Feb. 23, 1932. J. B. ICRE 1,846,336

SHIP AND AIRPLANE

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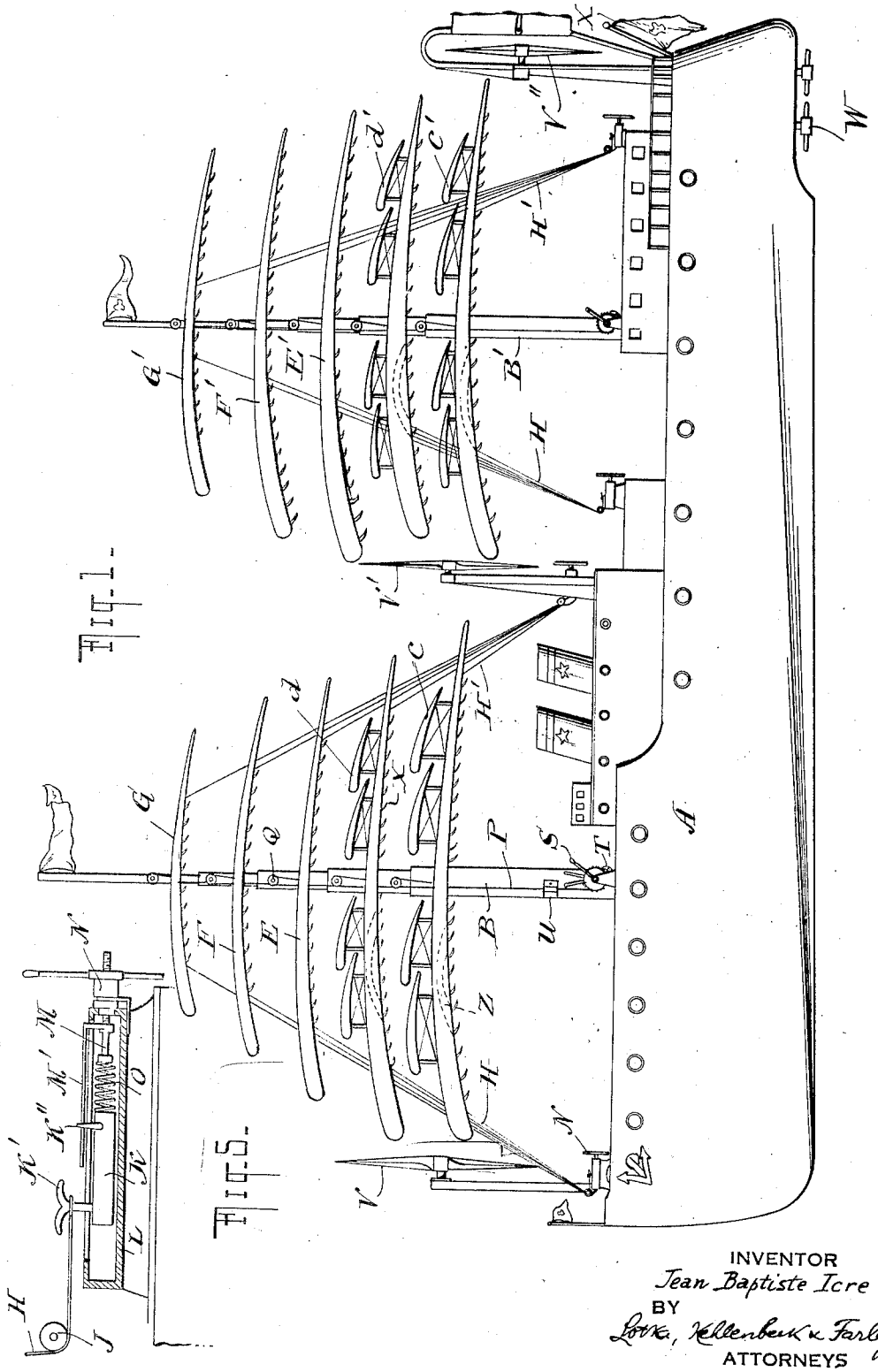


Fig. 1.

Fig. 5.

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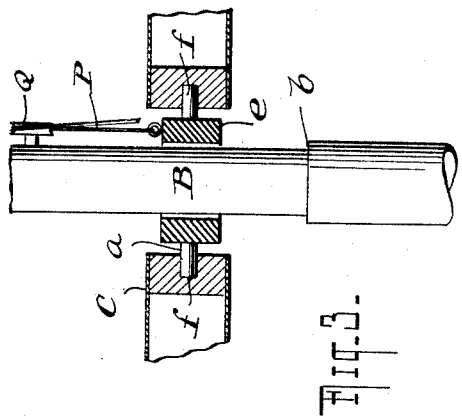


Fig. 3.

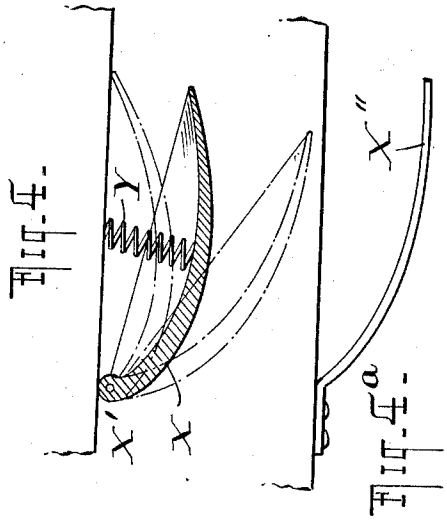


Fig. 4.

Fig. 4a.

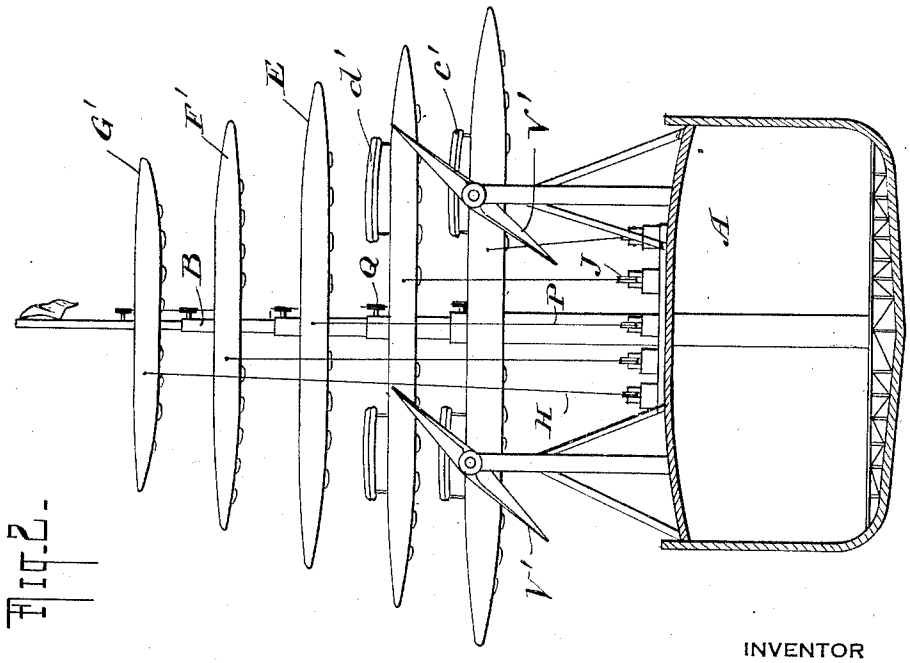


Fig. 2.

