C. I. MATSON.

AERIAL MACHINE.

APPLICATION FILED JUNE 4, 1910.

1,019,168.

Patented Mar. 5, 1912.

2 SHEETS—SHEET 1.

Fig. 1.

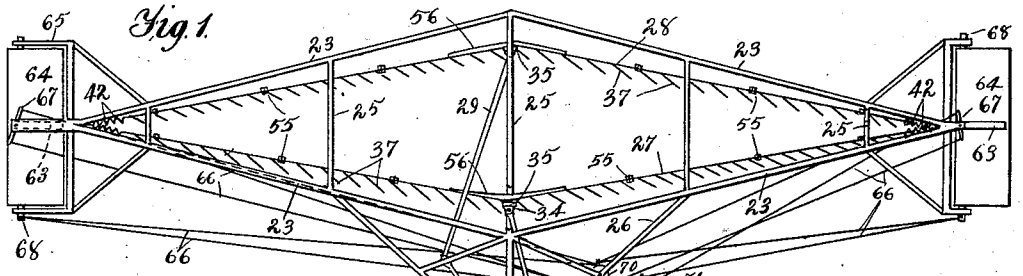

Fig. 3.

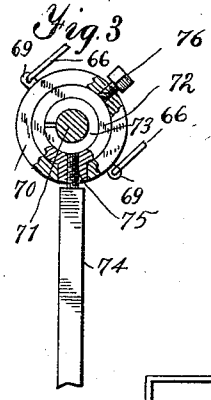

Fig. 5.

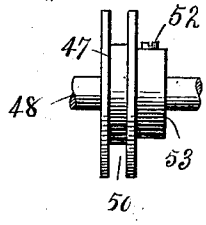

Fig. 2.

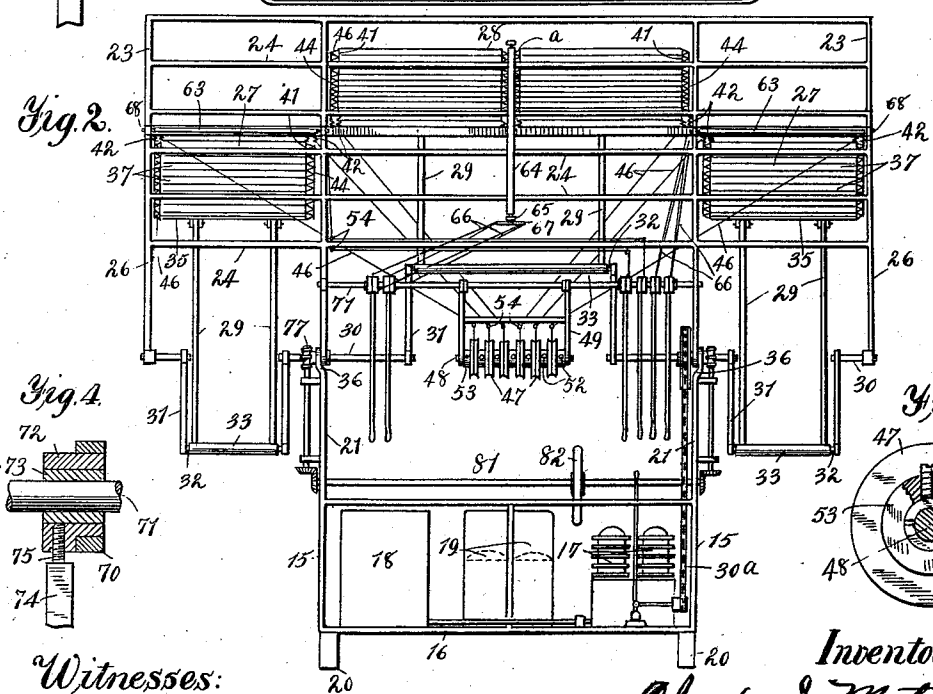

Fig. 4.

Fig. 6.

Witnesses:

C. F. Bassett

C. B. Benjamin

Inventor

Charles I. Matson

By Fitzsimmons & Benjamin

Atty.

