Oct. 7, 1947. A. J. ELLIOTT ET AL 2,428,656

DIRIGIBLE AIRSHIP

Filed June 18, 1941 4 Sheets-Sheet 1

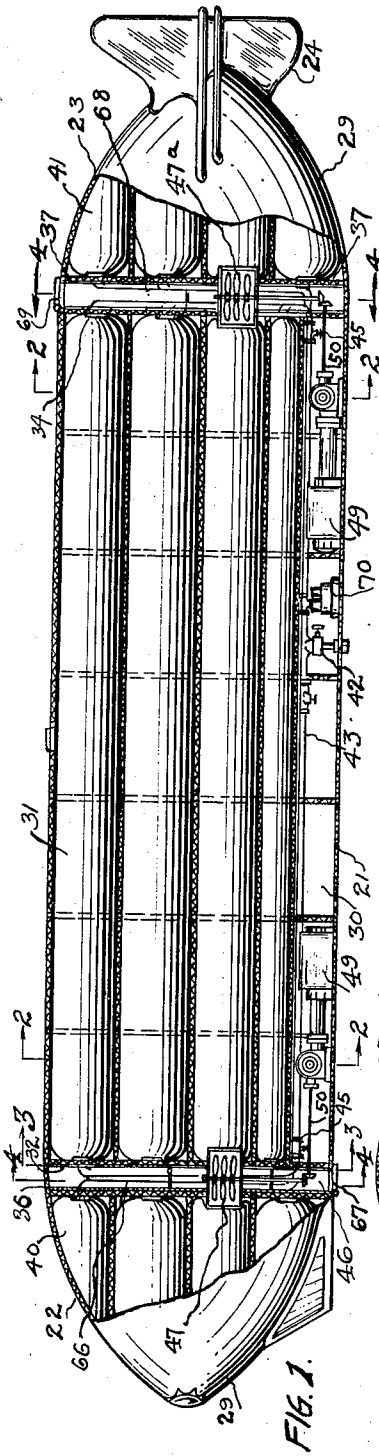


FIG. 1.

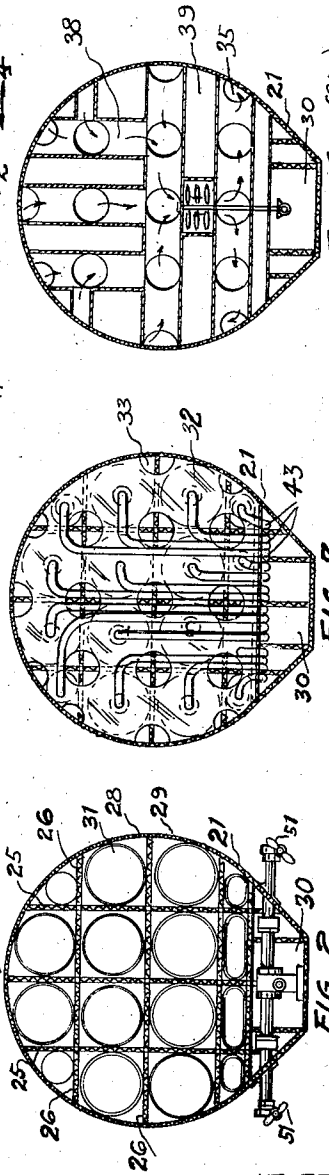


FIG 2.

FIG 3.

