H. MILLER.

FLYING MACHINE.

APPLICATION FILED MAY 7, 1910.

1,031,569.

Patented July 2, 1912.

6 SHEETS—SHEET 1.

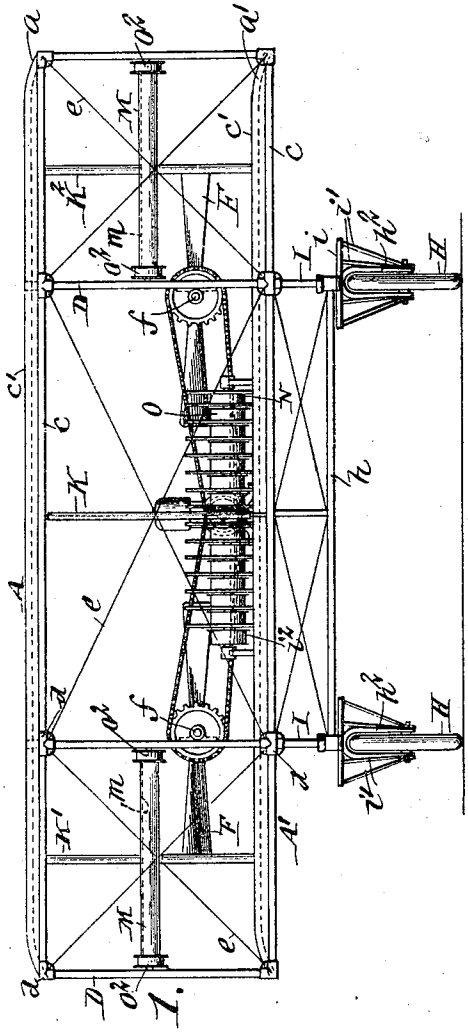

Fig. 1.

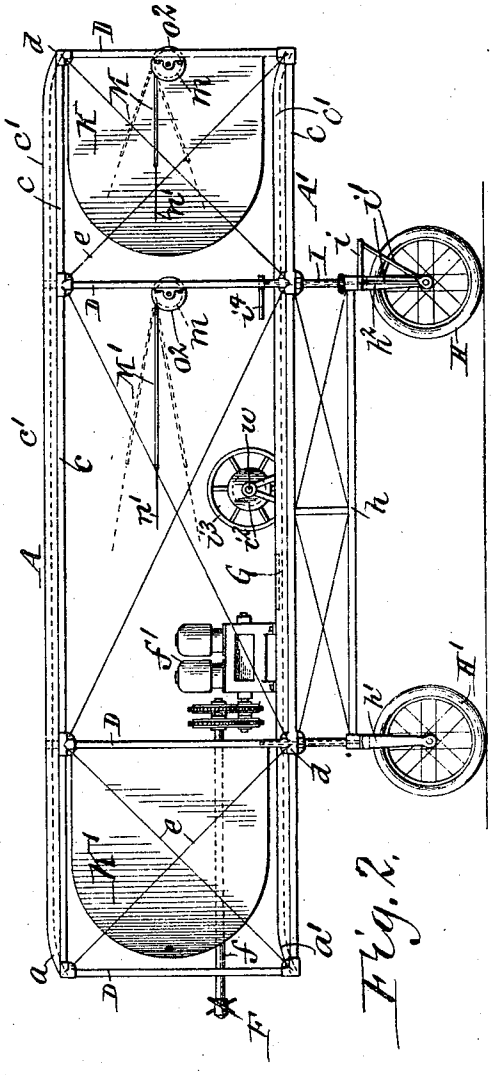

Fig. 2.

