

Patented May 7, 1918.

7 SHEETS—SHEET 1.

1,265,638.

Fig. 1.

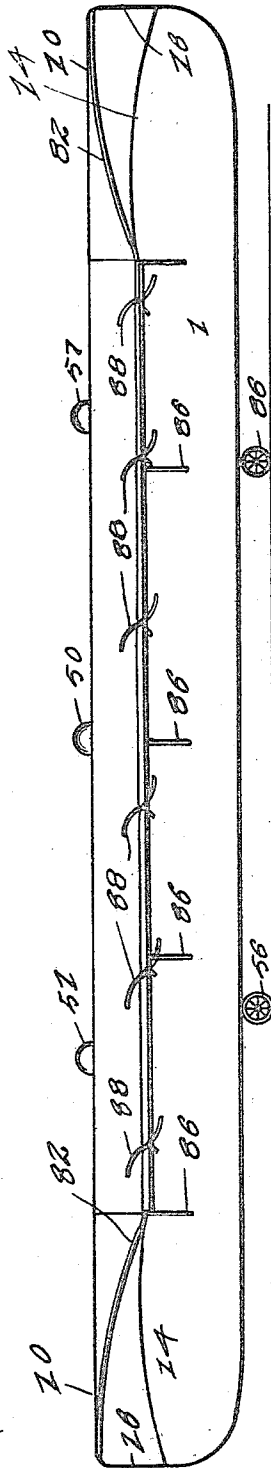
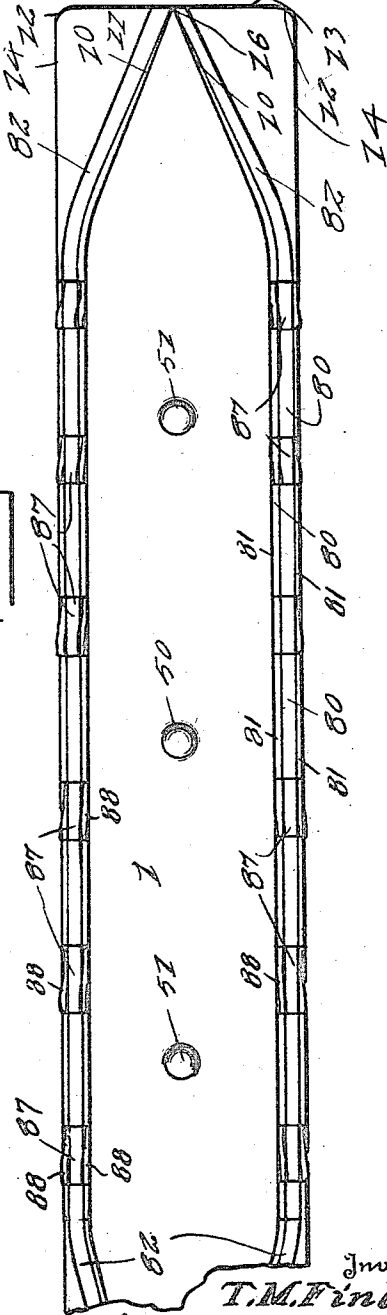


Fig. 2.



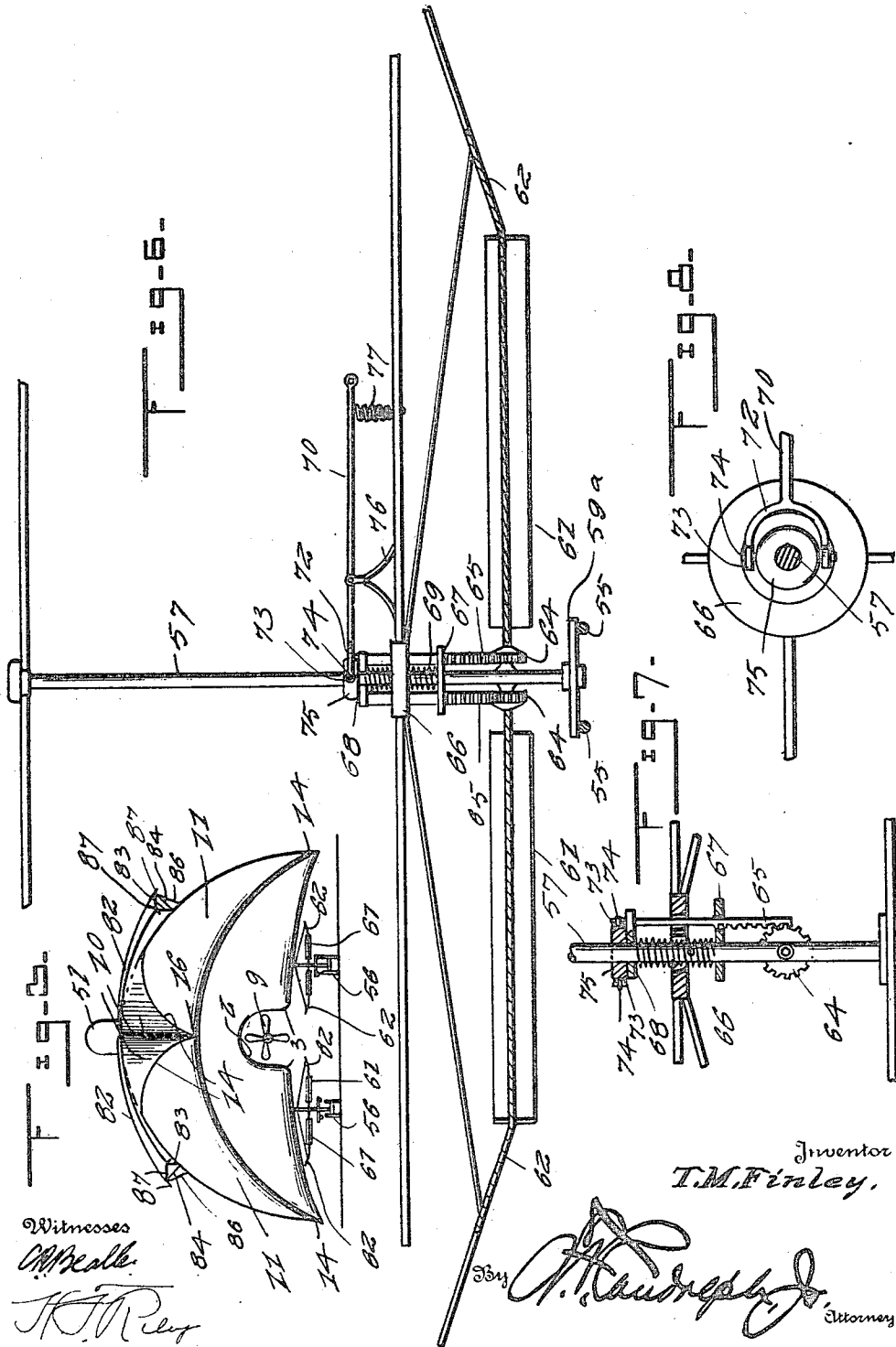
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1,265,638.

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AEROCRUISER.
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7 SHEETS—SHEET 2.