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FIG. 6.

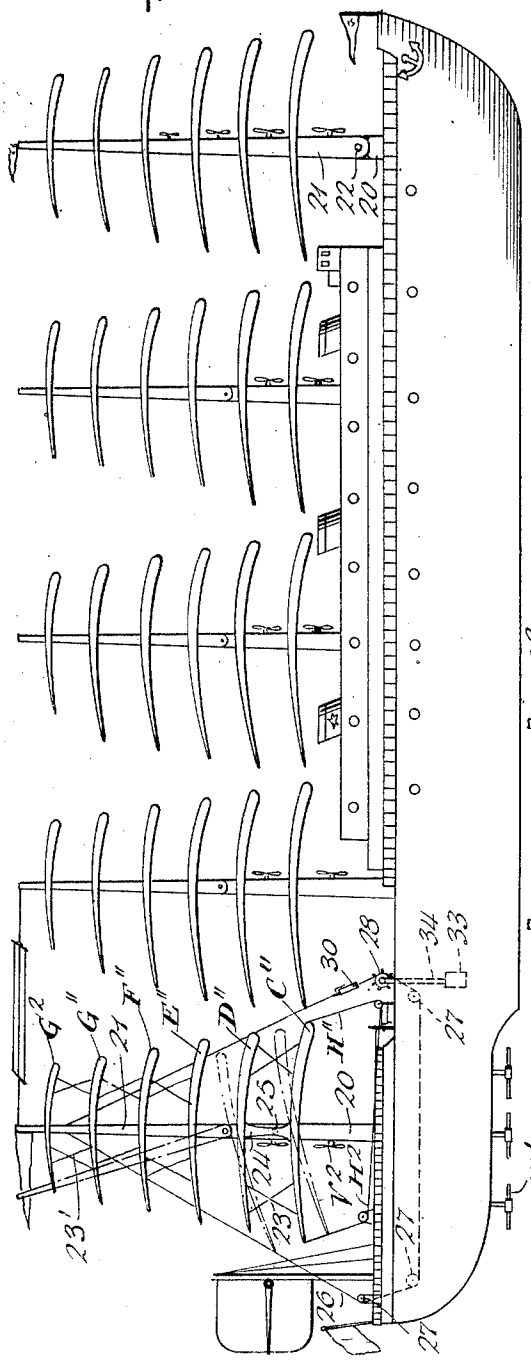


FIG. 9.

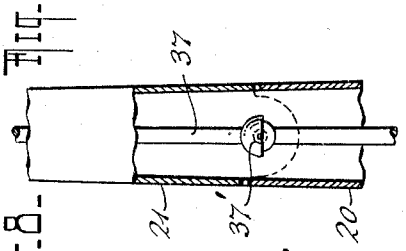


FIG. 8.

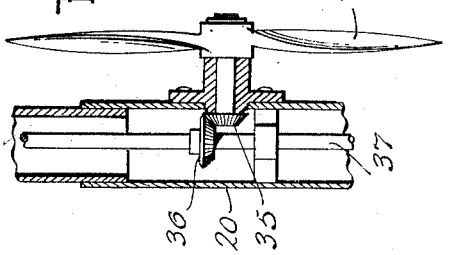


FIG. 7.

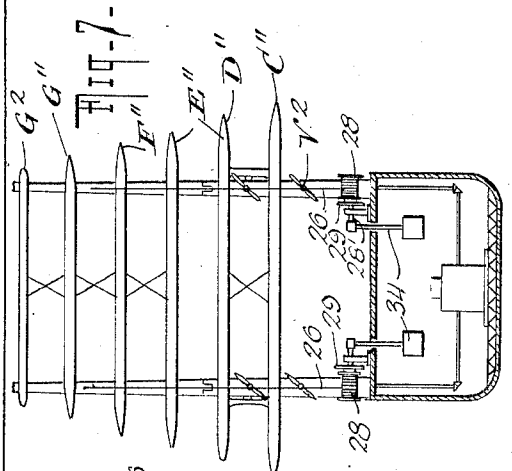
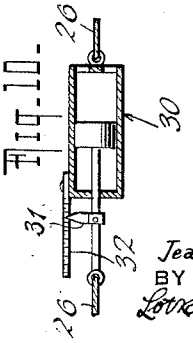


FIG. 10.



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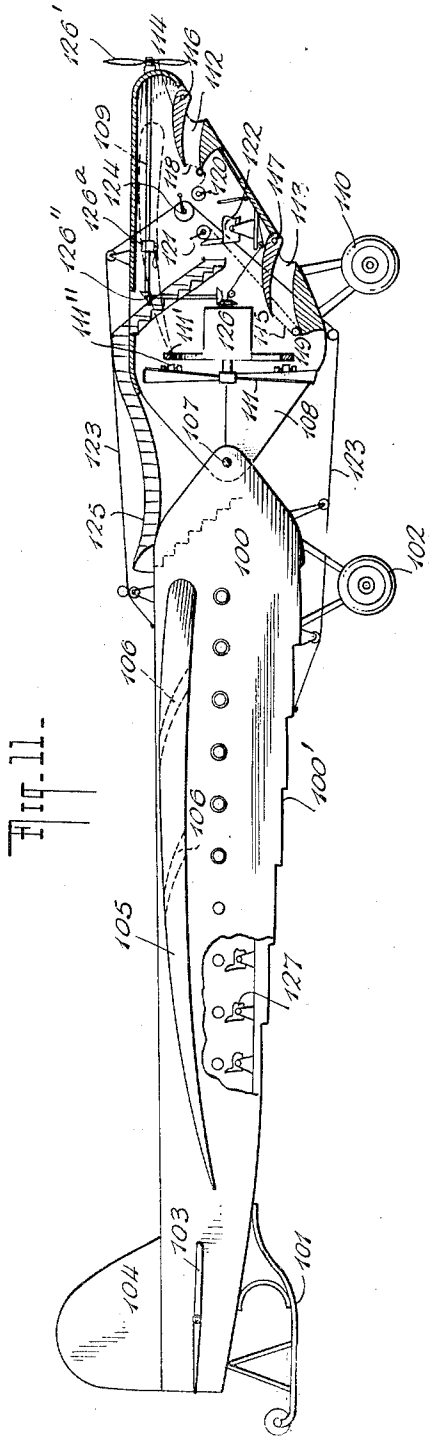


Fig. 11.

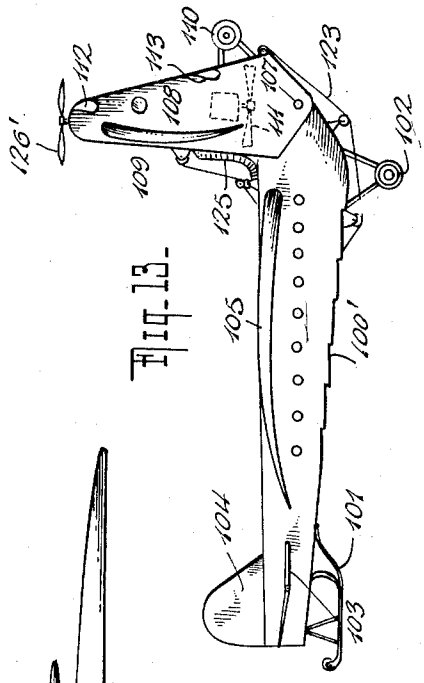


Fig. 13.