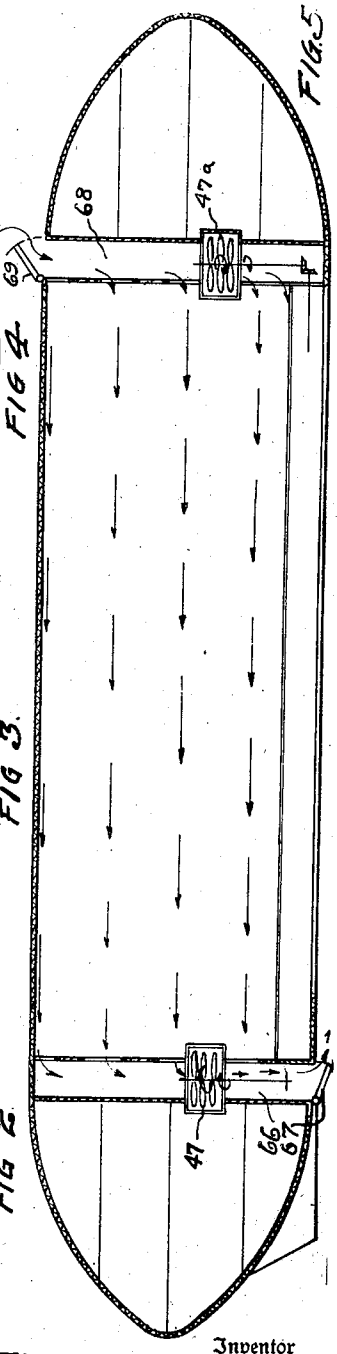


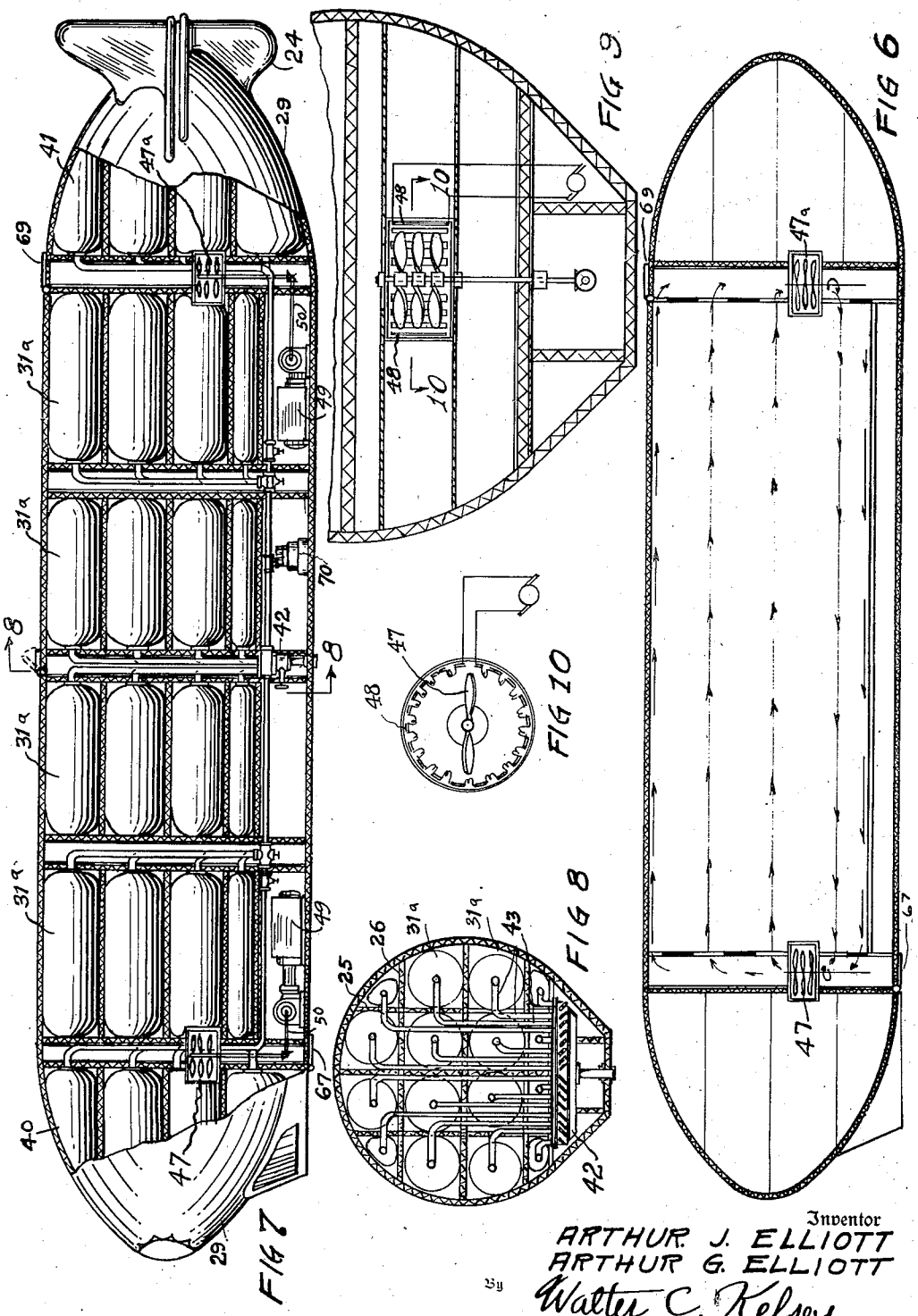
FIG. 5

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DIRIGIBLE AIRSHIP

Filed June 18, 1941 4 Sheets-Sheet 2



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DIRIGIBLE AIRSHIP

Filed June 18, 1941 4 Sheets-Sheet 3

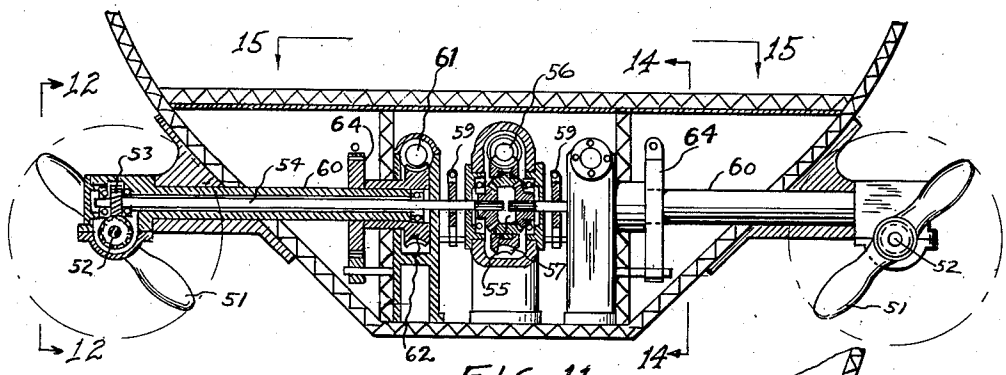


FIG. 11

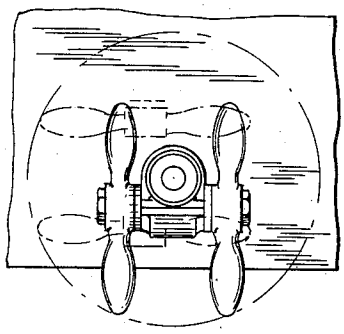


FIG 12

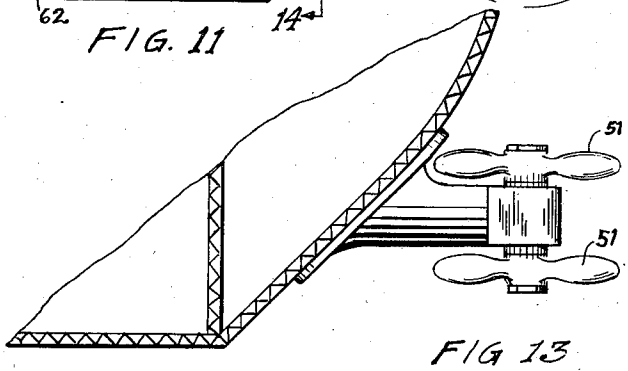


FIG 13

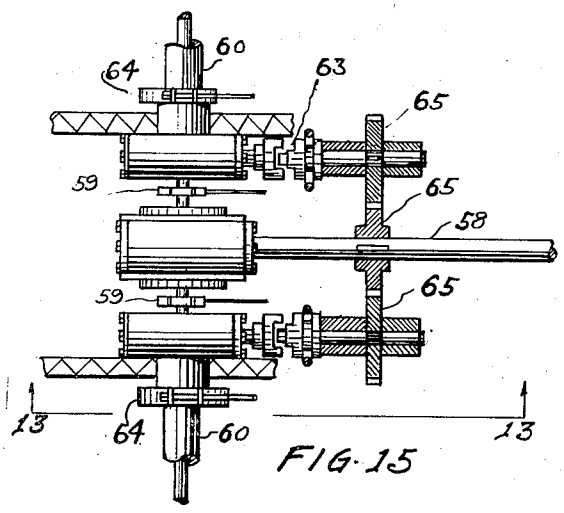


FIG. 15

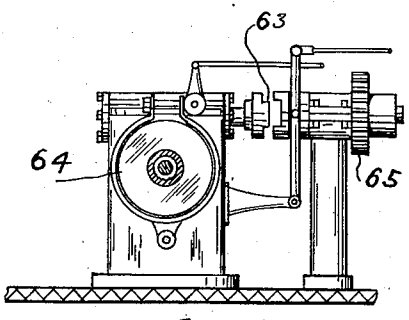


FIG 14

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DIRIGIBLE AIRSHIP