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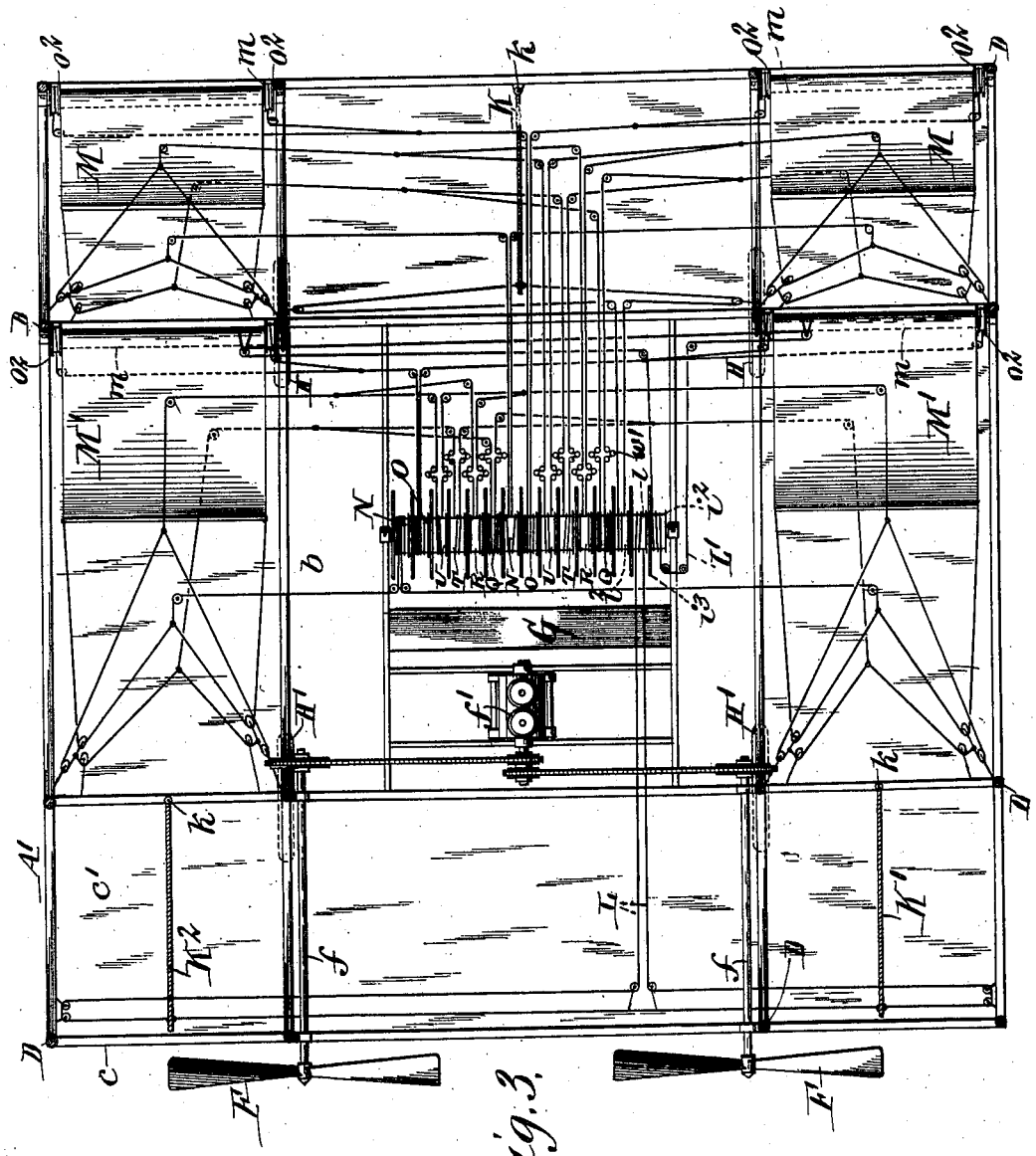

Fig. 3.

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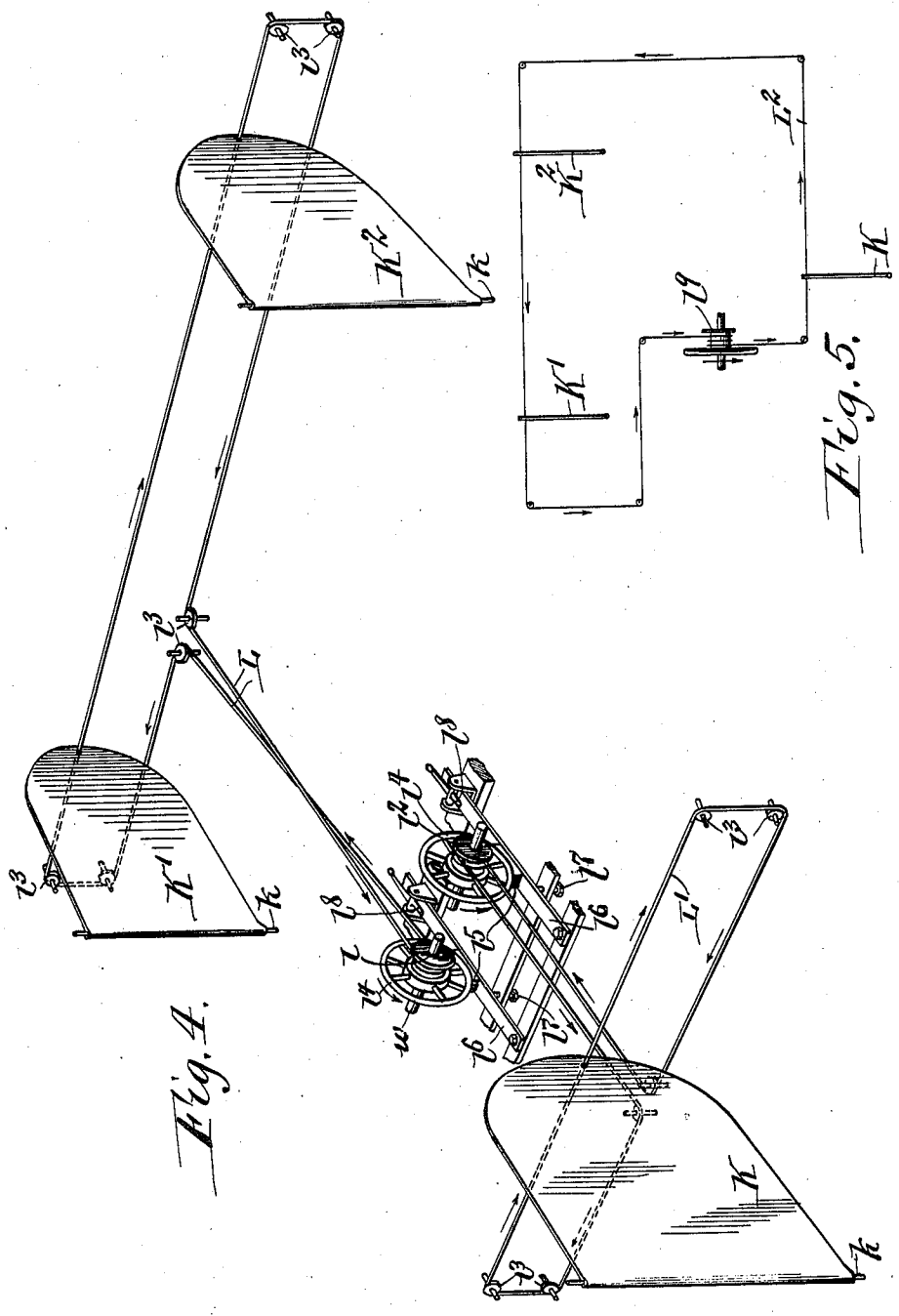

Fig. 4.