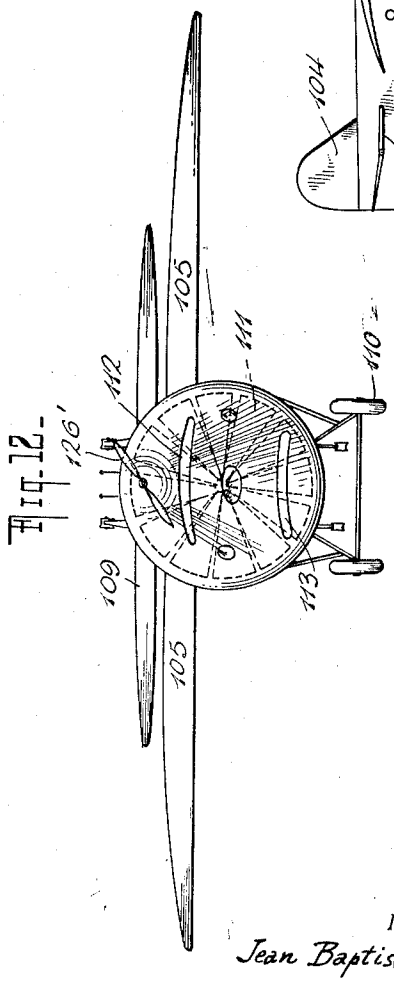


Fig. 12.

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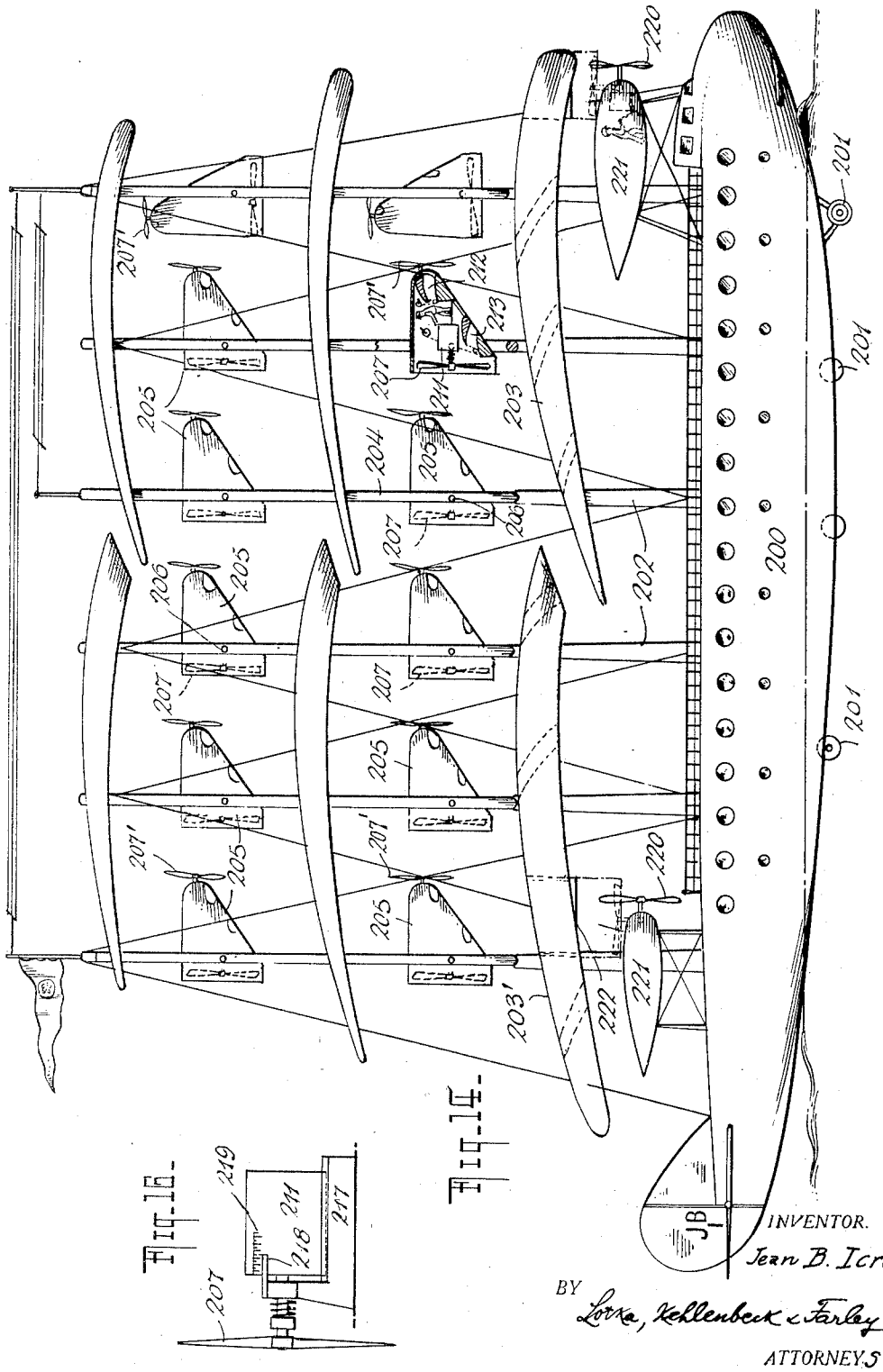


Fig. 14.

Fig. 15.

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Jean B. Icre

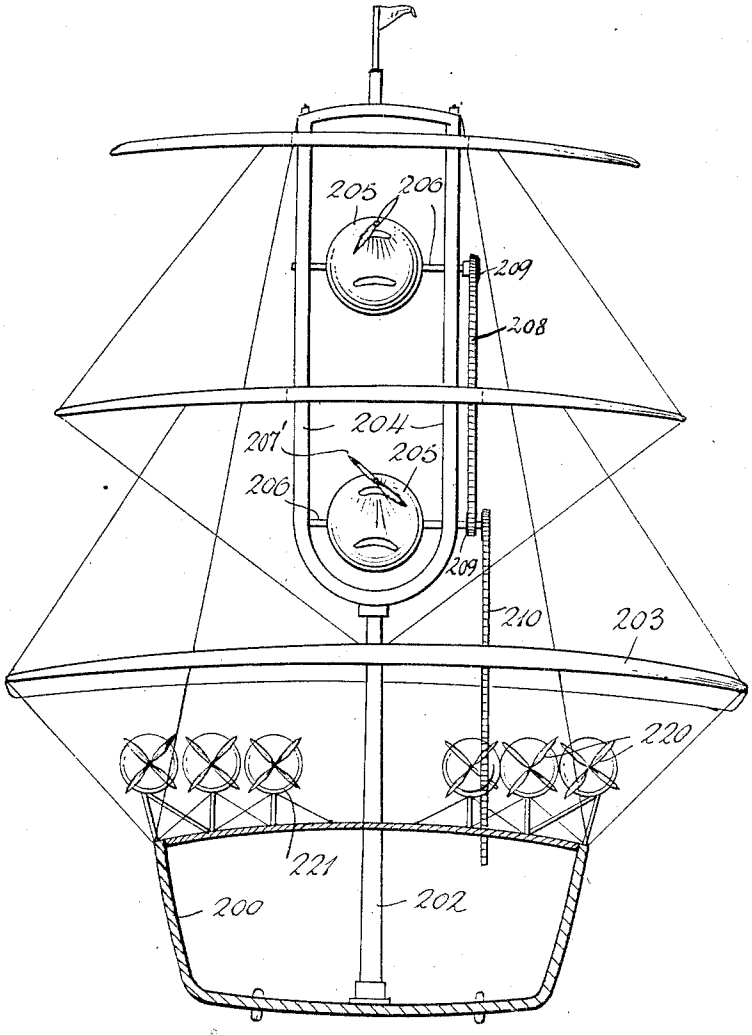
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SHIP AND AIRPLANE

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Fig. 15.