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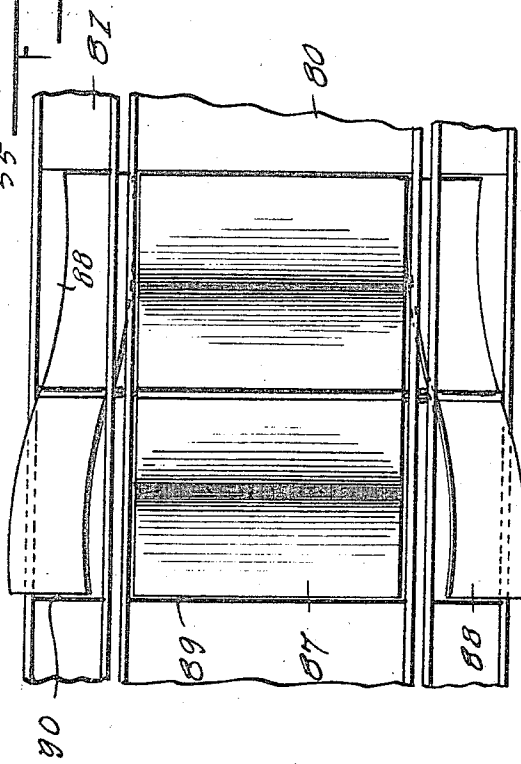
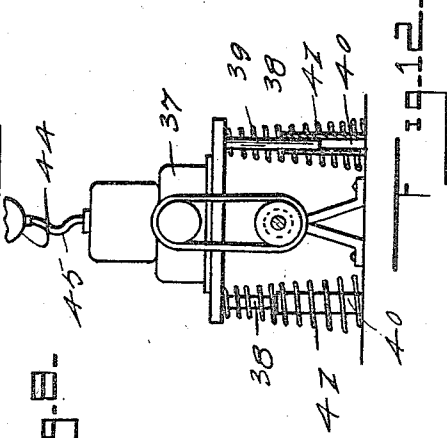
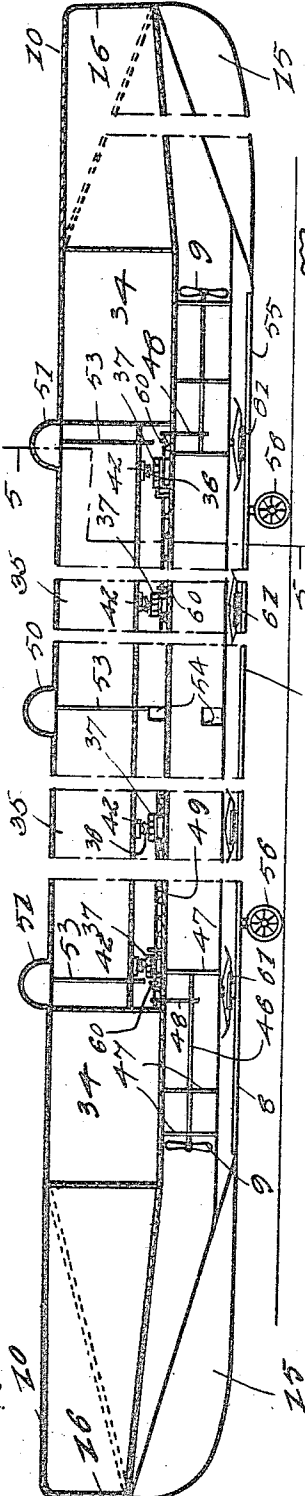
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7 SHEETS—SHEET 3.

Fig. 4.

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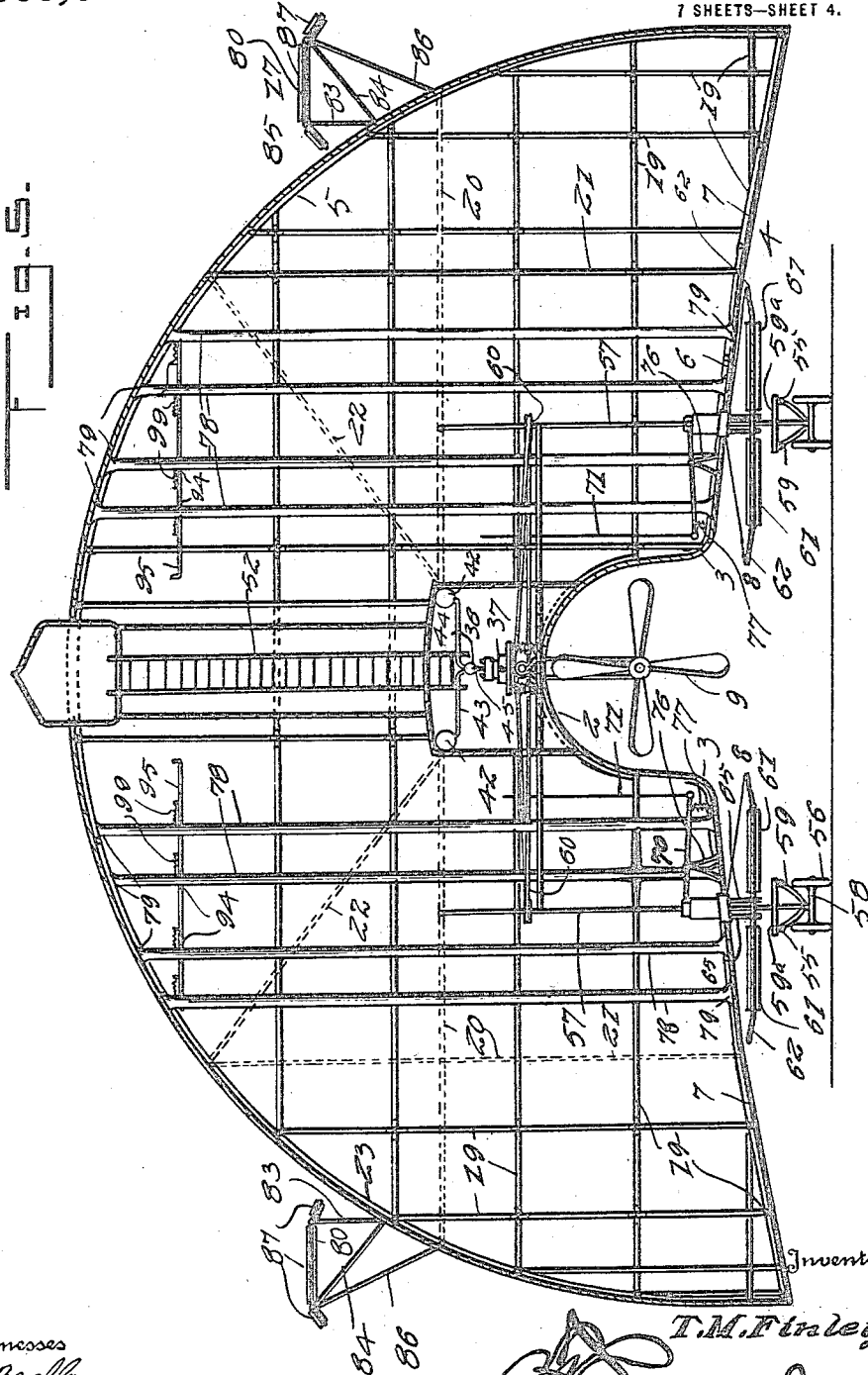
1,265,638.