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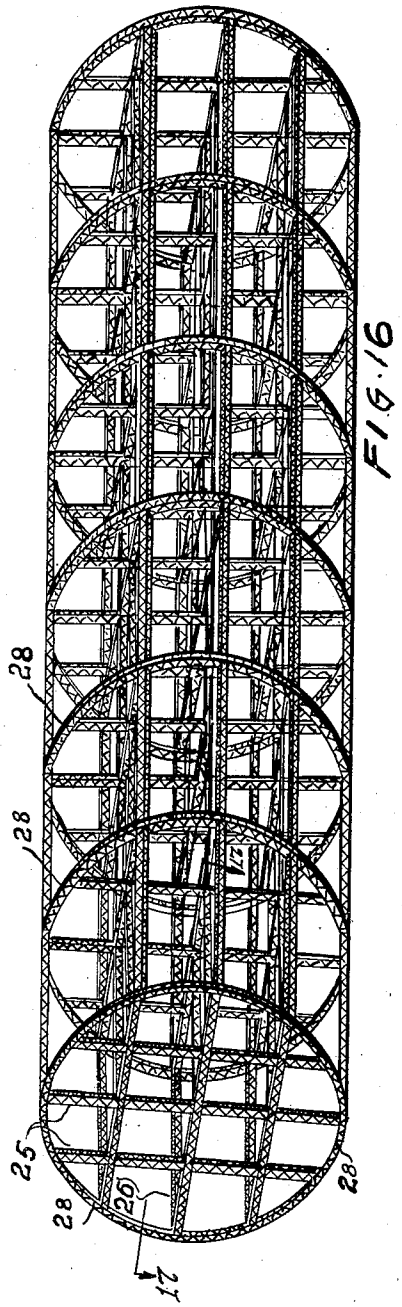


FIG. 16

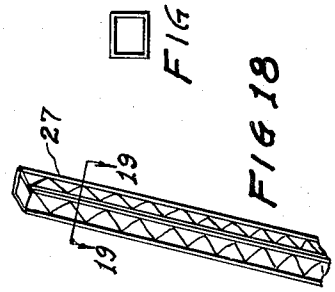


FIG 18

FIG 19.

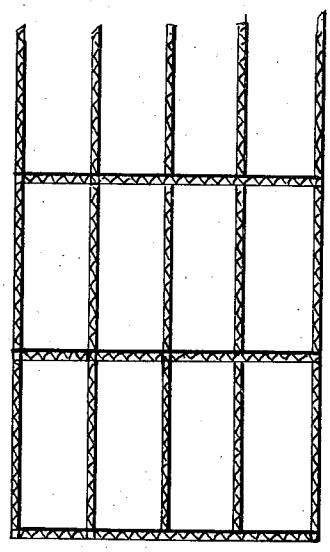


FIG 17

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UNITED STATES PATENT OFFICE

2,428,656

DIRIGIBLE AIRSHIP

Arthur J. Elliott, Cleveland, and Arthur G. Elliott, Geneva, Ohio

Application June 18, 1941, Serial No. 398,606

18 Claims. (Cl. 244—97)

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This invention relates to airships of the dirigible lighter than air type.