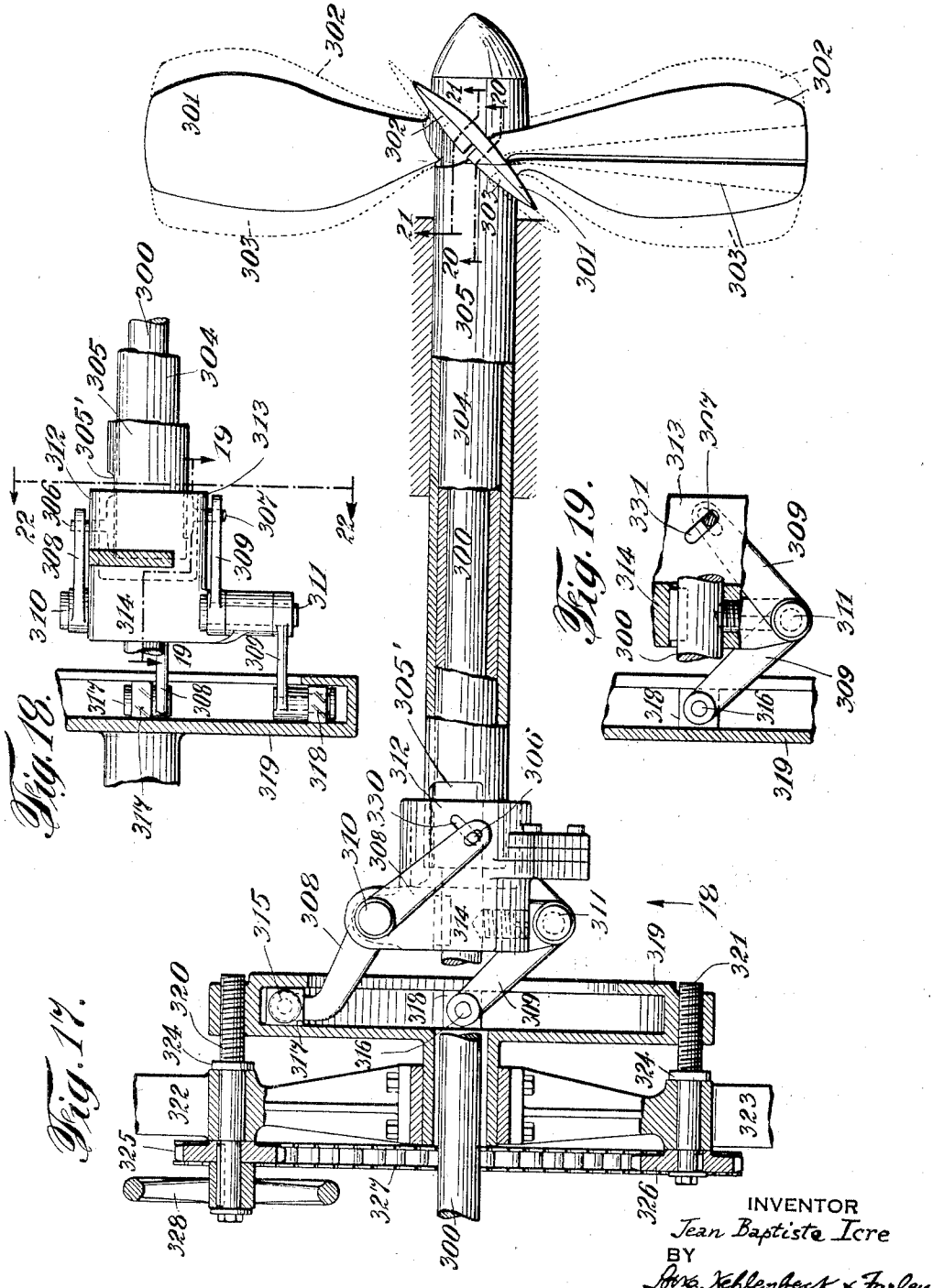
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SHIP AND AIRPLANE

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SHIP AND AIRPLANE

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Fig. 23.

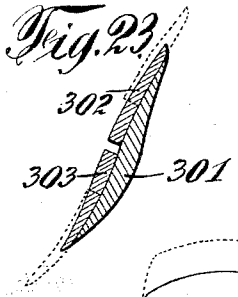


Fig. 20.a

Fig. 20.

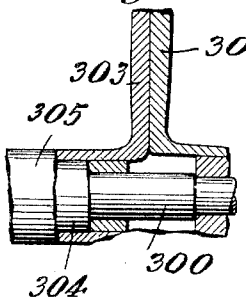


Fig. 21.

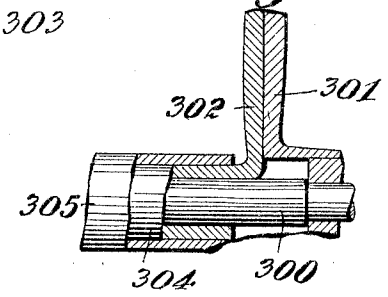
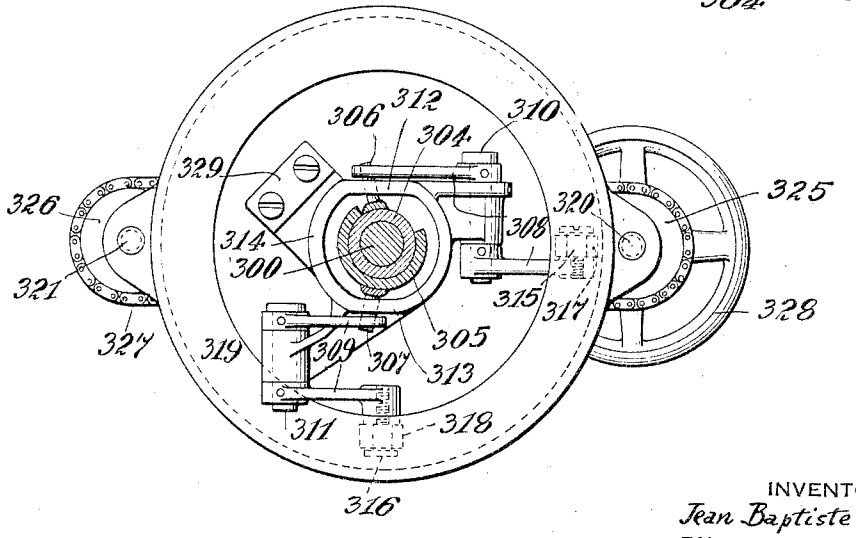


Fig. 22.



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Patented Feb. 23, 1932 1,846,336

UNITED STATES PATENT OFFICE

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SHIP AND AIRPLANE

Application filed December 2, 1929. Serial No. 410,948.