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APPLICATION FILED APR. 10, 1917.

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7 SHEETS—SHEET 4.



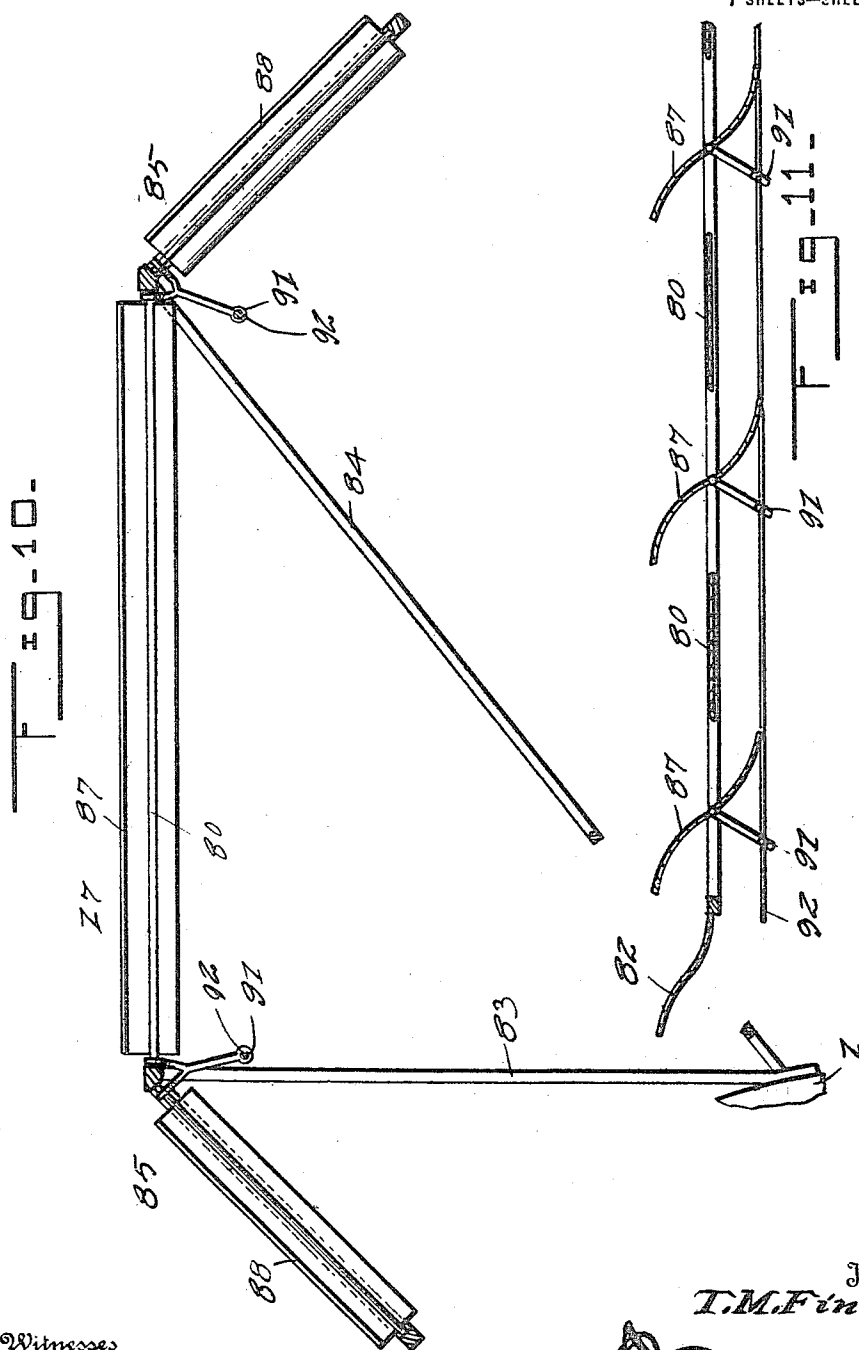
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7 SHEETS—SHEET 5.



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7 SHEETS—SHEET 7.

Fig. 18.

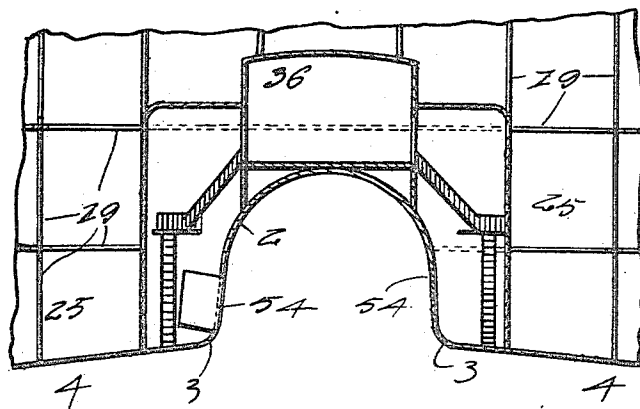


Fig. 19.

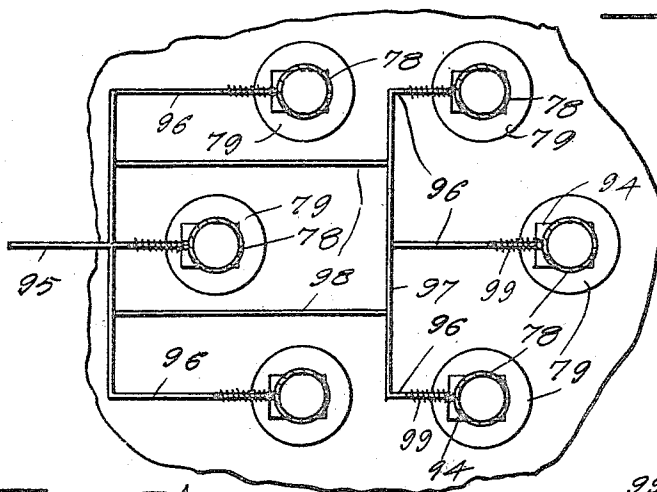


Fig. 21.

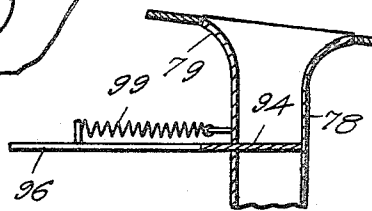
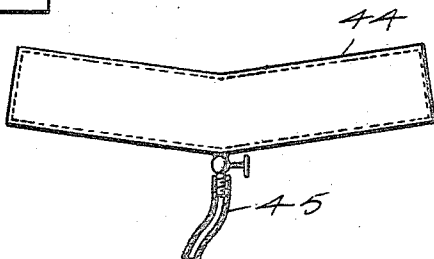


Fig. 20.

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UNITED STATES PATENT OFFICE.

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AEROCRUISER.

1,265,638.

Specification of Letters Patent.

Patented May 7, 1918.

Application filed April 10, 1917. Serial No. 160,978.