An object of our invention is to provide means for carrying a fixed quantity of gas under all conditions, which includes means for storing a portion of the gas and means for storing, regulating, and distributing the supply of gas.

Another object is to provide an improved framework construction which is rigid and adapted to withstand various strains and stresses to which it is subjected in use.

Another object is to increase the lifting capacity of the airship by controlling temperature and distribution of the gas through the entire ship.

Another object is to provide a safety feature by providing a series of cooperating gas bags, each of which can be individually inflated and deflated, thus permitting the airship to operate in case of accident incapacitating an individual gas bag.

Another object is to provide means for varying the angular relation of the propellers to the ship, thus permitting the propellers to be used for propelling, and for raising and lowering the ship.

Another object is to provide new and novel control and drive means for regulating the various mechanisms of the airship.

Another object is to increase the cruising range and lifting capacity by circulating air controlled throughout substantially the entire length of the ship.

Another object is to provide new and novel means for controlling the lifting capacity of an airship without the use of ballast.

Another object is to provide an airship of relatively simple construction, which requires relatively few parts and thus can be constructed at a relatively low cost.

Other objects are to provide a strong, safe dirigible, having a relatively large lifting capacity, the same being provided with easily operated controls, thus to lengthen the cruising range and lower the cost of passenger or cargo flights, and providing for inter-continental traffic and trans-oceanic flights with the greatest degree of safety.

Other and further objects of the invention will appear in the course of the following specification.

In the drawings forming a part of this specification:

Figure 1 is a central longitudinal section, partially in elevation of the preferred form of our invention,

Figure 2 is a section taken on the line 2—2 of Figure 1 showing gas chambers and propellers,

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Figure 3 is a section taken on the line 3—3 of Figure 1 showing the baffle plate,

Figure 4 is a section taken on the line 4—4 of Figure 1 showing fan chamber and air ducts,

Figure 5 is a diagrammatic view showing the valves in position to circulate cold air around gas chambers,

Figure 6 is a diagrammatic view corresponding to Figure 5 but showing the valves closed for circulating hot air around the gas chambers,

Figure 7 is a central longitudinal section, partially in elevation of a modified form of my invention,

Figure 8 is a section taken on the line 8—8 of Figure 1 showing the inflating manifold and valves,

Figure 9 is a fragmentary section through the tail of the airship taken on the line 9—9 of Figure 7,

Figure 10 is a section taken on the line 10—10 of Figure 9, showing heating means,

Figure 11 is a section taken on the line 11—11 of Figure 1, showing propeller controlling means,

Figure 12 is a partial side elevation taken on the line 12—12 of Figure 11, showing propellers in one position in full lines and the same in another position in dotted lines,

Figure 13 is a partial sectional view showing the propeller assembly in elevation rotated 90° from the position shown in Figure 12,

Figure 14 is an elevational view taken on the line 14—14 of Figure 11 showing the clutch and brake mechanism,

Figure 15 is a fragmentary plan view taken on the line 15—15 of Figure 11,

Figure 16 is a partial perspective view of the framework of the airship,

Figure 17 is a section taken on the line 17—17 of Figure 16,

Figure 18 is a broken perspective view of a frame member, while

Figure 19 is a section taken on the line 19—19 of Figure 18.

The preferred form of our invention comprises an elongated airship indicated generally by the numeral 21, shaped substantially circular in cross-section and having a nose portion 22 at the front and a tail portion 23 at the rear, while a rudder 24, projecting from the rear of the airship, is adapted to steer it in a well known manner. The framework of the airship 21 may be made of any suitable material such as aluminum, an alloy containing aluminum, or of any suitable light material, and comprises spaced longitudinally extending vertical frame members 25 joined by

spaced horizontally frame members 26. The frame members 25 and 26 may be formed in any suitable manner and may be joined together in any suitable manner, as by welding, or the like. Figures 18 and 19 illustrate the type of particular frame members used, the same being hollow in the form of a hollow square in cross-section and having diagonally disposed reinforcing members 27 along the sides thereof.

As shown in Figures 2 and 16, hoop frame members 28 are suitably secured to the frame members 25 and 26 at spaced intervals in any suitable manner, and an airship outer covering 29 made of rubber impregnated silk or of any suitable material is mounted around the framework in a well known manner. A compartment 30, extending substantially the entire length of the airship 21 along the bottom thereof, is positioned and arranged in such manner that it is adapted to house the operating mechanism, freight, and living quarters for the crew and passengers. As such compartments are well known in the art a detailed description of the same is omitted.

Helium, or other lighter than air gases, may be used in our airship, and in this connection, attention is directed to the novel elongated gas bags which are disclosed, the same extending substantially the entire length of the preferred form of our airship, each bag being individually connected to a source of gas and having individual cooperating valves, whereby the supply of gas in each bag may be separately regulated. This feature permits effective regulation of the ship and provides a safety feature, whereby the puncturing or incapacitating of an individual gas bag will not necessarily result in grounding of the airship.