Fig. 5.

Witnesses:-
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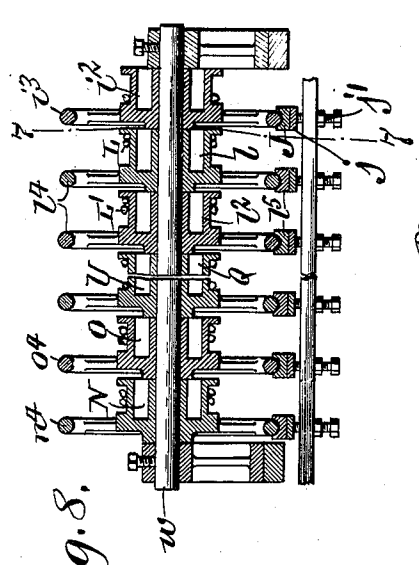

Fig. 8.

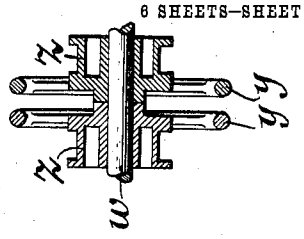

Fig. 9.

Fig. 6.

Fig. 7.

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6 SHEETS—SHEET 5.

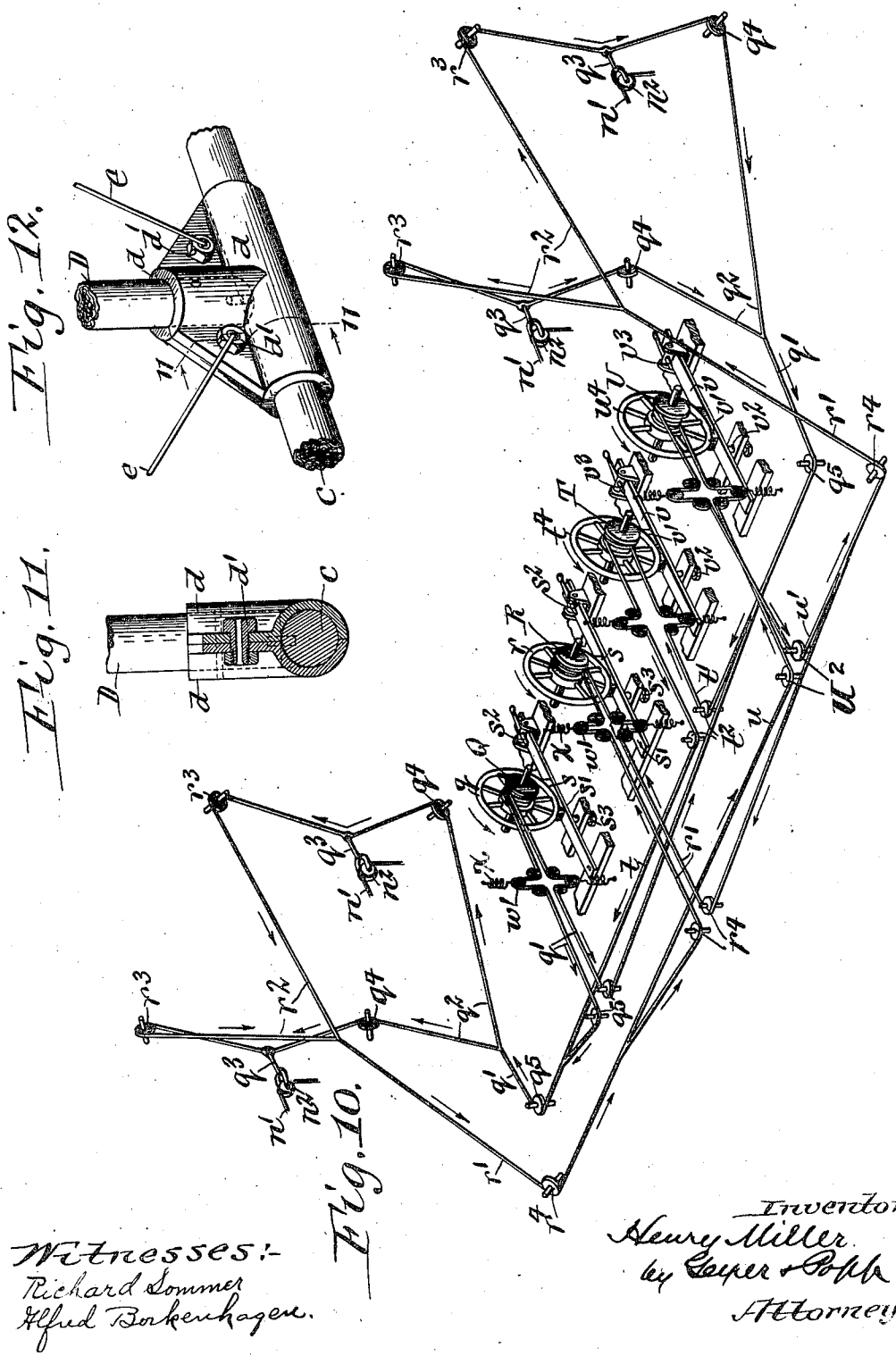

Fig. 12.