To all whom it may concern:

Be it known that I, Rev. THOMAS M. FINLEY, a citizen of the United States, residing at Westplains, in the county of Howell and State of Missouri, have invented certain new and useful Improvements in Aerocruisers; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The invention relates to improvements in airships.

The object of the present invention is to improve the construction of airships, more especially that shown and described in an application filed by me June 30, 1916, Serial No. 106,872, and to provide a simple, practical and efficient aerocruiser to be operated either lighter or heavier than air and embodying certain of the characteristics of the Zeppelin, the parachute and aeroplane and equipped with movable and relatively stationary planes and lifting and propelling propellers adapted to enable the airship to rise either vertically or while the same is traveling in a forwardly direction and to hover and descend gradually and gently so that there will be little jar or vibration incident to the landing of the aerocruiser.

A further object of the invention is to provide devices of this character adapted to operate in a dual capacity to control the ascent and descent of the aerocruiser, and capable also of being readily arranged so as to offer a minimum resistance to the progress of the cruiser through the air after the latter has attained the requisite momentum or speed.

A further object of the invention is to provide supporting planes adapted to cooperate with the propelling means to assist in maintaining a heavier than air body elevated, and equipped with means for causing such planes to operate in air of increased density so that they will render the airship stable and effectually prevent any tendency of the same to roll, pitch or whip.

Another object of the invention is to provide an aerocruiser adapted to be constructed of relatively large size and constructed so as to a great extent eliminate resistance to its forward movement and direct the displaced air to the supporting means

of the aerocruiser and tend to pack or condense the air beneath the same and beneath the supporting planes thereof, so that such displaced air, instead of impeding the progress of the cruiser, will assist the flight of the same and increase the stability thereof.

With these and other objects in view, the invention consists in the construction and novel combination of parts hereinafter fully described, illustrated in the accompanying drawings and pointed out in the claims hereto appended; it being understood that various changes in the form, proportion, size and minor details of construction, within the scope of the claims, may be resorted to without departing from the spirit or sacrificing any of the advantages of the invention.

In the drawings:

Figure 1 is a side elevation of an aerocruiser constructed in accordance with this invention.

Fig. 2 is a plan view of the same.

Fig. 3 is a front elevation of the aerocruiser.

Fig. 4 is a longitudinal sectional view of the aerocruiser.

Fig. 5 is a transverse sectional view taken substantially on the line 5-5 of Fig. 4.

Fig. 6 is an enlarged detail view of one of the rotary planes and lifting propellers.

Fig. 7 is a detail view of the means for opening and closing the blades of the lifting propeller.

Fig. 8 is a detail view of the actuating lever for opening the blades of the lifting propeller.

Fig. 9 is an enlarged detail view of a portion of one of the side planes.

Fig. 10 is an enlarged transverse sectional view of the same.

Fig. 11 is an enlarged detail longitudinal sectional view of the central member of the side planes.

Fig. 12 is a detail view of the cushioning means of the engines.

Fig. 13 is a detail sectional view of a portion of the body of the aerocruiser illustrating the manner of bracing the walls of the gas bags or buoyant section.

Fig. 14 is a detail view of a section of the walls of the body illustrating the arrangement of the reinforcing wires.

Fig. 15 is an enlarged detail sectional

view showing the manner of securing the covering to the braces for forming an air-tight connection.

Fig. 16 is an enlarged detail sectional view of a portion of the walls of the body.

Fig. 17 is an enlarged detail sectional view on the line 17—17 of Fig. 16.

Fig. 18 is an enlarged detail vertical transverse sectional view illustrating the arrangement of the entrances.

Fig. 19 is a detail horizontal sectional view illustrating the construction for opening and closing the upper ends of the vertical tubular passages for the rotary horizontal propellers.

Fig. 20 is an enlarged vertical sectional view of the upper end of one of the vertical passages.

Fig. 21 is a detail view of the oppositely inclined auxiliary feed tank.

Like numerals of reference designate corresponding parts in the several figures of the drawings.

In the accompanying drawings, in which is illustrated the preferred embodiment of the invention, the aerocruiser comprises in its construction a body 1 approximately crescent shaped in cross section and having a central longitudinal trough 2 of substantially semi-cylindrical shape provided with rounded or curved portions 3 at the side walls where the same merge into the bottom 4 of the body. The rounded portions of the side walls of the longitudinal trough form a flaring entrance at the bottom to facilitate the upward passage of the air into the trough.

The top 5 of the body consists of an arch, and the said bottom 4, which is divided longitudinally by the trough, has its side portions composed of inner and outer angularly related sections 6 and 7, which increase the effect of the body in forming a parachute like structure and at the same time tend to compress or condense the air both to cause the same to rush into the trough and also to enable rotary stabilizing planes or gyratory elements 8 to operate in a sufficiently dense medium to obtain a maximum effect in their operation on the air. The angularly related inner and outer sections 6 and 7 of the side portions of the bottom cause the said side portions to have a general inclination downwardly and outwardly from the opposite sides of the trough so that the body will have a tendency to compress or condense the air and force the same upwardly into the trough where the air will have the greatest density so as to be most effectively operated on by main driving propellers 9.

In order to enable the body to progress through the air with a minimum amount of resistance to divide the displaced air and cause the same to be directed beneath the

supporting means of the body for enabling such supporting means to operate on air of a maximum density, the body 1 is provided with ends or terminal portions each comprising a forwardly tapered top section 10 and a lower transversely curved forwardly tapered arcuate portion 11, which is rounded at the corners at 12 where the front edge 13 merges into the side edges 14 of the body of the aerocruiser. The front edge 13, which is preferably formed on a true arc, is relatively sharp and has its center or highest point located above the longitudinal center or axis of the body to produce an upward stroke 15 of the transversely curved underside of the terminal portion or section 11 and the upper face of the upper section is sloping or slanting and extends upwardly and rearwardly and presents an upper convex surface. The under surface has a downwardly and rearwardly inclination or slope and produces a slight forward or outward flare so that the curved lower section of the terminal portion or end of the body is wedge shaped and divides the air, the major portion passing beneath the section 11 and into the flared entrance formed by the concave under side of the section 11.

The top section 10, which tapers laterally to form a horizontal wedge, has a straight vertical front edge 16, and the side faces are straight or substantially flat and diverge rearwardly from the straight vertical edge 16, which rises from the center of the lower section 11 at the front edge thereof. The top or upper face of the section 10 has a slight curvature to conform to the configuration of the top or arch of the body and it forms a continuation or extension thereof with its central portion in a horizontal plane so that there is no tendency through any downward or forward taper of the top to cause a resistance to the upward nosing of the body, or a depressing action on the same when the body is traveling in a horizontal course. The upper tapered section, which divides the air passing over the lower transversely curved section, causes the said air to travel along the sides of the upper portion of the body and pass beneath side supporting planes 17. In this manner the air displaced by the body is directed to the side supporting planes and to the under side of the body and through the longitudinal trough thereof, causing the displaced air to assist in sustaining the said body and also to insure a maximum effect of the propellers and planes, instead of simply retarding or resisting the forward movement of the body through the air. The lines of the ends of the body are such that there is no abrupt shoulders to offer resistance to the body through the air, and with the construction shown and described, bodies of relatively

large size of a diameter of fifty feet and in excess thereof may be made with a gradual sloping of the end portions and a gradual flaring of the under side of the same, and the side portions of the body at the bottom form two great laterally extending wings adapted to gather the air and force the same with increased density into the longitudinal trough. The top of the trough intersects the flaring transversely curved lower faces of the terminal portions of the body and the side portions of such lower faces intersect and merge into the side walls of the trough.