In the preferred form of the invention the main gas bags, formed of suitable material, and indicated by the numeral 31 are positioned between the frame members 25 and 26 as shown in Figures 1 and 2. A front baffle plate 32 provided with a series of circular apertures 33 is provided at the front end of the main gas bags 31, while a rear baffle plate 34 is disposed at the rear of the gas bags 31. Baffle plate apertures 33 and 35, as shown in Figures 2 and 4 are aligned with spaces between the gas bags 31 and serve to facilitate the circulation of controlled air currents between the individual gas bags 31, as hereinafter explained. A front bulkhead wall 36 is spaced forwardly from the front baffle plate 32, while a rear bulkhead wall 37 is similarly spaced rearwardly from the rear baffle plate 34. The vertically extending space between the front bulkhead 36 and front baffle plate 32 and the corresponding space between the rear baffle plate 34 are provided with vertically extending ducts 38 and horizontally extending ducts 39 aligned with the front and rear baffle plate apertures 32, as shown in Figures 3 and 4 and facilitate the circulation of air.

The nose portion 22 and the tail portion 23 are provided with expansion pressure valving gas bags 40 and 41 respectively, adapted to be deflated when the ship ascends, and to relieve the excessive gas pressure in the gas bags 31 when the ship reaches such altitudes as cause expansion of the main gas air bags, as will readily be understood. A manifold valve 42 is provided at the bottom of the ship through which gas for inflating the gas bags 31 is admitted through supply pipes 43 leading to the individual gas bags 31, thus providing means for individually controlling the volume of gas supplied to each gas bag 31. Branch pipes 44 leading from supply pipes 43 permit excessive gas pressures on the gas bags 31 to be relieved, when necessary, the flow of such gases being regulated by valves 45, which are closed except when gas is to pass from the gas bags 31 to the expansion pressure valving gas bags 40 and 41.

The vertical extending space between the front baffle plate 32 and the front bulkhead wall 36 designated by the numeral 46 is provided with reversible fans 47 mounted on vertical axes and surrounded by suitable electrical heating elements 48, as shown in Figures 9 and 10, said fans being adapted to circulate and recirculate air along the gas bags 31, as hereinafter explained. Electrical current for said heating element 48 may be supplied from an electrical generator housed in said compartment 30, or by storage batteries, or by any suitable means. The space between the rear bulkhead wall 37 and the rear baffle plate 34 is provided with a similar fan 47*a* adapted to be operated in a manner similar to the front fan 47.

Power for propelling and operating the airship is supplied by two motors 49 which may be operated by gasoline or any other suitable means well known in the art. Shafts 50 and cooperating parts leading from the motors 49 propel the fans 47 and 47*a*.

The propulsion of the ship, as shown in Figures 11 through 15, is accomplished by four pairs of propellers 51, each mounted on operating shafts 52 driven by helical gears 53 through which shafts 54 have their inner ends extending into differential mechanism 55 driven by a worm 56 and worm gear 57 by drive shafts 58 driven by the motors 49. Brakes 59 are provided for each pair of propellers in order to facilitate the manipulation of the ship. Shafts 54 rotatably mounted in housings 60 which are adapted to be rotated by a worm 61 and worm gear 62 in order to change the angular relation of the propeller shafts 52, so that the propellers 51 may be positioned in such relation to the airship as to propel it, as illustrated in Figures 2 and 11, or in such relation thereto, as to assist in the ascent or descent thereof, as illustrated in Figures 12 and 13.

As shown in Figure 15 clutches 63 provide driving means for rotating worm gears 61 in order to control the change of angular relation of the propellers 51 to the airship. Brakes 64 shown in Figures 14 and 15 provide means for stopping the rotation of housings 60 when clutches 63 have been disengaged in placing propellers 51 in desired angular relations. Spur gears 65, as shown in Figures 14 and 15, provide driving means for clutches 63.

The vertically extending space between the front baffle plate 32 and front bulkhead wall 36 is designated by the numeral 66 and at the bottom thereof a gate valve 67 is provided for controlling the flow of air to and from said space 66. A similar vertically extending space at the rear of the ship designated by the numeral 68 is provided and the passage of air to and from said space is controlled by a gate valve 69. Both of the aforesaid gate valves are controlled from the compartment 30 in any suitable manner.

The modified form of our invention disclosed in Figure 7 resembles, in a general way, the airship described in the preferred form of our invention. In this modified form, however, the gas bags 31*a*, instead of extending substantially the entire length of the ship, are of substantially the same cross-section as those in the preferred form, but are somewhat shorter in longitudinal extent.

This type of airship may be found advantageous for certain types of work. The operations of inflating, deflating, flying, and regulating the airship of our modified form corresponds with those described in the preferred form.

A compressor shown in Figure 1 by the numeral 70 is provided in order that the gas in the expansion gas bags 40 and 41 may be drawn from them and returned to the main gas bags 31 and 31*a* at such a time that the airship descends from a higher altitude to a lower one, providing empty gas bags 40 and 41 in readiness for another ascent into higher altitudes. The ship upon rising to high altitudes and the gas in the gas bags 31 and 31*a* consequently expanding will flow from the bags 31 and 31*a* to the expansion bags 40 and 41 by opening valves 45 due to the difference in pressure existing in the bags 31 and 31*a* and 40 and 41.

The invention disclosed herein is operated as follows. The manifold valve 42 is regulated to receive a supply of gas, which may be helium, or any other suitable gas. Preferably in initiating flight gas is supplied to the gas bags 31 or 31*a*, the expansion pressure valve in the gas bags 40 and 41 are reversed for a use hereinafter explained.