Fig. 11.

Fig. 10.

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6 SHEETS—SHEET 6.

Fig. 13.

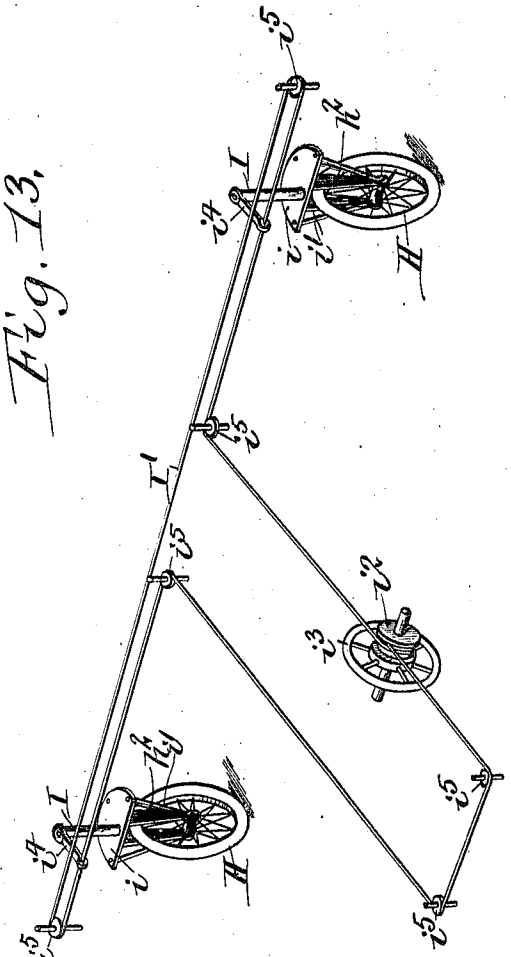
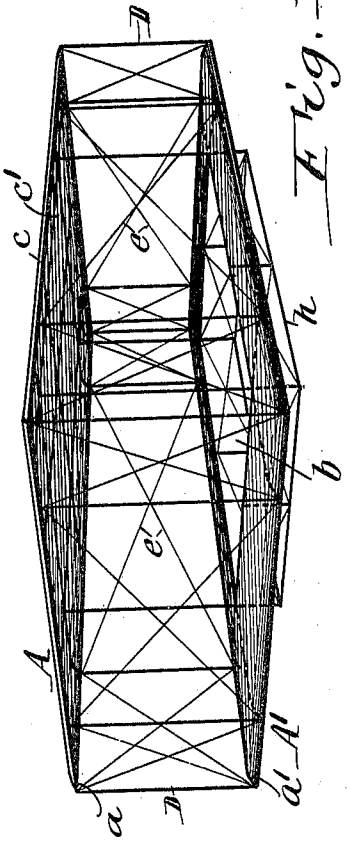


Fig. 14.



Witnesses:-
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UNITED STATES PATENT OFFICE.

HENRY MILLER, OF WASHINGTON, PENNSYLVANIA.

FLYING-MACHINE.

1,031,569. Specification of Letters Patent. Patented July 2, 1912.

Application filed May 7, 1910. Serial No. 559,977.

To all whom it may concern:

Be it known that I, HENRY MILLER, a citizen of the United States, residing at Washington, in the county of Washington and State of Pennsylvania, have invented new and useful Improvements in Flying-Machines, of which the following is a specification.

This invention relates to that class of flying machines or air ships which are commonly known as aero-planes and more particularly to that kind in which two planes are arranged one above the other and which are known as bi-planes.

It is the object of this invention to produce a flying machine of this character in which the areas of the supporting planes are utilized to better advantage for carrying a greater load than has been possible heretofore for a given surface of the planes; to provide superior means for steering the machine horizontally; to provide more efficient and reliable means for controlling the ascent and descent of the machine and also to maintain the same in an upright position, and to provide improved means for steering the machine while the same is running over ground.

In the accompanying drawing consisting of 6 sheets: Figure 1 is a front elevation of my improved flying machine. Fig. 2 is a side elevation thereof. Fig. 3 is a horizontal section of the machine showing the upper supporting plane removed. Fig. 4 is a perspective view showing one of the means for steering the machine horizontally in the air. Fig. 5 is a diagrammatic top plan view showing a modification of the means for steering the machine horizontally in the air. Fig. 6 is a diagrammatic perspective view showing the means for operating the planes which are utilized for steering the machine vertically and also maintaining stability of the same. Fig. 7 is a vertical longitudinal section taken in line 7—7, Fig. 8 and showing one of the hand controlling devices whereby the operator shifts one of the auxiliary planes. Fig. 8 is a fragmentary vertical transverse section in line 8—8, Fig. 7. Fig. 9 is a fragmentary vertical section, similar to Fig. 8 showing a slight modification in the construction of the mechanism for shifting the auxiliary planes. Fig. 10 is a diagrammatic perspective view showing the means for raising and lowering the vertical steering or stabilizing planes. Fig. 11 is a vertical section, on an enlarged scale, taken in line 11—11, Fig. 12 and showing one of the couplings for connecting and bracing adjacent frame members. Fig. 12 is a fragmentary perspective view of said coupling brace and frame members. Fig. 13 is a diagrammatic perspective view showing the means for shifting the ground steering wheels of the machine. Fig. 14 is a detached view of the upper and lower supporting planes of the machine and the uprights and braces connecting the same.

Similar letters of reference indicate corresponding parts throughout the several views.