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2 SHEETS—SHEET 2.

Fig. 7

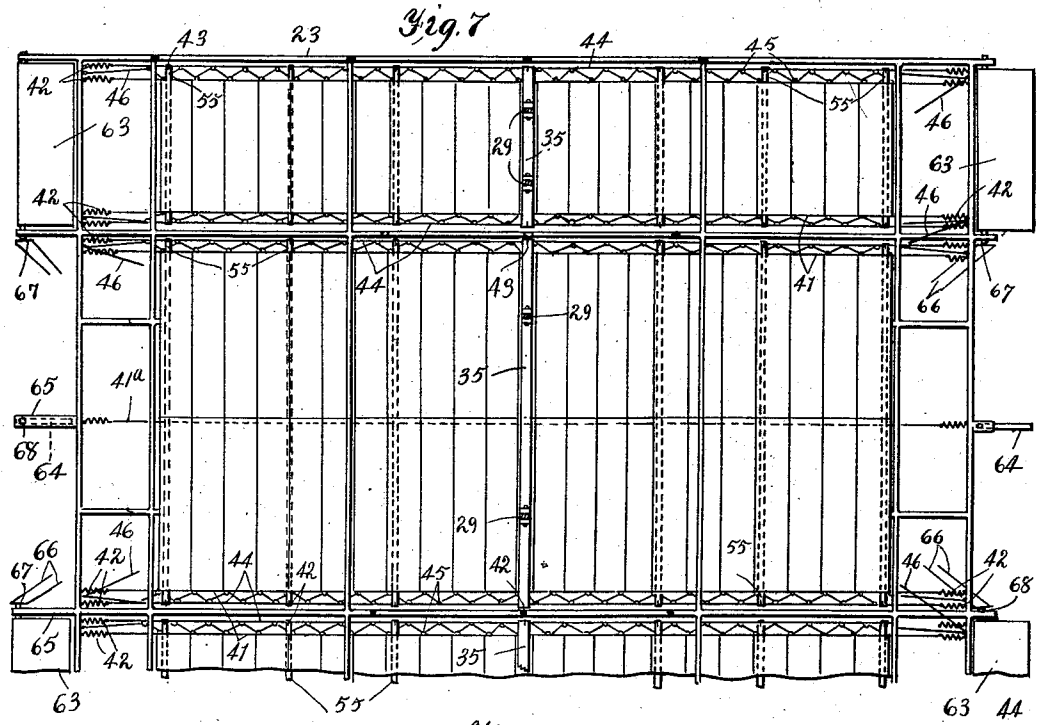


Fig. 8

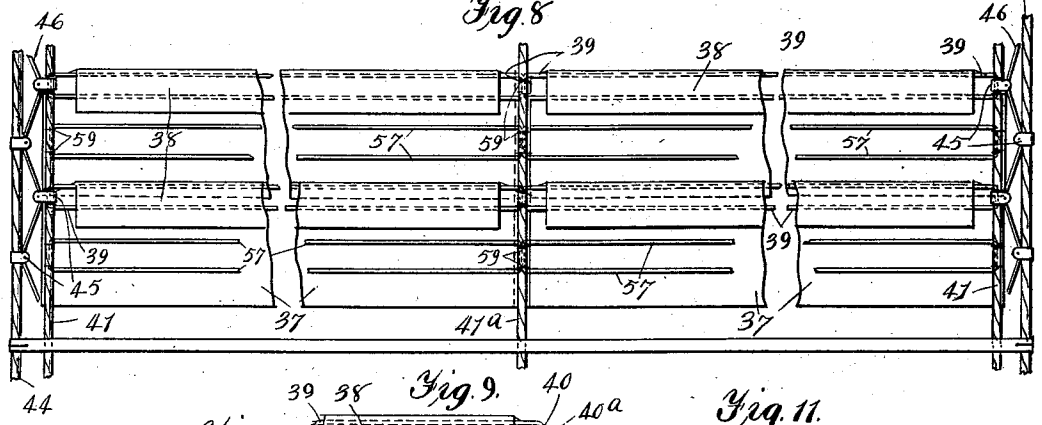


Fig. 9.