If desired, the four sets of propellers 51 may be shifted so that their axes are in the vertical position illustrated in Figure 13 as hereinbefore described. While the propellers are in this position they may be rotated in the proper direction to assist in lifting the airship in its ascent. As soon as the desired altitude is obtained one or more of the propellers 51 may be shifted so that their axes are in a horizontal position, as illustrated in Figure 11, and in this position the propellers 51 are adapted to propel the airship as will readily be understood.

We have discovered that the buoyancy of the airship may be increased by circulating hot air along the gas bags 31 and 31*a* and such circulation of air is illustrated in Figure 6. It will be noticed in Figure 6 that the valves 67 and 69 are both closed in order that the heated air may be re-circulated. Heating elements 48 surrounding the fans 47 and 47*a* are energized to produce heat which is circulated by the fans. Apertures 33 and 35 in the front and rear baffle plates 32 and 34 respectively direct the air currents between the air bags and cause it to be circulated along the gas bags in the paths indicated by the arrows. The circulation of heated air along the gas bags has been found to materially increase the lifting capacity of the ship and provides a new and novel feature.

After the airship is in flight the buoyancy thereof may be decreased without sacrificing any of the gas in the gas bags by circulating air from outside the airship as indicated in Figure 5. When cool air is thus circulated along the gas bags the gate valves 67 and 69 are open, the heating elements 48 are shut off, the fan 47*a* rotates in the same direction as hereinbefore mentioned, but the direction of rotation of the fan 47 is reversed to cause the cool air from the outside to be circulated in the manner indicated by the arrows in Figure 5. By thus circulating cool air from the outside it is possible to materially decrease the buoyancy of the airship without valving off any of the gas, and therefore this feature provides a means for regulating the buoyancy without discharging gas from the gas bags.

In case the airship ascends to such altitudes where there is excessive expansion of the gas bags, the gas pressure therein may be relieved by opening the valves 45 and permitting a part of the gas to pass to the expansion pressure valving gas bags 40 and 41. In grounding the ship the propellers 51 are shifted so that their axes are vertical and rotation of the propellers 51 in the proper direction will assist in drawing the airship to the earth.

The airship disclosed herein is adapted to be used for carrying freight and passengers, as will readily be understood. It will be apparent to those skilled in the art that the invention herein disclosed may be variously used or modified without departing from the spirit of the invention, or sacrificing the advantages thereof, and that the embodiment therein disclosed is illustrative only, and that our invention is not limited thereto.

We claim:

1. An airship, comprising: an outer envelope; principal means for containing gas, disposed in said envelope; auxiliary means for containing gas, disposed in said envelope; means for heating only said principal means for containing gas; and means for relieving excessive pressure in said principal means for containing gas, including said auxiliary means for containing gas, and means for transferring gas from said principal means for containing gas to said auxiliary means for containing gas.

2. An airship, comprising: an elongated outer envelope; means for containing gas, including a plurality of gas containers disposed in said envelope in cellular side-by-side relation relatively to the transverse cross-section of said envelope, so constructed and arranged that longitudinally extending air passages are provided by spaces left between adjacent gas containers; baffles extending transversely of said envelope and being spaced from the respective closed ends of said envelope and respectively disposed adjacent the ends of said gas containers, said baffles each having a plurality of apertures in approximate longitudinal alinement with respective longitudinal air passages; and means for positively causing air to flow through apertures in one of said baffles into corresponding passages, along said gas containers in relative heat-transfer relation therewith, through apertures in the other of said baffles.

3. An airship, comprising: an elongated outer envelope; means for containing gas, including a plurality of gas containers disposed in said envelope in cellular side-by-side relation relatively to the transverse cross-section of said envelope, so constructed and arranged that longitudinally extending air passages are provided by spaces left between adjacent gas containers; a first baffle extending transversely of said envelope and disposed adjacent corresponding ends of said gas containers, said first baffle having a plurality of apertures in approximate longitudinal alinement with respective longitudinal air passages; means, including a second baffle extending transversely of said envelope and spaced from said first baffle, constructed and arranged to provide communicating passage means between selected sets of apertures of said first baffle; and means, disposed in said communicating passage means, constructed and arranged to cause air to flow in said communicating passage means in a direction from one of said sets of apertures to the other of said sets.

4. An airship, comprising: an elongated outer envelope; principal means for containing gas, including a plurality of principal gas containers

disposed in said envelope in cellular side-by-side relation relatively to the transverse cross-section of said envelope, so constructed and arranged that longitudinally extending air passages are provided by spaces left between adjacent principal gas containers; auxiliary means for containing gas, disposed in said envelope, spaced longitudinally from said principal means for containing gas; wall means terminating said passages and separating said passages from the space in which said auxiliary means is disposed; means for causing heated air to flow in said passages along only said principal gas containers in relative heat-transfer relation therewith; and means for relieving excessive pressure in said principal means for containing gas, including said auxiliary means for containing gas, and means for transferring gas from said principal means for containing gas to said auxiliary means for containing gas.