The body of the machine is preferably formed by an outer covering 18 of cloth arranged on a frame work 19 preferably constructed of tubular metal and composed of longitudinal members and transverse connecting members 20 and vertical standards and inclined braces 21 and 22 forming a transverse bracing frame work. The longitudinal members are also designed to be connected by curved transverse members 23 extending from one side of the body to the other and preferably consisting of short sections and threaded couplings 24 connecting the sections of the transverse arcuate members 23 with one another, and also securing the said arcuate members 23 to the longitudinal members of the frame work. The size of the tubular members and the number and arrangement of the connecting and bracing members will of course be proportioned to the size of the body to secure the requisite strength and rigidity of the frame work, which is inclosed within the outer covering. The outer covering 18, which may be constructed of any suitable material, is designed to be supported exteriorly by reinforcing cloth-covered wires 25, which may of course be coated or covered in any other suitable manner to prevent them from cutting the fabric covering, which in practice may be used as a gas confining medium, and the tubular character of the frame work is designed to admit of the heating of the buoyant sections or gas bags for increasing the pressure and expansibility of the gas, and the buoyancy of the body.

The outer covering is designed to be secured to the frame work by fastening devices comprising bands 26 and threaded shanks 27, preferably constructed of aluminum, but any other suitable material may of course be employed. The bands are arranged on the tubular members of the frame work, as clearly illustrated in Fig. 17 of the drawings, and the threaded shank 27 passes through the covering and is equipped with a clamping nut 28, a metallic shield or plate 29 and an inner lining or layer of rubber 30 being preferably interposed between the clamping nut and the covering 18 to prevent injury to the latter and to enable a gas-

tight connection to be made at the points where the outer covering is secured to the frame work of the machine. Also curved or semi-tubular asbestos shields 31 are interposed between the tubular members and the outer covering to prevent the heat from the tubular members, when the latter are employed as conduits for a heating medium, from affecting the outer covering. Instead of employing asbestos in the construction of the shields, any other suitable non-heat-conducting material may of course be used, and the said shields conform to the configuration of the tubular members and fit around the outer portions thereof, the inner portions of the tubular members being exposed for heating the gaseous contents of the body. The cloth covered wires are in the form of bands and they are held in place by the metallic shields or middle plates 29 and extend around the body and conform to the configuration of the same. In the construction of the body the cloth is preferably arranged in transverse bands or sections and secured in overlapping relation by rubber cementing, which in practice, has been found to make joints of this character fully as strong if not greater in strength than the body of the cloth, owing to the overlapped material at the joints. The wires are adapted to reinforce the cloth where the same acts as the covering or wall of the gas bags or chambers, and owing to the clamping of the wires by the fastening means for securing the covering to the frame work they may be drawn as tightly as necessary to reinforce the cloth covering.

The gas bags or receptacles hereinafter described may be braced and reinforced by vertical and horizontal bracing rods 31^a having their terminal portions arranged in sleeves 32 extending inwardly from the cloth covering, which may be rubberized or otherwise treated to render it gas-tight, and the said sleeves are designed to be secured to the bracing rods by means of a binding or wrapping 33 of silk cord or other suitable material, which forms a gas-tight joint and effectually prevents any leakage of the gas at the points where the ends of the bracing rods are secured to the gas bags or walls of the gas compartments. Although the bracing rods are shown in a vertical and horizontal position, as illustrated in Fig. 13 of the drawings, they may of course be placed in any other desired manner.

The body is provided with end gas bags or compartments 34 and intermediate gas bags or compartments 35, the number and size of the gas bags or compartments, which form buoyant sections, may be varied to secure the desired proportions between the buoyancy or lifting power of such gas bags or compartments and the load to be carried by the airship, including the weight of the

same, and when the load varies incident to a change in the character or amount of the cargo, the consumption of fuel or other cause, the lifting power of the buoyant sections may be correspondingly varied by admitting air to a greater or less degree into some of the sections, and any suitable means may of course be employed such as air valves and controlling means for this purpose, or by cooling or heating the gas.

The body is preferably provided with a single central longitudinal compartment 36 for the occupancy of the crew of the airship, and the engines and other mechanism such as heating or refrigerating apparatus, and the said longitudinal compartment 36 preferably terminates at the end gas bags or buoyant sections 34 and is located directly over the longitudinal trough 2. The engines 37, which may be of any desired number and of any preferred type, are preferably mounted on shock absorbers 38 consisting of telescopic members 39 and 40 and cushioning springs 41, but any other suitable means may be employed for absorbing the jar and vibration of the engines and for preventing the same from being communicated to the frame work of the body and injuring the same.

The engines are supplied with fuel from overhead longitudinally disposed tanks 42 connected by suitable pipes 43 with a central auxiliary tank 44 preferably located over each of the engines and having terminal portions inclined upwardly in opposite directions so that any change in the position of the body from a horizontal to an inclination will not affect the proper feed of the fuel to the engines. The auxiliary tank 44 is connected by a suitable feed tube 45 with the engines and one or more of such feed tubes may of course be employed, suitable means being employed to permit the feed tube to adjust itself to the cushioning action of the shock absorbing devices which support the engines.

Two main vertically disposed propellers 9 are provided but any desired number may of course be employed, and these propellers are mounted on longitudinal propeller shafts 43 journaled in suitable bearings or supports 47 and connected by suitable gearing 48 with longitudinal aligned shafts 49 mounted in suitable supports and extending along the bottom of the compartments 36. Any suitable means may be employed for supporting the propeller shafts and the gearing 48 is shown in the form of belt and pulleys, which may be either plain or chains, but any other suitable gearing may of course be employed for this purpose. A pair of engines is preferably connected with each of the aligned shafts which terminate short of the central portion of the longitudinal compartment, and by employing a pair of engines for each of the aligned shafts an emergency set is

always at hand and the engines may be used alternately thereby greatly increasing the life of the engines and lessening the liability to accidents. The longitudinal compartment is designed to be made air-tight and to be supplied with suitable ventilating apparatus such as an air compressor for maintaining the desired pressure within the said compartment 36 so that the proper amount of oxygen will be supplied both to the crew and to the engines for securing a proper operation of the engines and the necessary density of the atmosphere for enabling the crew to operate at any elevation without inconvenience, suitable automatic release valves being of course provided for permitting the escape of the air and preventing excessive pressure within the compartment.

The body is provided with an operator's cab or pilot house 50 and with gun emplacements or compartments 51, preferably arranged as shown and extending both interiorly and exteriorly of the body and designed to be reached by vertical ladders 52 and 53 extending upwardly from the longitudinal compartment at the center and ends thereof, and the said compartment is designed to be provided with entrances located at opposite sides of the body and centrally of the same, as shown at 54. This will effect a proper balancing of the body with respect to the entrances and will enable access to be had to the longitudinal compartment from either side of the aerocruiser.