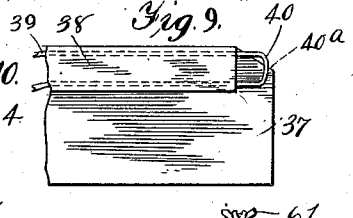


Fig. 10.

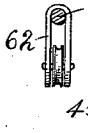


Fig. 11.

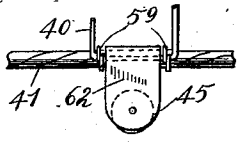
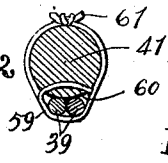


Fig. 12.



Witnesses

C. F. Bassett.

C. B. Benjamin

Inventor

Charles I. Matson

By Frederick B. Benjamin

Atty.

UNITED STATES PATENT OFFICE.

CHARLES I. MATSON, OF CHICAGO, ILLINOIS.

AERIAL MACHINE.

1,019,168. Specification of Letters Patent. Patented Mar. 5, 1912.

Application filed June 4, 1910. Serial No. 564,941.

To all whom it may concern:

Be it known that I, CHARLES I. MATSON, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Aerial Machines, of which the following is a specification.

My invention relates to aerial machines and has especial reference to heavier than air devices.

The paramount objects of the improvements which constitute the subject matter of this application for patent are:—to provide an efficient, safe and practical apparatus, which, by the employment of suitable motive power, may be elevated directly from the ground by the action of novel reciprocating structures and propelled when elevated by proper manipulation of the reciprocating devices supplemented by auxiliary planes and rudders.

Further objects of this invention are to furnish movable planes formed of a series of hinged vanes or valves, so arranged with overlapping margins as to provide an efficient supporting surface when the planes are moved in one direction, the said vanes yielding to the air pressure when moved in the opposite direction.

Other objects, stated in detail, are, to improve the manner of connecting the valves so that they will have a quick action; to provide a suitable tensioning mechanism, whereby the action of the vanes may be readily controlled, to furnish steering rudders, and to arrange convenient operating devices connected by cords or cables to the tensioning and steering appliances.

I accomplish the desired results by means of the apparatus illustrated in the accompanying drawings, which form a part of this application, the details of construction being disclosed in the following views:—

Figure 1 is a side elevation of an aerial machine embodying my improvements; Fig. 2 is a rear elevation; Figs. 3 and 4 are fragmentary views showing the details in the construction of the operating mechanism for controlling the steering vanes; Figs. 5 and 6 are details of the operating devices for controlling the tension of the vanes; Fig. 7 is an enlarged partial view showing the under surface of two adjacent reciprocating planes; Fig. 8 is a fragmentary view, also enlarged, of a portion of the median plane, showing the manner of attaching the valves to the supporting cables; Fig. 9 is an enlarged fragmentary view showing an end of one of the vanes; Fig. 10 is an edge view of one of the pulleys used in connection with the tensioning mechanism; Fig. 11 is a side elevation of a pulley, and Fig. 12 is an enlarged sectional view showing the manner of lashing or stitching the vane loops to the supporting cord.

Referring to the details of the drawings, the numeral 15 indicates the members of a rectangular main frame constituting the body of the machine. This frame is furnished with a floor 16 upon which is mounted a suitable motor 17, a supply tank 18 and seats 19, the latter designed to accommodate two persons. Beneath the main frame are arranged a pair of resilient supports 20, consisting of strips of wood bent into the form of runners, which rest upon the ground when the machine is not in flight. The upper part of the main frame is constructed of inclined side members 21 which meet in the middle after the manner of rafters as shown in the side elevation, Fig. 1. This portion of the structure is completed by suitable standards 22, arranged vertically at each end of the frame. Rockably mounted upon the rafters 21 and standards 22 is an upper or auxiliary frame, comprising side rails 23 arranged in lozenge form as seen from the side (Fig. 1) and connected by transverse bars 24 and upright braces 25, while inclined extensions 26 meet the angle formed by the said members 21, to which they are pivotally connected in a manner hereinafter described.