My present invention relates to ships and airplanes of novel character, having an improved propelling mechanism and members which may be termed wings, sails or planes, their function being similar, in many respects, to the planes of aeroplanes. These members embody a number of novel features, and in the preferred embodiment of my invention provision is made for adjusting such members so as to secure the best results under varying conditions. The main object of my invention is to obtain an efficient utilization of the motive power employed. Other objects and features of the invention will appear from the disclosure made in the accompanying drawings and in the description following hereinafter.

In said drawings, Fig. 1 is a side elevation of a ship embodying my improvements; Fig. 2 is a bow elevation of such ship with parts in section; Fig. 3 is a detail elevation, with parts in section, illustrating the connection of one of the sails or planes with the mast on which it is supported; Fig. 4 is a partial elevation of one of the resilient scales or flaps which I prefer to employ in connection with such sails, or some of them; Fig. 4ª is a similar view of another form of such resilient flap; Fig. 5 is an elevation, with parts in section, illustrating a mechanism for adjusting the sails and for indicating the lifting or pulling power exerted by them; Fig. 6 is a side elevation of another form of my invention; Fig. 7 is a vertical cross section of such second form; Fig. 8 is an elevation, with parts in section, showing the drive of one of the propellers employed in this second form; Fig. 9 is another detail of a propeller drive; Fig. 10 is a detail view of a tension indicator; Fig. 11 is a side elevation of an airplane embodying my invention, with parts in section; Fig. 12 is a front view of such airplane; Fig. 13 is a side elevation of this airplane with its parts in a different position; Fig. 14 is a side elevation (with parts in section) of a ship designed for traveling on land, on water, or in the air; Fig. 15 is a cross sectional elevation of such ship; Fig. 16 is a detail of a thrust indicator used in connection with the propellers of such ship; Fig. 17 shows an adjustable propeller embodying my improvements, with parts in section; Fig. 18 shows a portion of the construction illustrated by Fig. 17, in a view looking in the direction of the arrow 18 in Fig. 17; Fig. 19 is a detail section on the line 19—19 of Fig. 18; Figs. 20 and 21 are detail sections on the lines 20—20 and 21—21 respectively of Fig. 17; Fig. 20ª is a front elevation of the propeller; Fig. 22 is a detail section on the line 22—22 of Fig. 18; and Fig. 23 is a detail section of a slightly different form of propeller.

I desire it to be understood that the embodiments of my invention illustrated by the accompanying drawings are satisfactory and typical examples of my invention, but that the scope of the invention is broader than the specific embodiments.

In the ship constructed as shown in Figs. 1 to 5, the hull A has two masts B and B′ respectively, extending through sets of planes, sails, or wings, and in the example illustrated each set has five planes C, D, E, F, G and C′, D′, E′, F′, G′, respectively. The planes on the foremast B are shown of a greater length, in the fore-and-aft direction, than those on the mizzenmast B′, but in their general features, the two sets are alike, so that a detailed description of one of them will suffice. Each of the planes is thickened and rounded at its forward or leading edge, and tapers toward its rear edge; furthermore, the planes are concave on their lower surfaces lengthwise of the ship.

Each of the planes or wings is pivoted to swing about an axis extending transversely of the ship, and preferably the planes are also adjustable individually up and down along the respective masts. For this purpose, I may provide sleeves such as *e* mounted to slide along the respective masts, but held against turning relatively thereto, so that aligning pins *f* projected from said sleeve and pivotally engaged with the wing (say, C) will define an axis which will always be transverse with reference to the ship. The wing or plane is adapted to be swung on these pivot pins *f* in any suitable manner, for instance by means of wires or cables H, H′ connected

with the front and the rear portions of the plane and with appropriate manipulating or actuating devices, such as, for example, the one shown in detail in Fig. 5. Here the lower end of the cable H is shown as passed in contact with a guide roller J rotating about a stationary axis, the extremity of the cable being secured to a pin or cleat K′ on a slide K, movable horizontally along a stationary guide L. The slide K may be shifted, to swing the plane C on its pivot *f*, by the longitudinal movement of a rod M, held to slide (without turning) in a portion of the guide L and provided with a screw threaded portion in engagement with an actuating nut or handwheel N which is adapted to be rotated, but held against longitudinal movement. The connection between the sliding members K, M is preferably a yielding one, as by means of a coiled spring O the ends of which are secured to the members K, M respectively. I have also shown a pointer K″ carried by the slide K and arranged to indicate on a scale M′ held to move lengthwise in unison with the rod M. The pointer K″ will thus indicate the degree of tension of the spring O. It will be understood that each of the cables H, H′ will be connected with a separate adjusting mechanism of the character shown in Fig. 5. The opening (for instance *a*) at the central portion of each wing or plane will of course be of such a size and shape as to permit the intended pivotal movement or adjustment of said plane. The downward movement of each plane may be limited by constructing the mast with portions of progressively decreasing diameters or thickness, so as to form shoulders such as *b*, Fig. 3, which will act as stops for the respective sleeves *e*.

For the purpose of adjusting the sleeves *e* upwardly, they may be connected with individual cables P passed in contact with pulleys Q which are journaled on the respective masts, one end of each cable P being secured to a sleeve *e*, and the other winding on a drum such as R (there being a separate drum for each cable), a handle S serving to rotate the drum in the plane-raising direction, while suitable means (such as a pawl-and-ratchet mechanism T) may be provided to hold the drum normally against rotation in the direction corresponding to a lowering of the plane. A cable guide U may be located between the pulley and the drum R. When it is desired to lower a plane, the pawl of the mechanism T is disengaged, and the weight of the plane will cause it to move downward until it is arrested either by the stop *b* or by throwing said pawl back to its active position.

The masts B, B′ are shown as located in the longitudinal center of the ship, while to each side of such center I have shown screw propellers V, V′ operated by suitable connections from the power plant (not shown) of the ship. These propellers are arranged to rotate in the air, ahead of the respective sets of planes, and exert their propelling function partly by a direct effect on the air (both by traction and by reaction), and partly by the reaction of the stream of air which the propellers throw against the lower faces of the planes, and particularly the lowermost planes C, C′, D, D′, and E, E′, such stream of air being reflected downwardly and rearwardly from said lower faces. The downward reflection of the stream of air produces an upthrust on the planes and on the ship, thus facilitating its forward travel by raising the hull with respect to the water.

In addition to the air propellers described above, the ship may be provided with propellers acting on the water; these might be screw propellers of the well-known kind, or any other type, for instance feathering-blade propellers W rotating about upright axes and of a construction, for example, such as disclosed in several patents granted to me, particularly United States Letters Patent No. 1,471,896 dated October 23, 1923.

In the operation of a ship provided with planes such as described above, the planes will be adjusted, up or down along the respective masts, and also pivotally about the transverse axes constituted by the pins *f*. In each case the adjustment will be such as to obtain the maximum efficiency. This condition of maximum efficiency will be ascertained readily by noting the adjustment which gives the maximum tension to the spring O associated with each particular plane, said tension being indicated on the scale M′ by the pointer K″. It will be understood readily that this adjustment will depend on various factors, some of them variable, such as the direction of the wind with respect to the ship's course, the strength of the wind, the power of the air current thrown rearwardly by the air propellers V, V′, etc. During a voyage, the planes will therefore be adjusted as often as circumstances will make this desirable.