The body 1 is designed to be reinforced or braced at the bottom by longitudinal truss rods 55 arranged in pairs and located at opposite sides of the trough approximately centrally of the inner section 6 of the bottom portions of the body and forming means for mounting the wheels 56 and also supports for the lower ends of the vertical shafts 57 of the rotary planes or gyratory members and the lifting propellers. The wheels 56 are mounted on suitable axles 58, which are connected by suitable springs 59 with the truss rods 55. The lower ends of the vertical propeller shafts 57 are stepped in suitable bearings of transverse plates or bars 59^a which extend across the spaces between the truss rods and are suitably secured to the same. The vertical propeller shafts are connected by suitable gearing 60 with the aligned shafts and suitable compartments are provided in the body for the reception of the mechanism for controlling the blades 61 of the lifting propeller. Any desired number of the rotary planes may be employed and each consists of a central horizontal portion and an inclined upwardly extending marginal portion 62, forming a saucer shaped plane or gyratory element, as shown and described in the aforesaid application. The blades 61 of the lifting propeller are journaled in openings of the plane,

and they are equipped at their inner ends with pinions 64 meshing with vertically movable rack bars 65 operating in upper and lower guides 66 and 67 and adapted to move downwardly to open the blades of the lifting propeller and upwardly to close the same. The rack bars are connected at their upper ends to a suitable head 68, and a coiled spring 69, which is disposed on the vertical propeller shaft, is interposed between the head 68 and the lower guide 67 so as to be compressed when the rack bars and the head 68 are moved downwardly by a lever 70 to open the blades. When the blades are opened their lower portions are of greater area than the upper portions so that the pressure of the air against the lower portions of the blades will assist the closing movement of the said blades when the latter are free to move. Also the coiled spring 69 is adapted to positively move the rack bars and the head 68 upwardly when the operating mechanism 71, for controlling the lever 70, is released. The lever 70, which has a forked portion 72 to straddle the shaft, is provided with eyes 73 for the reception of pivots 74 of a collar 75 slidably arranged on the propeller shaft and located above the head 68 and adapted to enable the lever 70 to force the head and the rack bars downwardly. The lever 70 is fulcrumed intermediate of its ends on a suitable support 76, and a coiled spring 77 is connected with the outer end of the lever for maintaining the collar normally elevated. The operating mechanism 71, which may be of any desired construction, is designed to extend to the cab or pilot house of the aerocruiser and any suitable means such as an operating lever and a pawl or detent and toothed segment may be employed for locking the blades 61 in their open position. The openings 63 are of a size to fit the blades 61 when the latter are closed, and by mounting the lifting propellers in this manner they may be brought into operation when the machine is ascending or descending to control the upward and downward movement of the same and after the airship has reached the desired elevation and has attained a speed sufficient to enable the airship to maintain its flight and after the airship has attained such speed the lifting propellers may be closed and they will then complete the body portion of the gyrotory planes or elements and close the openings of the same. The lifting propellers will then be practically eliminated and will offer no resistance to the progress of the airship, but in coöperating with and forming a part of the rotary planes or gyrotory elements will assist in maintaining the said airship in a stable condition.

In order to supply the necessary air to the lifting propellers, the body is provided with an arcuate series of vertically disposed tubes

78 located above each of the rotary planes and lifting propellers and having tapered or flared terminal portions 79. The tubes 78 will permit a sufficient passage of the air through the body to enable the lifting propellers to operate with a maximum effect, and when the lifting propellers are not in use, the vertical tubes 78 may be closed at the top to form air pockets to assist the body in maintaining its elevation. Any suitable means may be employed for closing the upper ends of the vertical tubes and the latter also serve as bracing means for increasing the strength and rigidity of the frame work of the body. In practice, it will be preferable to provide mechanism automatically operable by the blade closing means for closing the upper ends of the vertical tubes 78 when the blades are moved to their closed position.

The side planes 17 are composed of central horizontal members 80 and inner and outer inclined side members 81 extending downwardly and outwardly and downwardly and inwardly in diverging relation to provide side longitudinal troughs which are located at the opposite sides of the body in position to receive the air divided by the upper tapered section 10. The central members of the side planes are provided with upwardly extending inclined terminal portions 82 adapted to deflect the air divided by the said top section 10 of the body for causing the same to rush beneath the side planes through the trough formed by the horizontal central members and the inner and outer inclined members of the said planes. These side planes, which are adapted to assist in supporting the body when the same is traveling through the air, also serve to maintain the body in firm equilibrium as they are located above the center of gravity of the body and serve to steady the same and prevent rolling, whipping, or pitching. The side planes are supported by vertical and inclined bars 83 and 84 and by suitable braces or stays 85 and 86, but any other suitable supporting frame work may be of course employed for this purpose. The central and side planes are provided with pivoted transversely disposed blades 87 and 88 operating in openings 89 and 90 in the said central and side members of the side planes and adapted to be opened and closed. These central and side blades, which are designed to be arranged in sets, are preferably curved in opposite directions at opposite sides of the pivots or pintles, and their front portions, which extend upwardly when they are arranged in the position shown in Fig. 11, are adapted to catch the air and force the same downwardly beneath the side planes. The pivots or pintles are provided with arms 91, which extend downwardly and to which are connected suitable operating rods

92. The blades of the central member are designed to be approximately twice the area of the blades of the side members, but the relative size of the blades may of course be varied and the said blades may be operated to extend their front portions above or below the central and side members and some of the sets may be extended below and others above to produce an upward passage of the air through some of the openings and downward passage of the air through other of the openings so that the air at the sides of the body will serve to lock the same in relatively rigid stability and thereby counteract any tendency of the body to roll or pitch. When the pivoted blades of the central and side members of the side planes are closed, they close the openings of the said side planes. The inclined side members will be braced and supported at intervals by suitable means.

The air, which is divided by the sharp top section of the body and sent around the sides of the same, reaches the side planes with its density increased affording the side planes increased power. The side planes arrest the air in its natural rush toward the thin air at the crest of the body and forces the air downward packing the same and causing such air to pack downward to the lower edges or side edges of the body so that such air will replace the packed air beneath the body and will produce a rush of air downward around the side edges of the body and upward to the trough and this action is intensified by the air rushing inward toward the fast moving body when the same is in motion. The friction resisting the forward movement of the bodies of airships is thus largely eliminated and the pressure of the air utilized in sustaining and facilitating the propulsion of the machine. Also by the tendency of the side planes to condense or pack the air beneath them they ride at all times on heavy streams of air. The blades when open draw the air from above and not only lighten the air at the crest of the body, but also serve to arrest the heavy streams of air that are rushing around the ends of the body and flowing toward the space of the thin or light air at the top of the machine, forcing such streams backward and downward and causing the air in such packed condition to flow around the side edges of the body. These bodies or streams of heavily packed or condensed air flowing in great quantity along the lower edges of the airship will hold the airship firmly in proper position and afford the body increased steadiness in flight and render the airship stable and safe.