I prefer for the general construction of the framework to use light steel tubing secured at the junction of the members by brazing, and, wherever necessary, the frame is strengthened by suitable wire guys and braces, in a manner common in apparatus of this class, but such wire braces are not shown in the drawing since their illustration would only tend to confusion of the details.

The upper rhomb-shaped section of the framework is designed for the support and protection of the planes and rudders, and also carries the operating levers and pulleys for controlling the steering or guiding members and the tensioning devices hereinafter

described, while the lower section or main frame carries the motor and operator, as previously mentioned.

When in the air the machine is supported and propelled by a series of movable flexible planes, of which there are three; viz., a pair of laterally arranged planes 27 and a central or intermediate plane 28, having an area equal to the combined surfaces of the two lateral planes. Each plane is attached at its opposite ends to the framework, in a manner hereinafter described, and the middle portion of each plane adapted to be moved upward and downward by means of crank rods 29, which are connected with a crank shaft 30 mounted on the connecting frame and receiving motion from the motor through a chain 30ª. The said shaft is furnished with comparatively wide cranks 31, located beneath each of the planes. The arms of the cranks are of proper length to give the required amount of movement to the plane center, and the crank wrist 32 in each case is provided with a loose sleeve 33, to which the lower ends of the crank rods 29 are connected, the upper ends of the said rods having suitable jointed connections 34 with a bar 35 which extends transversely beneath each plane, and is attached thereto. The upper ends of the inclined members 21 are offset at the upper ends, as indicated at 36, and serve as bearings for the crank shaft 30 which is operatively connected with the motor by the sprocket chain 30ª. The lower ends of the members 26 at each side are fused into a single piece which is provided with an aperture through which the crank shaft passes, thus forming a pivot upon which the upper or auxiliary frame can be rocked, to incline the planes relatively to the lower frame for a purpose hereinafter explained.

Each plane is made up of a number of connected hinged vanes or valves 37 of oblong shape and mounted so that their margins will overlap to form a continuous supporting surface when the plane as a whole is moved downward, but will turn in their hinges so as to open after the manner of valves when moved in the opposite direction, thus presenting a minimum amount of resistance to the air. I prefer to use for these vanes a heavy paper, which may be suitably treated to render it waterproof if desired. The material selected is first cut into oblong strips somewhat wider than the required breadth of the vane. One of the side margins is then folded over upon the main portion of the vane, and secured by a suitable adhesive, such folded portion or flap being indicated by the reference numeral 38. Beneath this flap is inserted an endless cord 39, placed with its strands parallel with and adjacent to, the flap margins, as shown in Figs. 8 and 9. The portion of the vane forming the flap is cut shorter than the body portion, permitting the cord to extend beyond the said flap at each end to form attaching loops 40. The adjacent corners of the vanes are cut on an incline as shown at 40ª, so as not to interfere with the cords 39, and the said loops 40 are secured to supporting cords or cables 41, extending from end to end of the frames parallel with the ends of the vanes. These supporting cables are attached at each end to coiled springs 42, secured to the ends of the upper frames; these springs permitting the middle portion of the planes to be moved upward and downward in the manner previously described. The cables 41 pass through notches in the ends of the cross bars 35 and are secured by lashings of smaller cord, as indicated at 43, Fig. 7. Arranged parallel with the cables 41, are guy ropes 44, which are attached to coiled springs 42 in the same manner and for the same purpose as in the case of the vane supporting cables 41. It will be evident that the vanes 37 when at rest will fall by gravity to an approximately vertical position, if the loops 40 are relaxed. It has been found by experiment that it is desirable to limit the degree of opening of the vanes so as to get a quicker return movement and for this purpose I provide means whereby a varying degree of tension may be given to the loops 40, consisting of a series of pulleys 45 attached at spaced intervals along the supporting cables 41, and the guy ropes 44, the pulleys being placed alternately on the coöperating members as shown in Fig. 8, and through these pulleys are riven tensioning cords 46, one extremity of each cord being attached to the frame at one end, and after passing through the pulleys in the manner shown the cords are led to grooved wheels 47, mounted upon a shaft 48 carried by a frame 49. The wheels 47 are furnished with a comparatively deep groove 50 to receive the end of the tensioning cord which is made fast in any suitable manner, and the said wheels are frictionally held upon the shaft by open rings 51, Fig. 6, the amount of friction being regulated by an adjusting screw 52 which passes through the hub 53 of the wheel to engage the ring. In order to change the course of the tensioning cords as required pulleys 54 are arranged wherever necessary. To render the planes, cables and ropes more rigid so as to insure an even movement, I provide stiffening bars or rods 55 which extend transversely above the planes and are notched at the ends to engage the guy ropes 44, being secured by lashings 43 in the same manner as described in connection with the center bars 35. For the purpose of preventing undue tilting or rocking of the cross or center bars 35, when reciprocated by the crank action, the cables