In its general organization this flying machine comprises upper and lower horizontal supporting planes A, A^1 which are preferably square or rectangular and arranged one above the other, with an intervening space in which is arranged the mechanism whereby the machine is driven and controlled. The upper plane is continuous or imperforate while the lower plane is provided centrally with an opening *b* preferably of rectangular form. By this means the air or wind is permitted to pass upwardly through the lower plane and engage with the unbroken surface of the upper plane, whereby the lower plane is prevented from blanketing the upper plane but permits the upper plane to rest effectively upon the air as well as the lower plane, thereby increasing the supporting capacity of the upper plane.

For the purpose of preventing the air from escaping too freely at the outer marginal edges of the supporting planes, these edges are turned downwardly slightly, as shown at *a*, a^1, thereby causing the air upon engaging with the undersides of the supporting planes to be trapped or pocketed, as it were, and offering a greater resistance to the descent of the machine when in mid air and permitting the same to carry a greater load than would otherwise be possible. Each of the supporting planes may be variously constructed so far as the details are concerned. It is preferable, however, to construct each of these planes of a frame

c composed of a plurality of longitudinal and transverse wood or hollow metal bars which are suitably connected and securing over this frame a covering c^1 of woven fabric or other light material such as is commonly used in flying machines for this purpose.

The two supporting planes are held at a suitable distance apart relatively to each other by means of a plurality of uprights D of wood or metal tubing each of which is connected at its upper and lower ends with the frames of the upper and lower supporting planes, so that together the uprights and plane frames form the main frame of the machine. The connection between each upright and a bar of one of the supporting planes may be effected by any suitable means, those shown in Figs. 1, 2, 11 and 12 comprising a coupling composed of two plates d, d adapted to embrace adjacent parts of one of the supporting plane bars and an upright and a hollow or tubular bolt d^1 connecting such plates. Distortion of the upper and lower planes relatively to each other is prevented and stiffening of the connection between the same is effected by means of diagonal braces, ties or guy wires e each of which is preferably secured to the coupling plates by passing the same through one of the hollow or tubular bolts thereof, as shown in Fig. 12.

The forward propulsion of the machine is effected by means of one or more screw propellers F, two of which are preferably arranged in rear of the space between the upper and lower supporting planes on opposite sides of the longitudinal center of the machine. Each of these propellers is mounted on a longitudinal shaft f journaled in bearings on the adjacent stationary part of the machine and driven by a suitable transmitting mechanism from an engine f^1 which is preferably of the explosion type and located in the central part of the space between the upper and lower supporting planes in rear of the operator's seat G, as shown in Figs. 1, 2 and 3.

While the machine is resting on the ground it is supported on the latter preferably by two front wheels H, H which are arranged transversely in line and two rear wheels H^1, H^1 which are also arranged transversely in line. These several wheels are mounted on a base, extension or hanger h depending from the frame of the lower supporting plane, which extension may be of the usual light construction common in this type of machines.

The rear wheels are preferably journaled in forks h^1 which are secured to the base of the machine so as to be incapable of turning horizontally. The front wheels, however, are journaled in forks h^2 each of which is secured to the lower end of an upright steering shaft I which is journaled in bearings in the adjacent part of the base and lower supporting plane frame, whereby these forks and the front wheels carried thereby may be turned horizontally for steering the machine while the same is resting on the ground. In order to strengthen the front forks and enable them to withstand the shock or strain to which they are subjected when striking an obstruction or while the machine is alighting on the ground, the upper end of the fork of each of the steering wheels is provided with a segmental head or table i projecting forwardly and toward opposite lateral sides thereof and connected at its front and side edges by means of inclined braces i^1 with the axle of the respective steering wheel or the adjacent part of the fork. By this means the resisting power of each steering post is materially increased and renders the same less liable to be bent or injured under the severe strains to which the same is subjected while in use.

Any suitable means may be provided for causing the two steering wheels to turn horizontally in unison, that shown in the drawings, Figs. 2, 3 and 13 comprising a drum i^2 arranged centrally between the upper and lower supporting planes adjacent to the operator's seat and provided with a hand wheel i^3 for turning the same, and an endless line, cord, cable or rope T^1 which is wound upon the drum i^2 and connected at different points with rearwardly projecting tillers or steering arms i^4 of the steering posts and passing around guide pulleys i^5 on the adjacent part of the stationary main frame of the machine. Upon turning the drum i^2 in one direction the steering wheels are turned horizontally for causing the machine to turn toward one side while upon turning the drum in the opposite direction the steering wheels will turn horizontally in a reverse direction. This drum is yieldingly held in any position in which it may be set by means of a clamping block or shoe J bearing against the lower edge of its hand wheel, a spring j preferably of the leaf or bar type supporting the clamping block or shoe and secured at one end to a part of the lower plane frame, and an adjusting screw j^1 bearing against the spring between its rear fixed end and the clamping shoe and supported upon an adjacent stationary part of the frame. Upon tightening or loosening this screw j^1 the frictional pressure exerted by the clamping shoe against the hand wheel may be varied as best suits the requirement. When it is desired to free the hand wheel and drum from the retarding effect of the clamping shoe the latter may be retracted from the hand wheel by means of a rotatable cam j^2 adapted to engage with the free end of the spring j and provided

with a handle j^3 whereby the cam may be moved into or out of its operative position. Upon turning the cam so that the same projects downwardly from its pivot and engages its highest part with the spring the clamping shoe will be depressed out of engagement from the hand wheel, as shown by full lines in Fig. 7, while upon turning the cam so that the low part of the same is presented to the spring, as shown by dotted lines in Fig. 7, the spring is permitted to raise the clamping shoe into engagement with the hand wheel.