The forward edge of each plane will normally be adjusted to a higher level than its rear edge, or in other words, each plane (and particularly its lower surface) will, in the main, be inclined forwardly and upwardly. Therefore, as the ship travels ahead, the air on which such upwardly-inclined lower wing or plane surfaces impinge will exert a lifting tendency on the wings and on the ship, thus raising the hull from the water to a certain extent and thereby reducing the resistance to the propulsion of the ship. As the speed of the ship increases, this lifting effect will become progressively greater, so that very high speeds may be obtained with a comparatively moderate expenditure of power.

The effect of the wings or planes may be increased by providing, on their lower surfaces, flaps or scales X pivoted at their forward edges about axes X′ extending trans-

versely of the ship and pressed away from said surfaces by springs Y, which have a tendency to open said flaps, say to an angle of 45 degrees (see dotted lines in Fig. 4). These flaps or scales are preferably formed with convex lower surfaces. The effective surface of each wing or plane is increased by the provision of these scales, and the lifting effect is further increased, at low ship speeds, by the fact that the lower surfaces of the scales will then form a greater angle (normally in an intermediate position, see full lines) with the horizontal than the wing surfaces proper. As the speed increases, however, the springs Y will be compressed further and the scales X forced toward and even against the lower surfaces of the wings, thereby reducing the resistance of the air to the forward travel of the wing. Instead of using pivoted scales X in conjunction with springs Y, I may, as shown in Fig. 4ª, employ scales X″ rigidly secured, at their forward edges, to the respective wings, and made of resilient material having a tendency to open the scales in the same way that the springs Y open the scales X of Fig. 4.

Another expedient for increasing the lifting effect of the wings consists in providing them with arched channels Z extending longitudinally within the wings, both the front and the rear end of each such channel being at the lower surface of the respective wing. It will be understood that a portion of the air current will enter such channel and exert an additional lifting effect on the wing, both by pressure on the upper wall of the channel and by the reaction effect of the jet of air issuing downwardly (and rearwardly) from the inclined rear portion of the channel. The drawings show such channels Z only on the two lowermost wings or planes C, C′, D, D′, but they might be provided on some or all of the other planes as well. While scales (such as X or X″) are shown on all of the planes, I might apply them to only some of the planes or wings. On each of the main planes C, D, C′, D′, I have shown partly overlapping additional planes *c*, *d*, *c′*, *d′*, to further improve the efficiency of the structure, such additional planes being connected rigidly with the respective main planes. Fig. 1 shows, at the stern, an additional air propeller V″, also a rudder *r* of the type used on airplanes or airships, said rudder being operated by any well-known or approved mechanism (not shown) to swing it about a vertical axis and about a transverse horizontal axis.

The embodiment of my invention illustrated by Figs. 6 to 10 employs masts consisting of a lower portion 20 secured to the hull rigidly, and an upper portion 21 movably connected with said stationary lower portion, to swing relatively thereto about a horizontal pivot 22 extending transversely of the ship. The upper mast portion may therefore be swung in a fore-and-aft direction, to assume different inclinations to the vertical, while always remaining in the same longitudinal vertical plane as the corresponding lower mast portion. The latter (except on the foremast) is shown as carrying two superposed planes C″, D″ of the same character as those described above. Instead of being individually adjustable, however, as in the form of my invention first described, the two planes C″, D″ on the same mast are shown as connected rigidly, by braces indicated at 23, to move in unison, and also by connecting bars 24 which, at a level midway between the two planes, are engaged pivotally by the pin 25 projecting from the mast portion 20, said pin being transverse and parallel to the pivot 22. By means of cables H″, H² and actuating mechanism of the same character as those described above with reference to Figs. 1 and 5, the pair of planes C″, D″ may be adjusted, as a unit, about the pin 25, for the same purpose and with the same advantages as set forth hereinabove.

The planes (such as E″, F″, G″, G²) carried by the upper mast portion 21 are secured thereto rigidly, and therefore move in unison relatively to the lower mast portion whenever the upper mast portion swings about the pivot 22. The planes of the upper mast portion may also be connected by suitable braces, as indicated at 23′.

The masts 20, 21 are not arranged in the longitudinal center of the ship, but in transverse pairs, the lower mast portions being located adjacent to the sides of the ship, as shown in Fig. 7, which also has the advantage of facilitating a very strong connection of the lower mast portions with the hull. It will be evident that a very staunch support is given the planes by pairs of masts, much superior to the arrangement first described in which each plane is supported only centrally, by a single mast. This latter construction is quite satisfactory in the case of yachts and other relatively small vessels, but for larger vessels I prefer the arrangement of masts in pairs.

A cable 26 extends forwardly and downwardly from the upper part of the mast portion 21 to suitable guides 27 and has a portion wound several times around a drum 28, the cable then continuing upward and forward to the upper part of said mast portion 21. By means of cranks 29 the drums can be rotated to give the upper mast portions 21 of the same pair different positions and thus vary simultaneously the inclination of all the upper planes on the mast portions 21 of the same pair, relatively to the horizontal. The position of maximum effect might be ascertained by interposing, in the cable 26, an elastic device 30, preferably a compressed air cushion, and providing a pointer 31 and a scale 32 as-

sociated therewith to indicate the tension of said air (and of the cable).

It will be evident that pitching of the ship will change the inclination of the lower mast portions, and would also tend to alter the inclination of the upper mast portions and of the planes carried thereby. To minimize the disturbing effects of such pitching, I have devised an arrangement which insures that notwithstanding the pitching, the upper mast portion will at all times retain the same position or angle to a vertical or plumb line. This I accomplish by means of a counterweight 33 secured to an arm 34 extending downwardly from the shaft of each of the drums 28. Normally, said arm is fastened to the drum shaft by a set screw or other means compelling drum and arm to rotate together; thus the weight 33, which holds the arm 34 substantially vertical at all times (irrespective of any pitching) will thereby also hold the drum 28 in such a position as to maintain the upper mast portions 21 at a constant angle to the vertical, irrespective of the pitching motion of the lower mast portions 20. Of course, when the drums 28 are rotated, as above referred to, for adjusting the inclination of the upper mast portions, the arm 34 will be temporarily loosened so that they may not rotate with the drums, and will then be secured again (in a vertical position) to the drum shaft 28 after such adjustment. It will be evident that in making any such adjustment, equal motions will be given to the two drums belonging to upper mast portions 21 of the same pair, so that such mast portions will remain parallel and all twisting strains on the planes will be avoided.

As a propelling mechanism, I have shown in this second form of my invention air screws V^2 journaled in the lower mast portions 20 to rotate about horizontal axes extending fore-and-aft. This, however, does not apply to the foremast, which is shown as carrying four air-screws V^2 on its pivoted upper portion 21. To operate the air screws or air propellers V^2, I may make the lower mast portions 20 hollow as shown in Figs. 8 and 9, and within such tubular mast portions bevel wheels 35 are secured on the shafts of said propellers, said wheels being driven by meshing bevel gears 36 on a shaft 37 actuated in any suitable manner from the power plant of the ship.

In addition to the air screws V^2, I may employ propellers acting on the water, for instance feathering-blade propellers W′ of the type referred to above in the description of the propellers W.

On the foremast, the pivot 22 has been shown considerably lower than on the other masts, and the stationary lower portion 20 of said foremast carries no planes or air screws, but all such planes and air screws are carried by the swinging mast portion. The drive shaft 37 would in this case require a joint in line with the pivot axis 22, for instance a Hooke joint 37′, or a bevel gear drive from a transverse shaft aligning with said pivot axis, so as to properly drive the shaft swinging with the mast portion 21, from some other shaft journaled in the mast portion 20 or some other stationary part.