adjacent said bars are reinforced or stiffened by flexible spars or rods 56 placed along the margins of the planes and secured firmly to the said bars and cables, in any convenient manner.

As previously explained, it is possible to limit the downward movement of the vanes by the amount of tension given to the flap cords 39, but in the upward movement it is found necessary to furnish some means other than the overlapping of the vane margins to prevent the free margin from being forced above the adjacent vane with which it engages when the planes are rapidly reciprocated. For this purpose endless stop cords 57 are arranged above the vanes in the manner shown in Fig. 8, the looped ends being secured to the vane supporting cables along the sides of the plane and in the case of the median plane, shown in said figure, an additional cable 41^a is stretched longitudinally along the line of junction of the ends of the two series of vanes and the inner looped ends of the stop cords secured thereto.

While I have shown the lateral planes as composed of vanes which extend entirely across the planes, and have represented the central or median plane as made up of only two such series or rows of vanes having their ends meeting in the median line, it is to be understood that in the practical application of these devices, a proportionately larger number of vanes will be used in the construction of a plane of given dimensions, the vanes being comparatively smaller in size, so that three or more rows of vanes will be required to extend across the plane, the additional supporting cables 41^a being arranged where needed, and if desired, tensioning devices similar to those shown arranged along the ends of the vanes may be located along the meeting ends of the vanes in the body of the planes, taking the place of the cable 41^a, such an arrangement being illustrated in Fig. 2, at *a*.

In order to obtain the best results in the assembling and operation of the vanes it has been found desirable to secure the loops 41 of the vane cords, and the looped ends of the stop cords 57 to their respective cables in the manner shown in Figs. 11 and 12. The end portion of the loop is laid parallel along the cable and secured by double stitches 59 taken through the cable so as to include only a small portion thereof, as indicated at 60 in Fig. 12. The ends of the thread are then carried to the opposite side of the cable and firmly knotted as shown at 61.

Any suitable type of pulley may be used for the tensioning cords, but I prefer the form shown in Figs. 10 and 11, which comprises a housing 62 formed of a single piece of thin metal bent double in the manner shown so as to embrace the cable or rope to which it is applied. Upon the front and rear of the upper frame are mounted rudders consisting of rectangular planes 63, 64, arranged respectively in horizontal and vertical position. These rudders are pivotally mounted in extensions 65 of the main frame and are controlled by cords 66 attached to cross arms 67 secured to the pintles or pivots 68 of the rudders. The cords 66 are then led to a position convenient to the operator, where their ends are attached to eyes 69 fixed upon opposite sides of adjusting collars 70 (Figs. 3 and 4) arranged upon a fixed shaft 71. The said collars 70 are mounted upon sleeves 72, open friction rings 73 being interposed between the sleeves and the said shaft 71. The collars are rotated to control the rudders by levers 74 which have threaded ends 75 adapted to pass through suitable threaded holes in the sleeves 72, and engage the friction rings 73, so that by screwing the said levers in and out the friction of the said rings upon the shaft may be varied as required. A set screw 76 permits the collar 70 to be adjusted relatively to the said sleeve 72. The upper frame, which is pivotally supported upon the crank shaft, may be rocked thereon to change the relative inclination of the planes, by means of worms 77, mounted upon shafts 78, which engage worm gears 79 fixed to the members 26, but loose with respect to the crank shaft 30. The lower ends of the worm shafts 78 receive motion through beveled gears 80 from a shaft 81, upon which is mounted a hand wheel 82 convenient to the operator's hand.