Horizontal steering of the air ship while in flight may be effected by various means but preferably by means of three upright steering planes K, K^1, K^2 which are arranged between the upper and lower supporting planes and each of which is pivoted at its front end by a rod k or otherwise to the frames of these planes, so that these steering planes can be turned horizontally into different angles and direct the movement of the flying machine accordingly. One of these horizontally steering planes is preferably arranged centrally between the front parts of the upper and lower supporting planes and the other two are arranged between the rear parts of the supporting planes on opposite sides of the longitudinal center thereof. For the purpose of causing the flying machine to respond quickly in its horizontal deflection from its course, means are provided whereby the rear end of the front steering plane is turned in a direction opposite to that in which the rear ends of the rear steering planes are turned. By this means the angle of incidence of the front plane at which it is engaged by the pressure of the wind or air is opposite the angle of incidence of the rear steering planes, whereby the machine is caused to turn more promptly about a vertical axis located centrally relatively to the area of the supporting planes. One of the means for thus operating the steering planes is shown in Fig. 4, of the drawings and comprises a cable L passing around a drum l and connected with the rear planes so that upon turning this drum in one direction or the other both rear planes will be turned together and maintained in parallelism, and the front steering plane is connected by means of a cable or endless line L^1 with another drum l^2 which is independent of the mechanism controlling the rear steering plane and which upon being turned in one direction or the other causes the front steering plane to be shifted horizontally. The intermediate parts of the front and rear steering cables L, L^1 pass around a guide pulley l^3 mounted on suitably stationary parts of the machine and the drums are arranged adjacent to each other and to the operator's seat and are provided with hand wheels l^4 whereby the same may be conveniently turned as desired by the operator.

Each of the steering drums l, l^2 is yieldingly held in its adjusted position by means of a clamping shoe l^5 engaging with its steering wheel, a bar spring l^6 supporting the shoe l^5, a screw l^7 whereby the tension of the spring may be increased or decreased and a cam l^8 engaging with said spring and adapted to move the clamping shoe out of its operative position or permit the spring to move the same into its operative position, in substantially the same manner as the holding device of the ground steering wheels, shown in Fig. 7.

By providing independent steering drums and cables for the front and rear steering planes, as shown in Fig. 4, the front and rear steering planes K, K^1, K^2 may be adjusted independently of each other or simultaneously as best suits the operator. If desired, however, the front and rear steering planes may all be united or connected by a single endless cord or cable L^2 with a single steering drum l^9, as shown in Fig. 5, which construction is so organized that the front and rear steering planes always turn horizontally and inversely relatively to each other. While the last mentioned construction is preferable in some respects owing to the fixed relation of the front and rear steering planes it has the disadvantage of rendering the steering planes useless in the event of breakage of the cable, whereas if one of the cables in the construction shown in Fig. 4, should become broken, the other cable would be available for steering the machine until repair of the broken cable could be effected.

For the purpose of steering the air ship or flying machine vertically and also permitting of righting or stabilizing the same if the same should list or careen in one direction or the other, a vertical steering or stabilizing mechanism is provided which is preferably constructed as follows and best shown in Figs. 1, 3, 6 and 10. M, M represent a pair of front steering and stabilizing planes which are arranged in the front part of the space between the upper and lower supporting planes on opposite sides of the longitudinal center of the machine and M^1, M^1 a pair of rear steering and stabilizing planes which are arranged in the space between the upper and lower supporting planes in rear of the front planes. Each of these steering and stabilizing planes is preferably constructed in the form of a flexible or pliable web or sheet of any suitable material which is mounted at its front end upon a horizontal roller m journaled transversely in suitable bearings on the main frame of the machine, so that this plane may be either wound up or unwound at its front end on its

roller and thereby expose more or less of the area of its rear end to the action of the air or wind. The unwinding of the corresponding pairs of steering and stabilizing planes is preferably effected simultaneously by means of two cords or cables n, n which have their corresponding inner ends wound upon the same drum N arranged adjacent to the operator's seat while the opposite ends of each of these cables is divided into two branches n^1, n^1 and connected with the rear end of one of the steering and stabilizing planes at opposite longitudinal edges thereof. The intermediate part of each of these last mentioned cables passes around suitable intermediate guide pulleys n^2, n^3 mounted on the adjacent stationary part of the machine frame. Upon turning the drum N forwardly by means of a hand wheel or handle n^4 arranged on one end thereof the cables n, n are wound in the same direction upon this drum and the corresponding pair of planes are unwound or extended, thereby presenting a greater or lesser area of these planes to the action of the wind. For again winding the flexible planes upon their rollers when a lesser area of the same is desired these rollers are turned in the reverse direction by means of two retracting cables o, o the inner ends of which are wound in the same direction upon a retracting drum O arranged adjacent to the operator's seat while the opposite end of each of the retracting cables is divided into two branches o^1, o^1 which pass around drums o^2, o^2 arranged at opposite ends of each of the plane rollers and turn therewith. The intermediate part of each retracting cable or line o passes around guide pulleys o^3 supported upon adjacent parts of the stationary frame. Upon turning the extending drum N forwardly, for extending a flexible pair of the planes M, M or M^1, M^1 the branches of the retracting cables are wound upon the drum o^2, o^2 while upon turning the retracting drum O backwardly the retracting cables are wound thereon at one end and unwound at their opposite ends from the plane drums o^2, thereby causing the plane rollers to wind the planes thereon and cause the extending cables to be unwound from the extending drum N.

