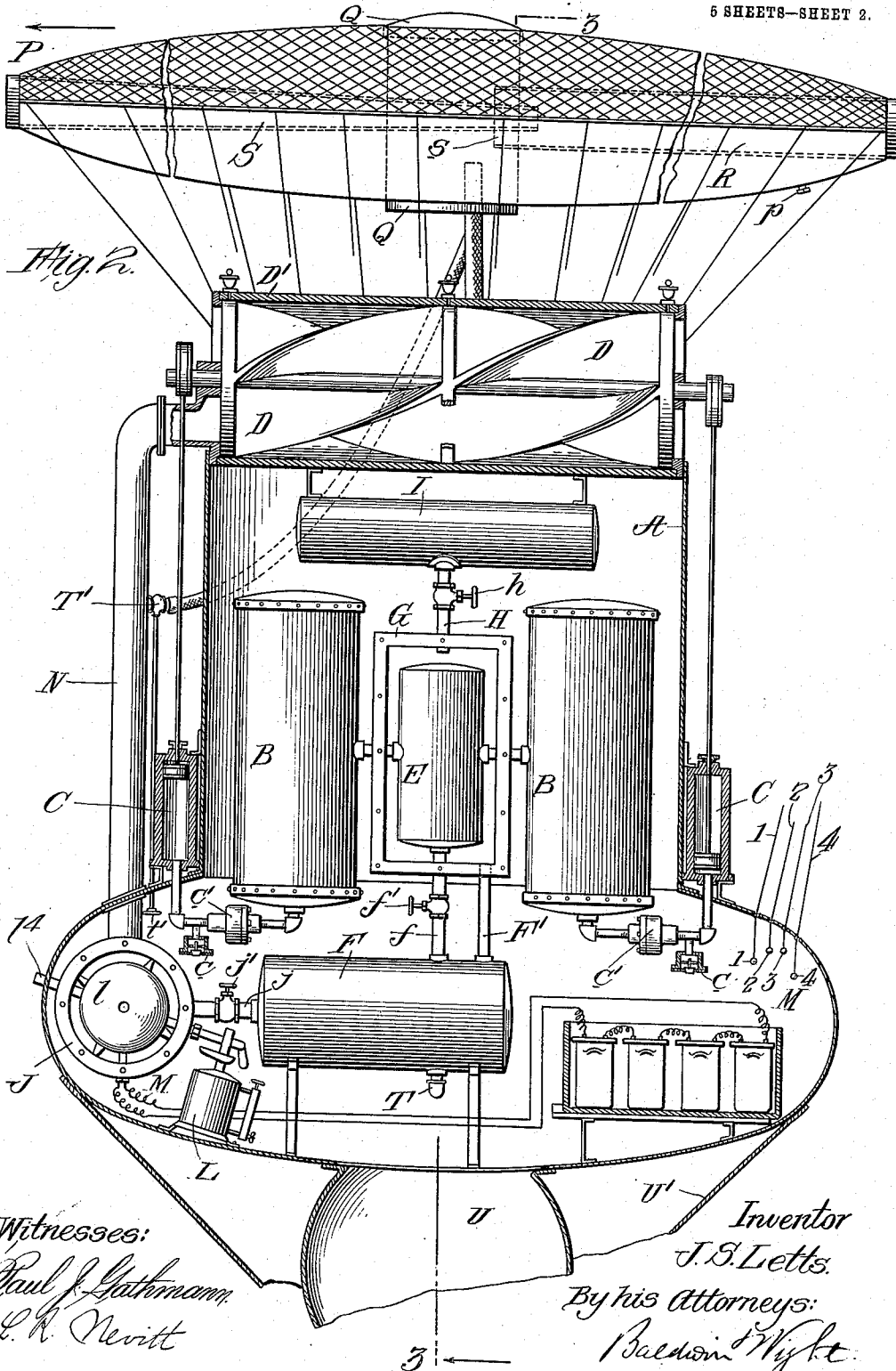


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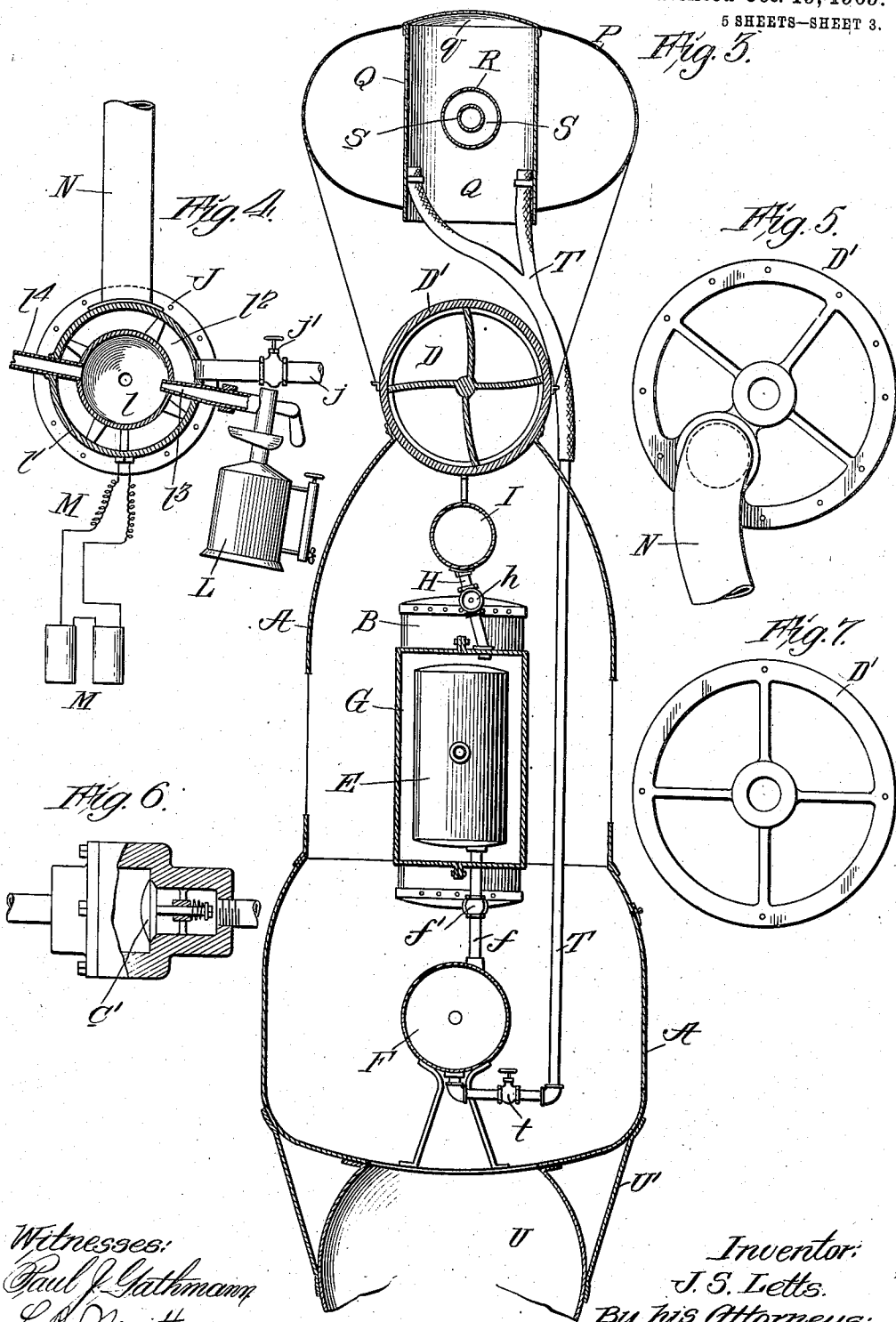
6 SHEETS—SHEET 2.



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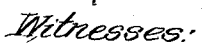


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5 SHEETS—SHEET 4.



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6 SHEETS—SHEET 5.

Fig. 10.