The operation of the machine is as follows:—The apparatus being at rest with the supports 20 in contact with the ground, to elevate the device the motor is started and this will cause an up and down movement of the central portions of the planes, the lateral planes moving in unison and in alternation with the central, or median plane. It will be readily understood that as each plane is moved upward in the manner stated the valves or vanes will swing downward at an angle, as shown in Fig. 1, so that there will be a minimum amount of resistance, but upon the downward movement the valves will close so that the plane will present a continuous surface and exert a lifting power proportional to the extent of surface and the rapidity of its action. If the upper frame is in a horizontal position the machine will ascend in a practically vertical direction. A forward and upward movement may be given to the apparatus by tilting the upper or auxiliary frame by means of the hand wheel 82 so that the forward end of said frame will be lower than the rear, and by reversing the inclination of the upper frame the machine will travel in the opposite direction. It will be understood that the vanes cannot assume a verti-

cal position owing to the restraint of the cords, their angle of relative direction being dependent upon the tension of said cords. This has a bearing upon the behavior of the machine as a whole since the pitch or inclination of the vanes will cause a bodily forward movement of the machine when ascending since the direction of least resistance will be parallel with the degree of the vane inclination. It will thus be seen that the higher the tension of the regulating cords the greater the forward movement which will, of course, be at the expense of the lifting power under like conditions. In other words this arrangement of the vanes at an inclination to the direction of the application of the power will result in a conversion of the resistance to the upward motion into a forward movement. The action of the rudders will be obvious, the horizontal ones deviating the flight vertically, while the vertical rudders will guide the apparatus to the right or left, such devices being in common use in aerial machines.

Having thus described my invention what I claim as new, is:—

1. In an aerial machine, the combination of a main frame, an auxiliary frame arranged above the main frame and having a pivotal connection with said main frame, flexible planes supported by their extremities on said auxiliary frame, and means for flexing said planes alternately in opposite directions.

2. In an aerial machine, the combination of two superposed frames, the upper frame extending beyond the lower frame, and adapted to rock thereon, flexible planes supported by their extremities on said auxiliary frame, and means for flexing said planes alternately in opposite directions.

3. In an aerial machine, the combination with a main frame, of an auxiliary frame mounted to oscillate thereon, flexible planes supported by their extremities on said auxiliary frame, and means for flexing said planes alternately in opposite directions.

4. In an aerial machine, the combination with a main frame, an auxiliary frame arranged to oscillate above said main frame, flexible planes secured by their ends to said auxiliary frame, said planes comprising series of hinged vanes, means for flexing said planes alternately in opposite directions.

5. In an aerial machine, the combination with an oscillating frame, of a flexible plane secured by opposite margins to said frame, said plane comprising series of vanes supported upon cords and having their margins overlapping, and means for flexing said plane alternately in opposite directions.

6. In an aerial machine, a main frame, an auxiliary frame pivotally mounted thereon, a flexible plane attached by opposite margins to said auxiliary frame, and means for reciprocating the central portion of the said plane in a direction at right angles to a line connecting its attached margins.

7. In an aerial machine, a main frame, a rock frame supported thereon, a plurality of flexible planes attached by opposite margins to the ends of said rock frame, and means for alternately reciprocating the central portion of the planes.

8. In an aerial machine, the combination with a main frame, a crank shaft mounted on said frame, an auxiliary frame arranged above the main frame and pivoted at its center on said shaft, means for oscillating said auxiliary frame, a plurality of flexible planes attached by opposite margins to said auxiliary frame, operative connection between the said crank shaft and the centers of said planes, and means for operating the shaft.