By the proper adjustment of the gas supply relative to the weight of the aerocruiser and its cargo, the same ratio of difference may be maintained at all weights. By vir-

tue of the fact that the gas in the body is not indispensable to the operation of the airship, but only assists in the flight of the same, the airship may be operated swiftly, safely and powerfully without a cubic foot of gas within it. This, it is clear, will be of material advantage as leakage or escape of the gas from the gas bags or compartments will not necessitate the descent of the airship which will be particularly adapted for use in territories exposed to the fire of anti-aircraft guns or the fire from other airships or flying machines. Also by reason of the parachute shape of the body, the airship may be made to hover at a high altitude without gas and may be maintained on an even keel through its shape and the operation of the rotary planes and propellers. Should there be any tendency of the airship to lose altitude while hovering without gas the descent would be so slow and gradual that it would be practically equivalent to hovering. The machine, also, without the aid of gas will rise off the ground on an aviation field and maintain its flight with a cargo of considerable weight, as the propeller blades operate in the trough of highly condensed air and the bottom of the body constitutes a vast supporting plane and in this respect operates to a greater advantage than an ordinary plane owing to the particular construction of the angularly related sections of the side portions and the central trough by which the air is gathered and packed.

The side planes with the pivoted blades serve as adjusting elevators and the said pivotally mounted blades are adapted to be arranged either to elevate or depress the machine and when they are open they are adapted to cause a great resistance to the direct passage of the air from front to rear and will cause such air to travel at a higher velocity through the openings of the central and inclined side members of the side planes in either a downwardly or upwardly direction according to the adjustment of the blades for elevating or depressing the airship, and, by an adjustment of several sets of the pivoted blades of the side planes to cause the air at certain portions of the said planes to pass upwardly through the openings and at other portions of the planes to pass downwardly through the openings, the air will operate to grip the side planes and maintain the body firm and steady. Also when it is not desired to use the pivoted blades of the side planes they will close in the openings and fill the same and form portions of the central and side members of the side planes in the formation of the upper side troughs, and owing to their curvature will maintain just enough resistance to materially assist in steadying the body of the machine when they are in their closed position. When the airship is subjected to

a strong gale and is hard to control on account of the force of the air, the steadiness of the machine may be materially increased and the machine maintained in safety by operating the blades of the rotating propeller planes so as to obtain a lifting effect and then turning or adjusting the pivoted blades of the side planes to produce a depressing effect, with the two opposing forces of equal power. This will serve to hold the body of the machine between the jaws of the opposite forces and will give an added tendency toward firmness, steadiness and safety.

On account of the great lifting power of the airship an almost perfectly equipped machine shop might be provided and by the aid of extra parts repairs might be made while the ship is in flight or hovering and without necessitating the descent of the same to the ground. This possibility too is made feasible by reason of the fact that all bearings and operating parts of the machine are accessible to the workman while the machine is held in a hovering position.

Any suitable means may be employed for opening and closing the vertical tubes or passages 78, and in the drawings the passages 78 are opened and closed by means of slidable cut-offs 94 connected with an operating rod 95 by means of stems 96 and connecting rods 97 and 98. The cut-offs are designed to be automatically closable by means of coiled springs 99 preferably connected at one end with the tubular passages and at the other end with the stems and arranged to be distended when the cut-offs are opened so that as soon as the operating lever or other device for actuating the operating rod 95 is released the cut-offs will be closed by the action of the springs 99. Any other suitable operating means may of course be employed and the springs may be arranged in any other desired manner for effecting this result.

No claim is made in the present application to the side supporting planes with their pivoted blades and the rotating planes and propellers *per se* as these features form the subject-matter of a separate application.

What is claimed is:

1. An airship of the class described including a body having a central longitudinal trough at the bottom dividing the bottom into side portions, said side portions being composed of angularly related sections adapted to gather and pack the air.

2. An airship of the class described including a body substantially crescent shaped in cross section and provided at the bottom with a central longitudinal trough and having an outwardly tapered substantially crescent shaped terminal portion presenting a forwardly and downwardly inclined upper face and a forwardly and upwardly inclined

lower face, said tapered crescent shaped front portion forming a flaring entrance at the front end of the trough.

3. An airship of the class described including an approximately crescent shaped body having a longitudinal trough at the bottom and having a terminal portion composed of a lower transversely curved section and an upper tapered or wedge shaped section located centrally of the lower section, the upper section being adapted to divide the air laterally and the lower section dividing the air and causing the same to pass above and below the said curved section.

4. An airship of the class described including a body substantially crescent shaped in cross section having a central longitudinal trough and provided with opposite angularly related bottom sections extending longitudinally of the bottom and adapted to gather and pack the air.

5. An airship of the class described including a body substantially crescent shaped in cross section having a tapered front portion presenting a transversely disposed arcuate front edge and having oppositely inclined upper and lower faces, and an upper section arranged centrally of the front edge and adapted to divide the air laterally above the said tapered portion.

6. An airship of the class described including a body approximately crescent shaped in cross section and provided with an outwardly tapered terminal portion having oppositely inclined upper and lower faces, and an upper section surmounting the said tapered portion centrally of the same and having rearwardly diverging side faces.

7. An airship of the class described including a body approximately crescent shaped in cross section and provided with an outwardly tapered terminal portion having an outwardly tapered front portion curved in cross section and presenting an arcuate front edge, and a horizontally tapered top section surmounting the said tapered portion and having an outer vertical edge rising at the center of the said arcuate edge.

8. An airship of the class described including a body approximately crescent shaped in cross section and provided with an outwardly tapered terminal portion having an outwardly tapered front portion curved in cross section and presenting an arcuate front edge, and a horizontally tapered top section surmounting the said tapered portion and having an outer vertical edge rising at the center of the said arcuate edge, said top section having a top or crest arranged in the same longitudinal plane as the top or crest of the body.

9. An airship of the class described including a substantially crescent shaped body having a longitudinal trough at the bottom and provided with an outwardly

tapered transversely curved terminal portion provided with a transverse arcuate outer edge and presenting gradually inclined upper and lower faces, the lower faces intersecting the end of the trough, and a horizontally tapered top section mounted centrally of the said tapered terminal portion and arranged to divide the air laterally.

10. An airship of the class described including a body substantially crescent shaped in cross section having a central longitudinal trough at the bottom, the bottom portions of the body at opposite sides of the trough being composed of angularly related inner and outer sections, said body having outwardly tapered transversely curved terminal portions provided with arcuate transverse edges and presenting inclined upper and lower faces and providing a flaring entrance at the bottom of the body, and a transversely tapered upper section centrally surmounting the tapered terminal portions and presenting rearwardly diverging side faces and having a vertical front edge rising at the central portion of the said arcuate front edge.

11. An airship of the class described including a substantially crescent shaped body having a central longitudinal trough at the bottom and provided with a transversely curved outwardly tapered terminal portion and having a centrally arranged horizontally tapered top section surmounting the said transversely curved terminal portion, a propeller operating within the bottom trough, and side troughs arranged exteriorly of the body at opposite sides thereof and located above the said bottom trough.