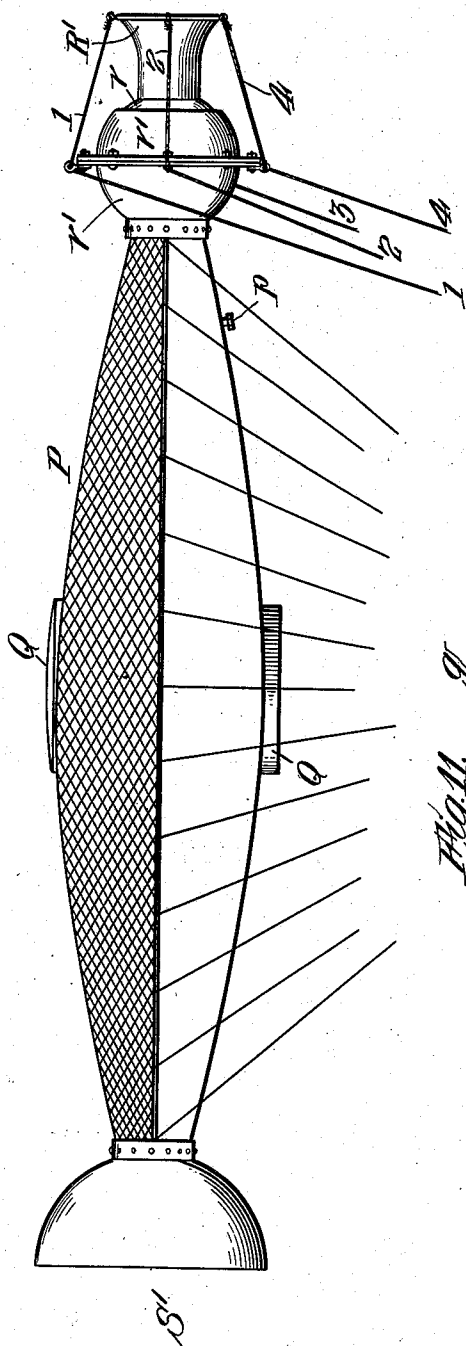
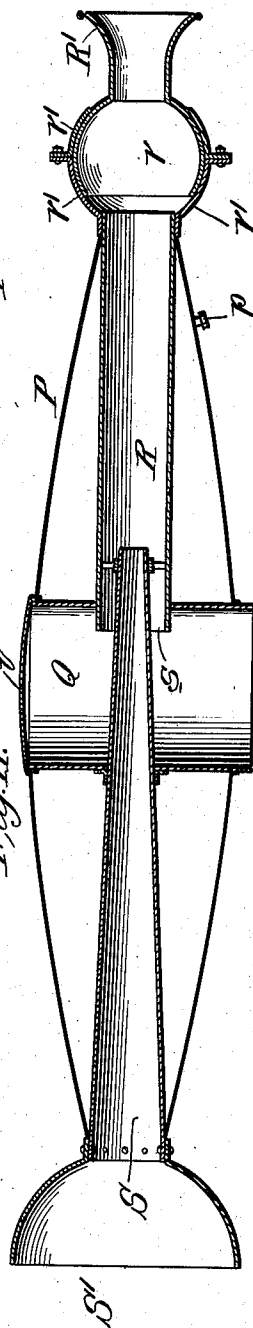


Fig. 11.



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UNITED STATES PATENT OFFICE.

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AERIAL NAVIGATION.

937,250.

Specification of Letters Patent.

Patented Oct. 19, 1909.

Application filed December 28, 1908. Serial No. 469,665.

To all whom it may concern:

Be it known that I, JEREMIAH S. LETTS, a citizen of the United States, residing in Dickinson, in the county of Stark and State of North Dakota, have invented certain new and useful Improvements in Aerial Navigation, of which the following is a specification.

The primary object of my invention is to provide novel means for propelling an air ship of the kind in which a cab for the director of the ship and for supporting the motive power and the propelling mechanism is suspended from a balloon.

According to my invention I employ liquid air in connection with compressed air to act upon a screw-propeller to cause the latter to revolve at a high speed and to thus propel the ship, the latter being raised to the desired elevation and sustained at such elevation by a dirigible balloon which latter is provided with means for forcing air into it upwardly and for causing air to pass through it longitudinally in such manner as to maintain the balloon in such elevated position and also aid in propelling it. Means is provided whereby the ship may be maintained in an upright position or tilted and also whereby it may be guided. As an additional means for raising the ship and holding it in an elevated position, I may employ a kite of improved construction.