The hand wheels n^4, o^4 of the plane extending and retracting drums are preferably arranged adjacent to each other and the cables are preferably wound upon the same in such a direction, so that these drums may be turned together in one direction about their axis by applying one hand of the operator to the hand wheel of one of these drums and the other hand of the operator to the hand wheel of the other drum for causing the extending cables to unwind in the same measure as the retracting cables wind up on their respective drum and vice versa. Any differential which necessarily occurs between the extent of movement of the extending and retracting cables owing to the variation in the diameter of the rolled up part of the planes may be compensated for by moving the extending and retracting drums relatively to each other the required extent to take up the slack in these cables or to pay out one of these cables somewhat faster as the exigencies of the case may require. Each of the extending and retracting drums may be yieldingly held in its adjusted position by means of a yielding clamping device which is constructed substantially like that shown in Fig. 7 with reference to the ground steering mechanism and which comprises a clamping shoe p bearing against the lower side of the respective hand wheel, a spring p^1 secured at one end of the main frame and supporting the clamping shoe on its central part, a rotatable cam p^2 engaging with the opposite or free end of the spring and adapted to move the clamping shoe into or out of its operative position, and a tension screw p^3 mounted on a stationary part of the frame and bearing against the spring p^1 between its fixed end and the clamping shoe. By thus projecting or pulling out the extensible and retractable planes more or less in a horizontal direction or parallel with the upper and lower supporting planes, it is possible to add to or subtract from the total supporting plane area and vary the carrying capacity of the machine in accordance with the load which the same is required to carry.

In addition to serving as supporting planes each pair of extensible planes may be raised and lowered at their rear ends for the purpose of changing their angle of incidence relative to the pressure of the wind or air and thus cause the air ship to either be steered upwardly or downwardly. When the rear ends of the extensible planes are raised the air or wind upon striking the upper side of the same causes the machine to be depressed while upon lowering the rear ends of these planes the wind upon striking the underside of the same causes the machine to be elevated. It will therefore be observed that by the proper manipulation of these planes the ship may be steered either upwardly or downwardly while in mid air. This raising and lowering of the rear ends of the extensible planes of each pair may be effected simultaneously by various means, those shown in the drawings being suitable and constructed as follows: Q, R represent two drums preferably arranged side by side adjacent to the operator's seat and adapted to be turned simultaneously in one direction or the other by the hands of the operator applied to hand wheels q, r arranged on these drums, respectively. Around the steering drum Q one end of two cables q^1 are wound

in the same direction while the opposite ends of each of these cables are provided with two lower branches q^2 which are connected with clevises q^3 upon which the intermediate pulleys n^2 are mounted which carry the two branches n^1 of the extension cord or cable of one of the extensible planes. Around the other drum R the corresponding ends of two cables r^1 are wound in the same direction but opposite to that in which the cables q^1 are wound around the drum Q. Each of these cables r^1 is divided at its outer end into two upper branches r^2 which also connect with the clevises q^3 upon which the guide pulleys n^2 are mounted. The upper branches r^2 pass around upper guide pulleys r^3 which are mounted on the frame while the cable of which they form a part passes around intermediate guide pulleys r^4. The lower branches q^2 pass around lower guide pulleys q^4 mounted on convenient parts of the main frame while the main cable of which they form a part passes around intermediate guide pulleys q^5 also mounted on suitable parts of the main frame. Upon turning the hand wheels Q, R and their drums together forwardly the cables q^1 unwind from the drum Q and the cables r^1 wind up on the other drum R, thereby causing the bodily movable guide pulleys n^2 over which the branch extension cords n^1 pass to be raised, while upon turning the drums Q, R together in the opposite direction the movement of their cables and branches are reversed, thereby causing the pulleys n^2 to be moved downwardly. It will thus be apparent that by properly manipulating the drums Q, R the pulleys n^2 may be raised or lowered different distances from their central or neutral position, so that the surfaces which are presented by the extensible planes may be inclined either in an upward or a downward position relatively to the direction of the wind and thereby cause the machine to be either raised or lowered or in other words tipped upwardly or downwardly for causing the machine to rise and fall.

Each of the drums Q, R may be held yieldingly in its adjusted position by a yielding retaining device which is substantially like that shown in Fig. 7 and comprises a shoe s bearing frictionally against its hand wheel, a spring s^1 carrying the shoe on its central part and fixed on the frame at one end, a rotatable cam s^2 bearing against the opposite end of the spring and adapted to move the same so as to engage or disengage the shoe from the hand wheel, and a screw s^3 for adjusting the tension of the spring and bearing against the latter between its fixed end and the shoe.