In Figs. 11, 12, and 13 I have shown an airplane with a body 100 having a tail skid 101, landing wheels 102, a horizontal rudder 103, and a vertical rudder 104, all of which may be of substantially usual construction. I prefer, however, to make the underside of the body 100 with transverse recesses 100′ the longitudinal surfaces of which are inclined upwardly and forwardly, as with such novel arrangement an increased lifting effect is obtained. At the sides of said body, I provide the main planes or wings 105, rigidly connected therewith. These wings may be made with channels 106 extending downwardly and forwardly from the upper wing surface to the lower wing surface, to increase the lifting effect by the action of the air currents traveling upwardly in said channels.

At the forward end of the hull or body 100, I have shown a transverse pivot 107 by which such body is connected with a movable nose or vacuum head 108 having auxiliary planes or wings 109 at its sides, and preferably also supplementary landing wheels 110. The nose 108 is hollow, having a wide opening at its rear end, and adjacent to said opening is located the propeller 111, the axis of which is normally horizontal and lengthwise of the airplane. At the front end of the nose 108 are two transverse openings 112, 113 through which air is adapted to travel on its way to the propeller 111. The propeller blades are preferably set relatively close together, as indicated in Fig. 12. The action of the propeller may be regulated by varying the effective area of the openings 112, 113, by means of adjustable flaps 114, 115 pivoted at 116, 117 respectively. The rush of the air tends to open the flaps, but they may be moved toward the closed position by suitable means under the control of the pilot, for instance by means of cables 118, 119 the operating and holding mechanism of which has its actuating member 120, 121 respectively within easy reach of the pilot, whose seat is indicated at 122. This seat is mounted on gimbals, or otherwise universally supported, so that the pilot may remain seated properly whether the nose is in the position shown in Fig. 11, or in the upwardly tilted position shown in Fig. 13, or in any intermediate position. The various controls are so constructed as to remain within easy reach of the pilot irrespective of the position given to the nose 108. The pilot can change the position of the nose relatively to the body 100 by any suitable mechanism, as an indication of which I have shown a

cable 123 both ends of which are secured to the body 100 while an intermediate portion of the cable is passed at least once around an adjusting drum 124 having a suitable operating handle and an appropriate holding device (not shown), for instance a pawl and ratchet. At 125 I have indicated a flexible staircase connecting the interior of the hull 100 with that of the nose 108. The engine is indicated at 126. The passengers' seats 127 in the body or hull 100 are preferably also mounted on gimbals or like joints.

During normal flight, the nose 108 will be approximately or exactly in longitudinal alignment with the body 100, as shown in Fig. 11, so that the action of the propeller 111 will be mainly or entirely forward. The air rushing rearwardly through the channels 112, 113 and striking the lower surfaces of the flaps 114, 115 will exert a supplemental lifting effect. When a very considerable increase of the lifting effect is desired, as in starting or landing, the nose 108 will be tilted upwardly, as in Fig. 13, and the channels 112, 113 will be closed by the flaps 114, 115, so that the rotation of the propeller 111 will create a partial vacuum on the inside of the nose or vacuum head 108, and the outside air rushing to fill the said vacuum, will exert an upward thrust on the rotating propeller and, through it, on the vacuum head 108, and thus the lifting power will be increased considerably. The airplane will thereby be enabled to rise vertically from the ground, and when it has reached a sufficient altitude, the structure 108 will gradually be adjusted by the pilot to the normal flying position, Fig. 11, the flaps 114, 115 being opened to the most favorable extent. When it is desired to alight vertically, the flaps 114, 115 are brought to the closed position, and the vacuum head or nose 108 tilted up, to obtain the result substantially as referred to above, the descent being obtained and regulated either by varying the number of revolutions of the propeller, or by proper adjustment of the flaps 114, 115. When reaching earth, the tail skid 101 will touch the ground first then the landing wheels 102, and finally the wheels 110. To take the end thrust which tends to bend the blades of the propeller 111 toward the motor 126 when a relatively high vacuum is produced within the nose or head 108, I may provide a backing or ring 111′ firmly secured to the said head and adapted to be engaged by rollers 111″ on the propeller blades whenever they are bent inwardly. Normally, these rollers will be out of contact with the ring 111′.

I prefer to provide an additional propeller, 126′, at the front of the nose or head 108, said propeller being driven from the engine 126 by suitable connections 126″. These should include a clutch, 126ª, whereby the propeller 126′ may be thrown out of action when the nose 108 is tilted up and the flaps 114, 115 closed for vertical travel of the airplane, so that in that case the full power of the engine will be available for the propeller 111. During normal flight, both propellers 111 and 126′ will be operated by the engine 126, the clutch 126ª being thrown in.

In order that the pilot may not be affected by the vacuum created in the nose 108, I would put him in an air tight cabin (not illustrated).

In Figs. 14, 15 and 16 I have shown a ship adapted to travel in the air and to rise from, or alight upon, land or water. The hull 200 is provided with landing wheels 201. The masts 202 support front planes 203 and rear planes 203′ which overlap at their adjacent ends, with a space between them. Each mast has a forked portion 204 in which propeller housings 205 are journaled about superposed horizontal axes 206 extending transversely of the ship. Each of the housings is tapered or somewhat cone-shaped, and at the wide end thereof is located the propeller 207, mounted to rotate about an axis perpendicular to the axis 206 on which the housing is adapted to swing. The propeller axis may therefore be swung in a vertical plane extending lengthwise of the ship, and such axis may be brought to a horizontal position, so that the propeller will exert exclusively or chiefly a propelling action, or to a vertical position, to exert a lifting action and cause the ship to rise from land or water. The propeller axis may, of course, also be given intermediate or inclined positions. Any suitable mechanism may be employed for swinging the propeller housings 205 about their axes 206. For instance, the shafts of two superposed housings may be connected by a chain 208 fitting sprockets 209 on said shafts, and one of these shafts may also carry a pinion in mesh with an actuating rack 210 movable vertically by means of any suitable mechanism (not shown). Suitable means (not shown) are also provided for rotating the propellers 207 irrespective of the position given to the respective housings 205.

The housing 205 is similar in construction to the nose 108 and has superposed openings 212, 213 at the end farthest away from the propeller 207 the blades of which are set relatively close together and also adjacent to the surrounding wall of the housing 205. The housing 205 also carries a propeller 207′ similar to the propeller 126′ of Fig. 11, and it will be understood that this propeller 207′ will be connected with the motor 211 by a connection and a clutch of the same character as those indicated in Fig. 11. In registry with the central portion of the propeller 207, which is practically inactive in any event, I have shown the motor 211. Flaps 214, 215 are placed adjacent to the openings 212, 213 respectively and may be operated by means similar to those described with reference to Fig. 11. Adjacent to the propeller 207, I place an

indicator 216, of any suitable construction, enabling the pilot or other member of the crew to ascertain the thrust of the propeller. For instance, the propeller 207 together with its shaft and its motor 211, may be slidable lengthwise on suitable guideways 217 (Fig. 16), against the action of a spring 218, the tension of said spring, and therefore the propeller thrust, being indicated by a stationary pointer 218, on a scale 219 provided on the movable motor 211.