In the accompanying drawings,—Figure 1 is a view mainly in side elevation with some parts broken away of an air ship embodying my improvements. Fig. 2 is a view partly in side elevation and partly in vertical section of the same with some of the lower parts omitted. Fig. 3 shows a vertical section on the line 3—3 of Fig. 2. Fig. 4 is a detail view of the heater employed for expanding the compressed and liquid air. Fig. 5 is an end view of the propeller and the pipe for supplying it with the expanding air. Fig. 6 is a detail view of one of the valves used between the compressing pumps and the compressed air cylinders. Fig. 7 is a view of one end of the propeller. Fig. 8 shows a front elevation of a kite which may be used in raising and sustaining the ship. Fig. 9 shows how the kite may be applied to the ship. Fig. 10 shows a side elevation of the dirigible balloon preferably employed. Fig. 11 shows a longitudinal section thereof.

The cab has a suitable shell or casing A

within which are arranged two compressed air cylinders B into which air is forced by two air pumps C operated from the shaft of a screw-propeller D mounted on top of the cab casing A. Air is admitted to the pump cylinders on the up stroke of the pistons through the valves *c*, the valves *c'* between the pumps and the compressed air cylinders being then closed. On the down stroke the valves *c* close, while the valves *c'* open.

Compressed air is discharged from the cylinders B into a cylinder E which is connected by a pipe *f* with a cylinder F in the lower part of the cab. The cylinder E is surrounded by a casing G which is connected by means of a valved pipe H with a reservoir I for liquid air. As is well understood, the compressing of air generates heat, and when the compression is very great, the air is raised to a very high temperature. The expansion of liquid air creates intense cold. According to my invention the cold produced by the expansion of liquid air is largely counterbalanced by the heat produced by the compressing of air, so that the compressed air enters the cylinder F from the cylinder E and the expanding liquid air enters said cylinder through a pipe *F'* with their temperatures greatly modified. The great force of the expanding liquid air is made capable of use, while the freezing effects often incident to the use of liquid air are avoided. The pipe H is provided with a regulating valve *h*, while the pipe *f* has a similar valve *f'*.

From the tank F the air is conveyed by a pipe *j* having a valve *j'* to a heater J, which may be constructed and operated in the manner shown and described in my application for Patent No. 447,821, filed August 10, 1908. Fig. 4 shows this heater and, as illustrated, it comprises a spherical chamber *l* surrounded by a spherical casing *l'* with a space *l''* between them to which the compressed air is admitted from the pipe *j*. *L* indicates a "torch" or hydro-carbon burner, of well known construction, connected by a pipe *l''* with the chamber *l* and its discharges the burning fluid into this chamber. *l'* is an exit pipe for the chamber *l*. If preferred, an electric heater M may be employed in place of or supplemental to the "torch" L. In the heater J the air has its temperature raised and is expanded and made suitable for use as a propelling force.

It passes from the heater through a pipe N to a screw-propeller D mounted in a suitable casing D' attached to the upper part of the casing A. The air under enormous pressure passes through the propeller causing it to revolve at high speed and with great force and to thus propel the ship.

The cab and its propeller are suspended from an inflatable balloon P which may be inflated or deflated at p in any suitable way. The balloon P is provided with a centrally arranged cylinder Q closed at the top g , open at the bottom and closed at the sides except at those parts which receive the pipes R and S. The pipe R is preferably of uniform diameter and it extends from the rear end of the balloon into the cylinder Q, while the pipe S, which extends from the front end of the balloon through the cylinder Q and into the pipe R, tapers from its front end rearwardly, there being a space s between the inner end of the pipe S and the walls of the pipe R. The front or outer end of the pipe S is preferably provided with a flaring or bell-mouthed air receiver S' into which the air rushes as the balloon moves forward and which serves to concentrate a large body of air and direct it into the pipe S through which it passes to the pipe R and draws air up into the cylinder Q and causes it to pass from said cylinder through the space s and out through the pipe R the outer or rear end of which is preferably provided as shown with a dirigible bell-mouthed air deliverer R'. This may be made as most clearly shown in Figs. 10 and 11. As illustrated the bell-mouthed or flaring air deliverer R' is formed on its inner end with an enlarged semi-spherical part r which is inclosed in a correspondingly shaped casing r' in which it fits snugly so as to retain its position under ordinary condition, but wherein it is capable of adjustment in any desired direction, *i. e.*, the air deliverer has a universal or ball and socket connection with the rear end of the tube R and it may be turned in any desired way by means of wires or cords 1, 2, 3, 4 which extend to the cab within easy reach of the navigator or where they may be connected with any suitable operating mechanism.