5. An airship, comprising: an elongated outer envelope; means for containing gas, disposed in said envelope, constructed and arranged to leave at least two longitudinally extending air passages in at least one of which air is adapted to flow in heat-transfer relation to said gas containing means, said passages being spaced relatively to the transverse cross-section of said envelope; means providing a first communicating passage between said longitudinal passages at one of the corresponding ends thereof; means providing a second communicating passage between said longitudinal passages at the other one of the corresponding ends thereof; said longitudinal passages and said communicating passages providing a closed circuit for the flow of air from said first communicating passage, thence longitudinally in one of said longitudinal passages, thence in said second communicating passage, thence longitudinally in the opposite direction in another of said longitudinal passages back to said first communicating passage; means adapted to heat air in said circuit; and blower means for positively causing air to flow in said circuit so that air may be circulated and re-circulated in said circuit in heat-transfer relation to said heating means.

6. An airship, comprising: an elongated outer envelope; means for containing gas, disposed in said envelope, constructed and arranged to leave at least two longitudinally extending air passages in which air is adapted to flow in heat-transfer relation to said gas containing means, said passages being spaced relatively to the transverse cross-section of said envelope; means providing a first communicating passage between said longitudinal passages at one of the corresponding ends thereof; means providing a second communicating passage between said longitudinal passages at the other one of the corresponding ends thereof; said longitudinal passages and said communicating passages providing a closed circuit for the flow of air from said first communicating passage, thence longitudinally in one of said longitudinal passages, thence in said second communicating passage, thence longitudinally in the opposite direction in another of said longitudinal passages back to said first communicating passage; means adapted to heat air in said circuit, and blower means for positively causing air to flow in said circuit so that air may be circulated and re-circulated in said circuit in heat-transfer relation to said heating means.

7. An airship, comprising: an elongated outer envelope; means for containing gas, disposed in said envelope, constructed and arranged to leave at least two longitudinally extending air passages in at least one of which air is adapted to flow in heat-transfer relation to said gas container means, said passages being spaced relatively to the transverse cross-section of said envelope; means providing a first communicating passage between said longitudinal passages at one of the corresponding ends thereof; means providing a second communicating passage between said longitudinal passages at the other one of the corresponding ends thereof; said longitudinal passages and said communicating passages providing a closed circuit for the flow of air from said first communicating passage, thence longitudinally in one of said longitudinal passages, thence in said second communicating passage, thence longitudinally in the opposite direction in another of said longitudinal passages back to said first communicating passage; means adapted to heat air in said circuit; blower means for positively causing air to flow in said circuit so that air may be circulated and recirculated in said circuit in heat-transfer relation to said heating means; and valve means, for opening said closed circuit to communication with the air outside of said envelope, so constructed and arranged that operation of said blower means causes air to flow from air outside of said envelope into one of said communicating passages, into and through said at least one longitudinal passage, into the other of said communicating passages and from there discharged to the air outside of said envelope.

8. An airship, comprising: an elongated outer envelope; means for containing gas, disposed in said envelope, constructed and arranged to leave at least two longitudinally extending air passages in which air is adapted to flow in heat-transfer relation to said gas containing means, said passages being spaced relatively to the transverse cross-section of said envelope; means providing a first communicating passage between said longitudinal passages at one of the corresponding ends thereof; means providing a second communicating passage between said longitudinal passages at the other one of the corresponding ends thereof; said longitudinal passages and said communicating passages providing a closed circuit for the flow of air from said first communicating passage, thence longitudinally in one of said longitudinal passages, thence in said second communicating passage, thence longitudinally in the opposite direction in another of said longitudinal passages back to said first communicating passage; means adapted to heat air in said circuit; blower means for positively causing air to flow in said circuit so that air may be circulated and re-circulated in said circuit in heat-transfer relation to said heating means; and valve means, for opening said closed circuit to communication with the air outside of said envelope, so constructed and arranged that operation of said blower means causes air to flow from air outside of said envelope into one of said communicating passages into and through said longitudinal passages, into the other of said communicating passages and from there discharged to the air outside of said envelope.

9. An airship, comprising: an elongated outer envelope; means for containing gas, including a plurality of gas containers disposed in said envelope in cellular side-by-side relation relatively to the transverse cross-section of said envelope, so constructed and arranged that longitudinally extending air passages are provided by spaces left

by said gas containers; a first baffle extending transversely of said envelope and disposed adjacent corresponding ends of said gas containers, said first baffle providing apertures communicating with said air passages; means, including a second baffle extending transversely of said envelope and spaced from said first baffle, constructed and arranged to provide communicating passage means between selected apertures provided by said first baffle; and means, disposed in said communicating passage means, constructed and arranged selectively to positively cause air to flow in said communicating passage means in either direction.

10. An airship, comprising: an elongated outer envelope; means for containing gas, including a plurality of gas containers disposed in said envelope in cellulular side-by-side relation relatively to the transverse cross-section of said envelope, so constructed and arranged that longitudinally extending air passages are provided by spaces left between adjacent gas containers; a first baffle extending transversely of said envelope and disposed adjacent corresponding ends of said gas containers, said first baffle having a plurality of apertures in approximate longitudinal alinement with respective longitudinal air passages; means, including a second baffle extending transversely of said envelope and spaced from said first baffle, constructed and arranged to provide communicating passage means between selected sets of apertures of said first baffle; means, disposed in said communicating passage means, constructed and arranged to cause air to flow in said communicating passage means in a direction from one of said sets of apertures to the other of said sets; and valve means constructed and arranged to put said communicating passage in communication with the air outside of said envelope.