12. An airship of the class described including a body approximately crescent shaped in cross section and having a central longitudinal bottom trough and provided with a tapered transversely curved terminal portion, said body being also provided with a horizontally tapered wedge shaped top section surmounting the said tapered portion and adapted to divide the air laterally, and side troughs located at opposite sides of the body in rear of the tapered top section and arranged to receive the air divided by the same.

13. An airship of the class described including a body approximately crescent shaped in cross section and having a central longitudinal bottom trough and provided with a tapered transversely curved terminal portion, said body being also provided with a horizontally tapered wedge shaped top section surmounting the said tapered portion and adapted to divide the air laterally, side troughs located at opposite sides of the body in rear of the tapered top section and arranged to receive the air divided by the same, means carried by the side troughs for

depressing the body, and lifting propellers carried by the body to counteract the effect of the said means and maintain a firmness and steadiness of the body in the air.

14. An airship of the class described including a body approximately crescent shaped in cross section and having a central longitudinal bottom trough and provided with a tapered transversely curved terminal portion, said body being also provided with a horizontally tapered wedge shaped top section surmounting the said tapered portion and adapted to divide the air laterally, side troughs located at opposite sides of the body in rear of the tapered top section and arranged to receive the air divided by the same, pivoted blades mounted on the troughs and operable to depress the body, and lifting propellers carried by the body and arranged to counteract the effect of the said blades to produce a firmness and steadiness of the body in the air.

15. An airship of the class described including a body substantially crescent shaped in cross section, longitudinal truss rods arranged in pairs at opposite sides of the bottom of the body, and supporting wheels provided with axles and having springs extending upwardly from the axles and connected with the truss rods.

16. An airship of the class described including a body provided at opposite sides with longitudinal truss rods arranged in pairs, supporting wheels arranged in pairs, axles connecting the members of the pairs of supporting wheels, and springs centrally secured to the axles and having upwardly diverging portions connected with the truss rods.

17. An airship of the class described including a body, spaced longitudinal truss rods located beneath the body, a vertical propeller shaft mounted in the body and extending below the same, a transverse bar connecting the truss rods and having a bearing receiving the lower end of the propeller shaft, and a propeller carried by the shaft.

18. An airship of the class described including a body, truss rods located at opposite sides of the body and arranged in pairs, transverse bars connecting the pairs of truss rods and provided with bearings, vertical shafts mounted in the body and extending below the same and having their lower ends stepped in the said bearings, and rotary elements carried by the vertical shafts and arranged interiorly of the body between the same and the truss rods.

19. An airship of the class described including a body, truss rods located at opposite sides of the body and arranged in pairs, transverse bars connecting the pairs of truss rods and provided with bearings, vertical shafts mounted in the body and extending below the same and having their lower ends

stepped in the said bearings, rotary elements carried by the vertical shafts and arranged interiorly of the body between the same and the truss rods, and carrying wheels having 5 axles and connected with the truss rods.

20. An airship of the class described including a body, truss rods located at opposite sides of the body and arranged in pairs, transverse bars connecting the pairs of truss 10 rods and provided with bearings, vertical shafts mounted in the body and extending below the same and having their lower ends stepped in the said bearings, rotary elements carried by the vertical shafts and arranged 15 interiorly of the body between the same and the truss rods, and carrying wheels arranged in pairs and provided with axles and having springs, said springs being provided with upwardly diverging arms secured to the 20 truss rods.

21. An airship of the class described including a frame work, a fabric covering arranged over the frame work and having gas compartments, fastening devices consisting of bands arranged on the frame 25 work, and threaded shanks extending through the covering and provided with exterior nuts.

22. An airship of the class described including a frame work, a fabric covering arranged over the frame work and having gas compartments, fastening devices consisting of bands arranged on the frame 30 work, threaded shanks extending through the covering and provided with exterior nuts, and shields consisting of metal plates having linings at their inner faces and interposed between the nuts and the fabric.

23. An airship of the class described including a frame work having tubular members adapted to form conduits for a heating medium, a fabric covering arranged on the 40 frame work and having gas bags or compartments, and fastening devices connecting the fabric covering with the frame work, and shields of non-heat-conducting material interposed between the fabric and the tubular members and conforming to the configuration of the latter, said tubular 50 members being exposed at the inner sides away from the fabric covering.

24. An airship of the class described including a frame work having tubular members adapted to form conduits for a heating 55 medium, a fabric covering supported by the frame work, a fastening device comprising a band arranged on the tubular members, and a shank extending from the band and piercing the covering and provided with 60 an exterior nut, an approximately semi-tubular shield of non-heat-conducting material arranged on the outer portion of the tubular member and interposed between the same and the fabric covering, and an outer 65 plate or shield having an inner lining and

interposed between the nut and the fabric covering.

25. An airship of the class described including a fabric covering having opposite inwardly extending tubular portions or 70 sleeves, a bracing rod extending through the tubular portions or sleeves, and a wrapping surrounding the tubular portions or sleeves to form a gas-tight connection.

26. An airship of the class described including a frame work, a fabric covering supported by the frame work, said frame work being provided with fastening devices having shanks piercing the covering and 75 provided with exterior clamping nuts, shields consisting of plates interposed between the clamping nuts and the fabric covering, and reinforcing elements arranged exteriorly of the covering and secured to the same by the said shields. 85

27. An airship of the class described including a frame work, a fabric covering supported by the frame work, said frame work being provided with fastening devices having shanks piercing the covering and 90 provided with exterior clamping nuts, shields consisting of plates interposed between the clamping nuts and the fabric covering, and crossed reinforcing wires arranged exteriorly of the covering and secured 95 between the same and the shield by the latter.

28. An airship of the class described including a body, a propeller, an engine located within the body and connected with 100 the propeller, spaced tanks located above the plane of the engine, an auxiliary tank connected with the spaced tanks and having oppositely inclined upwardly extending terminal portions, and a feed pipe connecting the auxiliary tank with the engine. 105

29. An airship of the class described including a hollow body substantially crescent shaped in cross section and provided with 110 a longitudinal trough located at the bottom of the body, said body being also provided at opposite sides of the trough with tubular passages extending through the body from the top to the bottom and 115 located at opposite sides of the trough, and rotary propellers operating beneath the said passages at opposite sides of the trough.

30. An airship of the class described including a hollow body having a longitudinal trough at the bottom and provided at opposite sides of the trough with arcuate series of tubular passages extending through the body from the top to the bottom thereof, and rotary elements operating beneath 125 the body at the said passages.

31. An airship of the class described including a hollow body having a longitudinal trough at the bottom and provided 130

at opposite sides of the trough with arcuate series of tubular passages extending through the body from the top to the bottom thereof, said passages having tapered or flared upper and lower terminals, and horizontal propellers located beneath the body at the said passages.

32. An airship of the class described including a hollow body having a longitudinal trough at the bottom and provided at opposite sides of the trough with arcuate series of tubular passages extending through

the body from the top to the bottom thereof, said passages having tapered upper and lower terminals, horizontal propellers located beneath the body at the said passages, and means for closing the passages at the top to form air pockets in the body.

In testimony whereof I affix my signature in presence of two witnesses.

THOMAS M. FINLEY.

Witnesses:

M. D. LEWIS,

BENNETT S. JONES.