By means of the wire 1, the outer end of the deliverer R' may be raised so as to direct the outgoing air upward, thus causing the stern of the balloon to be depressed and the bow to be correspondingly elevated and thus the balloon will be directed upward. In like manner by means of the wire 4 the outer end of the deliverer may be turned downwardly, the stern of the balloon raised and the bow depressed and by means of the wires 2 and 3 proper lateral movements may be given to the deliverer to direct the movement of the balloon either to the right or to the left. Thus the balloon is under the per-

fect control of the navigator while the cab is directed in the manner hereinafter described.

A pipe T, provided with a valve t , extends from the cylinder F to the interior of the cylinder Q, and I may also use a pipe T' regulated by a valve t' extending from the pipe N to the cylinder Q in connection with the pipe T or supplemental thereto. Air under great pressure may thus be made to enter the cylinder Q, strike against the top thereof, react, and thus exert a lifting force on the balloon. The air also rushes into the space s and out rearward through the pipe S and exerts a propelling force to move the balloon forward. The passage of air to the cylinder Q may be regulated by the valves t and t' to cause the balloon to move forward at the same speed as that of the ship, or it may be made, in some cases, to propel the entire ship.

In starting the ship, the cylinders B having been first filled with compressed air and the reservoir I containing liquid air, the valves h and f' may be opened so that the expanding air will pass to the cylinder F. At first the valve j' may be closed while the valve t is opened. The buoyancy of the balloon and the air rebounding from the top of the cylinder Q will cause the ship to rise. The valve j' may then be opened and the propeller set in motion. This puts the pumps into operation and more compressed air is supplied to the cylinders B. In this way the ship may be raised and propelled. Of course the balloon may be made of such size as to raise the ship without the use of compressed air in the cylinder Q.

In order to balance and guide the ship, I may attach to the bottom thereof the devices for this purpose illustrated in Fig. 1 where a spherical chamber U is shown with a casing U' to which are attached feet or standards U² which may be used to support the ship when on the ground. U³ indicates a weight or plummet having a rod u to which is attached a cord, rope or cable, u' connected to a winding drum or windlass w^2 by means of which the plummet or weight may be raised and lowered. By means of suitable winding drums w^3 and cords, ropes or cables u^4 , the position of the plummet relatively to the central vertical axis or center of gravity of the ship may be changed so as to tilt the ship in the desired direction to aid it when descending or ascending when in motion.

W indicates a rudder controlled by a drum w and suitable cords, ropes or cables, w' . I have indicated diagrammatically only the parts above referred to. It is obvious that in practice the several drums will be placed within convenient reach of a director of the ship.

In order to assist in elevating the ship and

sustaining it, I may employ a kite X of improved construction, such as illustrated in Figs. 8 and 9. The kite proper, as shown, is composed of a main tube or cylinder x having arms or branch tubes x' , and a number of similar diagonally arranged tubes x'' , connected at opposite ends with the tubes x , x' . The tube x is closed at the top and open at the bottom, while the tubes x' are closed at their outer ends. Y indicates a vessel for air under high compression which is connected with the tube x by a pipe y provided with a valve y' . X' indicates the tail of the kite. Z indicates the string or rope leading from the kite.

In the use of these devices the string may be attached to an automobile O and the valve y opened. The air rushing from the vessel Y passes into the tube system and out through the bottom of the tube x causing the kite to ascend after the manner of a sky-rocket, and if the automobile be driven at a suitable speed, the kite will mount high into the air. The automobile may then be driven to the air ship and the string attached to a windlass Z' mounted on any desired part of the ship and controlled in any suitable way. The kite helps in elevating the ship and in holding it in an elevated position while the ship may be propelled in the manner before described.

I claim as my invention:

1. In an air ship, the combination of a propeller, a compressed air reservoir, means for compressing the air in the reservoir, a reservoir for liquid air, means for causing the heat developed by the compressed air to raise the temperature of the liquid air and vice versa, and means for leading the compressed air and the expanding liquid air to the propeller.

2. In an air ship, the combination of a propeller, a compressed air reservoir, a reservoir for liquid air, means for causing heat developed by the compressed air to raise the temperature of the liquid air and vice versa, means for leading the compressed air and the expanding liquid air to the propeller, and air compression pumps driven by the propeller.