11. An airship, comprising: an elongated outer envelope; means for containing gas, including a plurality of gas containers disposed in said envelope in cellular side-by-side relation relatively to the transverse cross-section of said envelope, so constructed and arranged that longitudinally extending air passages are provided by spaces left between adjacent gas containers; a first baffle extending transversely of said envelope and disposed adjacent corresponding ends of said gas containers, said first baffle having a plurality of apertures in approximate longitudinal alinement with respective longitudinal air passages; means, including a second baffle extending transversely of said envelope and spaced from said first baffle, constructed and arranged to provide first communicating passage means between selected sets of apertures of said first baffle; means, disposed in said first communicating passage means, constructed and arranged to cause air to flow in said first communicating passage means in a direction from one of said sets of apertures to the other of said sets; baffle means, at the other ends of said gas containers, constructed and arranged similarly to said first and second baffle to provide second communicating passage means for said other ends of said gas containers; and valve means constructed and arranged to put said first and second communicating passage means in communication with the air outside of said envelope.

12. An airship, comprising: an elongated outer envelope; means for containing gas, disposed in said envelope, constructed and arranged to provide at least two longitudinally extending air passages in at least one of which air is adapted to flow in heat-transfer relation to said gas containing means, said passages being collateral and spaced relatively to the transverse cross-section of said envelope, and said passages having corresponding first ends and corresponding second ends; and means for positively causing air to flow into the first end of a first of said passages, thence longitudinally therein, and out of the second end thereof, and for positively causing air to flow into the second end of a second of said passages, thence longitudinally therein, and out of the first end thereof.

13. An airship, comprising: an elongated outer envelope; means for containing gas, disposed in said envelope, constructed and arranged to provide at least two longitudinally extending air passages in at least one of which air is adapted to flow in heat-transfer relation to said gas containing means, said passages being collateral and spaced relatively to the transverse cross-section of said envelope, and said passages having corresponding first ends and corresponding second ends; and means for selectively either positively causing air to flow into the first end of a first of said passages, thence longitudinally therein, and out of the second end thereof, and for positively causing air to flow into the second end of a second of said passages, thence longitudinally therein, and out of the first end thereof, or for positively causing air to flow into corresponding ends of said passages, thence longitudinally in said passages to the other corresponding ends of said passages.

14. An airship, comprising: an elongated outer envelope; means for containing gas, disposed in said envelope, constructed and arranged to provide at least two longitudinally extending air passages in at least one of which air is adapted to flow in heat-transfer relation to said gas containing means, said passages being collateral and spaced relatively to the transverse cross-section of said envelope, and said passages having corresponding first ends and corresponding second ends; means providing a first communicating passage between said first ends; means providing a second communicating passage between said second ends; and means, including blower means disposed in at least one of said communicating passages, constructed and arranged for selectively positively causing air to flow in either direction in said at least one communicating passage.

15. An airship, comprising: an elongated outer envelope; means for containing gas, disposed in said envelope, constructed and arranged to provide at least two longitudinally extending air passages in at least one of which air is adapted to flow in heat-transfer relation to said gas containing means, said passages being collateral and spaced relatively to the transverse cross-section of said envelope, and said passages having corresponding first ends and corresponding second ends; means providing a first communicating passage between said first ends; means providing a second communicating passage between said second ends; and means, including blower means in at least said first communicating passage, constructed and arranged for positively causing air to flow in said first communicating passage to one end thereof, thence longitudinally in a first of said longitudinal passages, thence in said second communicating passage, thence longitudinally in a second of said longitudinal passages to the other end of said first communicating passage.

16. An airship, comprising: an elongated outer envelope; means for containing gas, disposed in said envelope, constructed and arranged to provide at least two longitudinally extending air passages in at least one of which air is adapted to flow in heat-transfer relation to said gas containing means, said passages being collateral and spaced relatively to the transverse cross-section of said envelope, and said passages having corresponding first ends and corresponding second ends; means providing a first communicating passage between said first ends; means providing a second communicating passage between said second ends; and means, including blower means in at least said first communicating passage constructed and arranged for selectively positively causing air to flow in said first communicating passage to one end thereof, thence longitudinally in a first of said longitudinal passages, thence in said second communicating passage, thence longitudinally in a second of said longitudinal passages to the other end of said first communicating passage, or positively causing air to flow from one of said communicating passages into corresponding ends of said longitudinal passages, thence longitudinally in said longitudinal passages to the other of said communicating passages.

17. An airship, comprising: an elongated outer envelope; means for containing gas, including a plurality of gas containers disposed in said envelope in cellular side-by-side relation relatively to the transverse cross-section of said envelope, so constructed and arranged that collateral longitudinally extending air passages, having corresponding open ends, are provided by spaces left between adjacent gas containers; and blower means for causing air to flow into corresponding open ends of said passages along said gas containers in relative heat-transfer relation therewith and out at the opposite corresponding ends of said passages.

18. An airship, comprising: an elongated outer envelope; means for containing gas, disposed in said envelope, constructed and arranged to provide at least two longitudinally extending air passages in at least one of which air is adapted to flow in heat-transfer relation to said gas containing means, said passages being collateral and spaced relatively to the transverse cross-section of said envelope, and said passages having corresponding first ends and corresponding second ends; means providing a first communicating passage between said first ends; means providing a second communicating passage between said second ends; valve means constructed and arranged to put said communicating passages respectively in communication with the air outside said envelope; and means, including blower means disposed in at least one of said communicating passages for positively selectively causing air to flow in either direction in said at least one communicating passage.

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