9. In an aerial machine, a main frame, an oscillating frame mounted on the main frame, flexible planes supported by opposite margins on the oscillating frame, and means for alternately flexing said planes in opposite directions, and means for operating said oscillating frame independently of the said means for flexing the planes.

10. In an aerial machine, the combination of a main frame, an auxiliary frame pivotally mounted thereon, means for inclining said auxiliary frame relatively to the main frame, flexible rectangular planes comprising series of hinged vanes, said planes attached by opposite margins to the ends of said auxiliary frame, springs connecting the planes with said auxiliary frames, a crank shaft and operative connection between said shaft and the centers of said flexible planes.

11. In an aerial machine, a flexible plane comprising a series of vanes arranged to form a continuous surface, each of said vanes consisting of a single piece, hinges for said vanes consisting of a cord formed with projecting loops, supporting cables attached to said loops, and means for varying the tension of said cords.

12. In an aerial machine, a flexible plane, comprising a series of overlapping vanes, cords attached to said vanes and having projecting loops, cables extending parallel with the lateral margins of the plane, and attached to said loops, guy ropes arranged parallel with said cables, pulleys attached to said cables and ropes, and cords engaging said pulleys and adapted to vary the tension of the cords attached to the vanes.

13. In an aerial machine, a series of overlapping vanes, hinge cords attached to one margin of said vanes and having projecting loops, cables arranged adjacent said vanes and attached to said loops, guy ropes arranged parallel with said cables, pulleys attached to said cables and ropes, cords engaging said pulleys and adapted to vary the

tension of the said hinge cords, and stop cords for the vanes.

14. In an aerial machine, a series of overlapping vanes, hinge cords attached to one margin of said vanes and having projecting loops, supporting cables arranged adjacent to said vanes and attached to said loops, stop cords for the vanes, and means for varying the tension of the said hinge cords.

15. In an aerial machine, a series of overlapping vanes, each of said vanes formed of a single piece having a marginal flap folded upon the main portion and secured by a suitable adhesive, an endless cord inserted under said flap and having portions projecting in the form of loops, cables supporting said loops, and means for varying the tension of said endless cords.

16. In an aerial machine, a plane formed by a series of overlapping vanes, each formed of a single piece, a hinge for each vane consisting of an endless cord secured by folding one margin of the vane thereover, supporting cables extending parallel with the margins of the plane and attached to said cords, springs connecting said cables with the frame of the machine, and means for varying the tension of said endless cords.

17. In an aerial machine including a frame, a plane formed of a series of overlapping vanes, supports for the plane comprising a series of parallel cables, springs connecting the ends of the cables to the said frame, hinge cords attached to the vanes and secured to said cables, and means for varying the tension of the said hinge cords.

18. In an aerial machine, a main frame, a rock frame arranged above the main frame, a plurality of planes formed of a series of overlapping vanes, supports for the vanes comprising a series of parallel cables, springs connecting the ends of the cables to the rock frame, hinge cords attached to the vanes and secured to the said cables, and means for varying the tension of the said hinge cord.

19. In an aerial machine, a main frame, a rock frame arranged above the main frame, a plurality of planes formed of a series of overlapping vanes, supports for the vanes comprising a series of parallel cables, springs connecting the cables to the rock frame, hinge cords attached to the vanes and secured to the said cables, guy ropes arranged parallel with the cables, pulleys attached to said cables and ropes, cords engaging said pulleys, means for operating said cords, comprising frictionally mounted wheels and means for varying the friction of the wheels upon their bearings.

20. In an aerial machine, a main frame, an auxiliary frame rockably mounted thereon, means for rocking said frame, a plurality of flexible planes supported upon the auxiliary frame, means for reciprocating said planes, rudders pivotally mounted upon said auxiliary frame, and means for operating the rudders, comprising a shaft, a plurality of split collars mounted on the shaft, sleeves embracing the collars, set screws passing through the sleeves and engaging said collars, and levers attached to the screws, and adapted to turn the screws and rotate said sleeves and collars.

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

CHARLES I. MATSON.

Witnesses:

H. De Los Higman,

Chas. F. Bassett.