3. In an air ship, the combination of a propeller, a compressed air reservoir, means for compressing the air in the reservoir, a reservoir for liquid air, means for causing the heat developed by the compressed air to raise the temperature of the liquid air and vice versa, a tank into which the expanding compressed air and liquid air are delivered, and means for conveying air therefrom to the propeller.

4. In an air ship, the combination of a propeller, a compressed air reservoir, means for compressing the air in the reservoir, a reservoir for liquid air, a vessel into which compressed air passes from the compressed

air reservoir, a casing surrounding this vessel to which liquid air is admitted, a heater through which the compressed air and the vaporized liquid air passes, and means connecting this heater with the propeller.

5. In an air ship, the combination of a propeller, a compressed air reservoir, a reservoir for liquid air, a pump driven by the propeller and connected with the compressed air cylinder, a vessel into which air passes from the compressed air cylinder, a casing surrounding this vessel to which liquid air is admitted, a heater through which the compressed air and vaporized liquid air passes and a connection between this heater and the propeller.

6. In an air ship, the combination of a balloon, a chamber therein closed at the top and open at the bottom, and means for forcing air under pressure into said chamber to aid in raising the balloon.

7. In an air ship, the combination of a propeller, a reservoir for liquid air, a heater, means for conveying the expanding liquid air to the heater and a connection between the heater and the propeller.

8. In an air ship, the combination of a cab, a balloon, a reservoir for liquid air, a heater for the expanding liquid air, and means for conveying the heated expanding air from the heater to the balloon to assist in elevating it.

9. In an air ship, the combination of a cab, a balloon provided with a chamber closed at the top and open at the bottom, a pipe extending from said chamber to the rear end of the balloon and through which air passes from said chamber out through the rear end of the balloon, a reservoir containing liquid air carried by the cab, and means for conveying expanding liquid air to said chamber in the balloon, for the purpose specified.

10. In an air ship, the combination of a cab, a balloon connected therewith having a chamber closed at the top and open at the bottom, a pipe extending from said chamber to the rear end of the balloon and through which air passes from said chamber out at the rear end of the balloon, another pipe extending from the front end of the balloon through the first-mentioned chamber and into the first-mentioned pipe and through which air passes from the front of the balloon into the pipe leading to the rear end of the balloon, a compressed air reservoir within the cab, a reservoir for liquid air also in the cab, a vessel in which the expanding compressed air and the expanding liquid air are received, a heater communicating with this vessel, and a communication between the heater and the before mentioned vessel in the balloon.

11. In an airship, the combination of a balloon, a chamber closed at the top and

open at the bottom located in the middle portion of the balloon, a pipe extending from said chamber to the rear end of the balloon and through which air passes from said chamber out at the rear end of the balloon, a bell-mouthed air-deliverer at the rear end of said pipe, and a ball-and-socket joint between said air-deliverer and said pipe.

12. In an airship, the combination of a balloon, a chamber closed at the top and open at the bottom located in the middle portion of the balloon, a pipe extending from the front end of the balloon through said chamber, another pipe into which said first pipe extends and which communicates with said centrally-located chamber and extends to the rear end of the balloon, a bell-mouthed air-receiver at the open end of the first-mentioned pipe, and a dirigible bell-mouthed air-deliverer at the rear end of the balloon.

13. An airship comprising a balloon, a cab, a plummet, a rod from which it is suspended, means in the cab attached to the rod for raising and lowering it with the plummet, and means in the cab connected with the plummet for swinging it either forward or

backward, about an axis extending horizontally through the upper end of the rod.

14. The combination with an air ship, of a kite comprising a main vertical tube which is open at the bottom and closed at the top, other tubes communicating with said main tube, means for balancing the kite, a vessel for compressed air and a communication between said vessel and the main tube of the kite.

15. The combination with an air ship, of a kite comprising a main central tube closed at the top and open at the bottom, lateral arms communicating with said central tube, diagonally arranged tubes extending from the main tube to the arms, means for balancing the kite, a vessel for containing air under pressure, a connection between said vessel and the tubular structure of the pipe, and means for connecting the kite with the air ship.

In testimony whereof, I have hereunto subscribed my name.

JEREMIAH S. LETTS.

Witnesses:

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R. F. WARREN.