Beneath the lower planes 203, 203′, I have located a plurality of propellers 220, driven by motors located in stream-line housings 221, the motor shaft being adjustable by suitable means from a horizontal position to a vertical one. In the latter case the propeller, then rotating in a horizontal plane, will co-operate with a cylindrical shell 222, open at the bottom but closed at the top and sides, so that the propeller will tend to produce a vacuum in said shell, with a resulting lift exerted by the air rushing toward such vacuum. When the propeller 220 is in its normal position, indicated by full lines, the shell 222 will be retracted by sliding it upwardly into the plane 203 or 203′, it being understood that the upper surface of such plane has no opening in line with the shell 222.

When the ship is to rise or descend vertically, or substantially so, the propellers 207′ will be thrown out of action, only the propellers 207 and 220 being used, in the tilted position in which they will rotate in horizontal planes. The propellers 207′ will be thrown into action only for normal flight.

In Figs. 17 to 23, I have shown an adjustable propeller which I prefer to use in connection with the parts of my invention described above. In this propeller construction, the central driven shaft 300 carries rigidly at its free end, a set of main blades 301 for instance four such blades. Against the rear faces of these blades 301 are fitted the two sets of supplementary, adjustable blades 302, 303. When brought close together, the blades 302, 303 of the same pair will lie behind, and be fully overlapped by, the corresponding blade 301, each of the blades 302, 303 being about half as wide as the blade 301, and the two blades 302, 303 together having practically the same outline as the blade 301 when they are folded behind it as shown in Figs. 17 and 20. The blades 302, 303 may be moved apart in the direction indicated in said figures, along the rear surface of the blade 301, to the limit open position indicated by dotted lines, or to any position intermediate between said limit position and the closed or folded position shown in full lines. It will be obvious that by such adjustment I am enabled to vary the effective width of the propeller blade, as may be desirable under different conditions of operation, as in starting or stopping.

For the purpose of adjusting the blades 302 and 303 simultaneously and equally, in opposite directions, I have shown the following mechanism: The four blades (or rather half-blades) 302 are secured rigidly to a sleeve 304 which is mounted loosely on the shaft 300 so as to be capable of both turning thereon and sliding lengthwise thereof. The four blades 303 are secured rigidly to a second sleeve 305 surrounding the sleeve V and capable of turning thereon and of sliding longitudinally thereof. On opposite sides, the sleeves 304, 305 are provided with rigid radial outwardly-extending pins 306, 307 respectively. The outer sleeve 305 has a suitable opening or cutaway portion 305′ so that the pin 306 may be free to move as will be described presently. The pins 306, 307 are connected pivotally with levers 308, 309 respectively which are fulcrumed at 310, 311 respectively on plates or brackets 312, 313 respectively rigidly secured to the shaft 300, as by being made integral with a hub 314. The other arms of the elbow levers carry pivots 315, 316 respectively for slides 317, 318 respectively engaging a suitable annular guide 319 concentric with the shaft 300, said guide being normally stationary, but being adjustable lengthwise of the shaft, for instance by adjusting shafts 320, 321 screwing into threaded holes in the guide 319. The shafts 320, 321 are journaled in stationary bearings 322, 323 and are held against longitudinal motion, as by collars 324. Sprocket wheels 325, 326 mounted on said shafts rigidly are connected by a chain 327 so that they will move in unison when one of them is rotated by a handwheel 328. A weight 329 may be provided to balance the rotating structure.

The levers 308, 309 might simply be pivoted to the pins 306, 307 respectively, but I prefer to provide an additional guide for said pins by means of oppositely inclined slots 330, 331 in the plates 312, 313 respectively. It will be understood that these additional guides serve to steady the pins 306, 307, but are not absolutely essential. The slots 330, 331 would be rectilinear when the contacting faces of the blades 301, 302, 303 are plane as in Fig. 17. I may, however, give such contacting faces a curved formation, as in Fig. 23, and in this case the guide slots in the plates 312, 313 would be given the proper curve or cam shape to insure the desired movement of the blades 302, 303.

It will be understood that as long as the guide 319 remains in the same position, the relative position of the blades 301, 302, 303 will remain unaltered. When, however the guide 319 is moved lengthwise of the shaft 300, this will cause the levers 308, 309 to swing in such a manner as to turn the sleeves 304, 305 in opposite directions relatively to the shaft 300 and at the same time to move them lengthwise of said shaft in opposite di-

rections, thereby causing the blades 302, 303 either to open fanwise as indicated by dotted lines in Figs. 17, 20, and 23, or to close behind the respective blades 301, as shown in full lines. The effective area of the propeller blades is thus varied.

Various modifications may be made without departing from the nature of my invention as set forth in the appended claims.

I claim:

1. In a craft of the character described, a hull, masts carried thereby, propellers, and planes adjustable up and down on said masts and also adjustable to swing about axes transverse to the hull, independently of said up and down adjustment.

2. In a craft of the character described, a hull, plane-carrying masts movably connected with the hull to swing about transverse axes, and means for preserving an approximately vertical position of said masts notwithstanding any pitching movements of the hull.

3. In a craft of the character described, a hull, a propeller, a structure adjacent to the propeller having a channel leading to the propeller in a direction which is normally lengthwise of the hull and rearwardly to said propeller, adjustable means controlling the effective area of said channel, and an indicating device for measuring the thrust of the propeller as it varies in accordance with the adjustment of said means.

4. In a craft of the character described, a hull, masts thereon, housings pivoted on said masts to swing about transverse axes and provided with channels extending lengthwise of such housings, propellers in the path of the air passing through such channels, and adjustable mechanism for varying the effective cross section of such channels.

5. In a craft of the character described, a hull, masts carried thereby, propellers, planes spaced from each other and adjustable up and down on said masts, and supplemental planes located between two of said first-mentioned planes and movable in unison with one of them.

6. In a craft of the character described, a hull, a mast carried thereby, superposed planes on said masts, and supplemental planes located between two of said first-mentioned planes.

7. In a craft of the character described, a hull, a plane connected therewith adjustably, means for adjusting the plane relatively to the hull, and an indicating device connected with said adjusting means, for measuring the lifting effect of the plane in its various adjustments.

8. In a craft of the character described, a hull, a tubular mast having a lower portion stationary relatively to the hull and an upper portion pivoted to said lower portion about an axis transverse to the hull, a propeller journaled on said upper mast portion, and propeller-driving mechanism extending within said tubular mast and comprising movably connected portions located within the lower and the upper mast portions respectively.

9. In a craft of the character described, a hull, a forked mast thereon, a housing pivoted on said mast within the fork thereof to swing about a transverse axis and provided with a channel extending lengthwise of such housing, a propeller in the path of the air passing through such channel, and adjustable mechanism for varying the effective cross section of such channel.

10. In a craft of the character described, a hull, a forked mast thereon, a housing pivoted on said mast within the fork thereof to swing about a transverse axis, and a propeller carried by said housing.

11. In a craft of the character described, a plane, a propeller located below said plane, a carrier for said propeller, said carrier being pivoted to swing about a transverse axis, to vary the position of the propeller shaft with respect to the horizontal, and a shell depending from said plane and arranged to co-operate with the propeller when the propeller axis is upright.

12. In a craft of the character described, a plane, a propeller located below said plane, a carrier for said propeller, said carrier being pivoted to swing about a transverse axis, to vary the position of the propeller axis with respect to the horizontal, and a shell movable up and down relatively to said plane adjacent to the lower surface thereof, and arranged to co-operate with said propeller when the propeller axis is upright.

In testimony whereof I have hereunto set my hand.

JEAN BAPTISTE ICRE.