For the purpose of utilizing each pair of extensible planes as a means for righting the machine or maintaining its equilibrium, separate means are provided whereby one of the extensible planes of each pair may be lowered relatively to its central position while the other is raised relatively to this position, thereby causing the wind upon engaging the downwardly inclined extensible plane to lift the machine on the respective side while the wind engaging with the upwardly inclined extensible plane on the other side of the machine will cause the last mentioned side thereof to be depressed, thereby causing a restoration of the machine to its normal upright position. For the purpose of thus manipulating each pair of extensible planes a shifting device is provided which comprises two stabilizing drums T, U arranged adjacent to the operator's seat. Around the drum T is wound a cable one end or part t of which is connected with the lowering cable q^1 of the right hand extensible plane, while the other end or part t^1 of this cable connects with the depressing lowering cable q^1 of the companion plane, the intermediate parts of the cable t, t^1 passing around guide pulleys t^2, as shown in Fig. 10. Around the other stabilizing drum U a cable is wound one end u of which is connected with the lifting cable r^1 of the right hand extensible plane while the other end u^1 of said cable is connected with the lifting cable r^1 of the corresponding left hand plane. The intermediate parts of the cord or cable u, u^1 pass around guide pulleys u^2 mounted on the main frame. If now it is desired to raise the extensible plane of a pair on one side of the machine and depress the corresponding plane of this pair on the other side of the machine to correct or counteract the listing of the machine in one direction, the drums T, U are turned together in one direction by the operator applying opposite hands to the hand shifting wheels t^4, u^4 of these drums. Upon turning the stabilizing drums together in the other direction the position of the right and left hand extensible planes is reversed, thereby causing the machine to be righted in the opposite direction. The arrows in Fig. 10 show the direction in which the drums and cables move while stabilizing the machine in one direction.

Each of the stablizing drums is yieldingly held in its adjusted position in the same manner as the other drums heretofore referred to, which means comprise a bar spring v provided between its ends with a clamping shoe v^1 adapted to engage with the hand wheel of the respective drum, an adjusting screw v^2 engaging with this spring between its fixed end and the clamping shoe and a cam v^3 for shifting the opposite or free end of the spring so as to engage the clamping shoe with the hand wheel or disengage the same therefrom. While the stabilizing drums T, U are being shifted by the operator the clamping shoes of the steering drums Q, R are rendered inopera-

tive by their cams, so that these last mentioned drums are free to turn and shift their position without interfering with the free movement of the stabilizing drums. On the other hand while the steering drums Q, R are in use the clamping shoes of the stabilizing drums T, U are rendered inoperative so as to not interfere with the free movement of the steering drums. For convenience the several drums and their hand wheels are all mounted side by side on a single rod or shaft w in front of the seat of the operator, so that they are all within convenient reach and can be manipulated without requiring the operator to shift his weight, thereby avoiding unnecessary disturbance of the equilibrium of the machine. Each of the cables may also be provided with a tightener so as to take up any slack which may be present in the same, which tightener, as shown in Fig. 10, may consist of a pulley w^1 engaging with the cable or cord and a spring x connecting said pulley with the frame.

In the operation of the machine all of the extensible planes may either be used as auxiliary supporting planes to supplement the action of the main supporting planes, or they may be all used as vertical steering planes. These two pairs of extensible planes may also be used simultaneously for stabilizing the machine or only one pair of these planes may be utilized for stabilizing the machine while the other pair may be used as supporting planes or steering planes.

In Fig. 8 the steering wheels of the several drums are all arranged at corresponding ends thereof. Inasmuch, however, as these drums are used principally in pairs, the hand wheels y, y of companion drums z, z may be arranged at the opposing ends of the drums of each pair, as shown in Fig. 9, whereby the operator will be able to select the proper pair of drums to be manipulated with greater facility and certainty.

I claim as my invention:

1. A flying machine comprising a main horizontal supporting plane, an auxiliary plane arranged substantially parallel relatively to the main plane and capable of being wound up or unwound for exposing more or less of its area to the wind and having its axis arranged horizontally and transversely, and means for bodily raising or lowering said auxiliary plane.

2. A flying machine comprising a main horizontal supporting plane, an auxiliary plane arranged substantially parallel with the main plane and capable of being wound up or unwound for exposing more or less of its area to the wind, a roller to which one end of said auxiliary plane is secured, means for unwinding said auxiliary plane from said roller comprising a tackle which connects with the other end of the same, and means for raising and lowering said tackle.

3. A flying machine comprising a main horizontal supporting plane, an auxiliary plane arranged substantially parallel with the main plane and capable of being wound up or unwound for exposing more or less of its area to the wind, a roller to which one end of said auxiliary plane is secured, means for unwinding said auxiliary plane from said roller comprising a tackle which connects with the other end of the same, and means for raising and lowering said tackle comprising a tackle connected with the first mentioned tackle.

4. A flying machine comprising a main horizontal supporting plane, an auxiliary plane arranged substantially parallel with the main plane and capable of being wound up or unwound for exposing more or less of its area to the wind, a roller to which one end of the auxiliary plane is secured, means for winding the auxiliary plane upon said roller comprising a drum on the roller, a retracting drum and a cord wound at its opposite ends around the roller drum and said retracting drum, means for unwinding the auxiliary plane from said roller comprising an extending drum and an extending cord connecting the extending drum with the free end of said auxiliary plane, and means for raising and lowering the free end of said auxiliary plane comprising a pulley around which said extending cord passes adjacent to the free end of the auxiliary plane, a vertical shifting cord connecting with said pulley, a lifting drum to which one end of said shifting cord is secured, and a lowering drum to which the other end of said shifting cord is attached.

5. A flying machine comprising a main horizontal plane, a pair of auxiliary planes arranged substantially parallel with the main planes and each adapted to be wound up or unwound for exposing more or less of its area, means for winding up and unwinding said auxiliary planes, and means for raising and lowering one end of each of said auxiliary planes.

6. A flying machine comprising a main horizontal plane, a pair of auxiliary planes arranged substantially parallel with the main planes and each adapted to be wound up and unwound for exposing more or less of its area, means for winding up and unwinding said auxiliary planes, and means for moving one end of each of said auxiliary planes vertically in opposite directions.

7. A flying machine comprising a main horizontal plane, a pair of auxiliary planes arranged substantially parallel with the main planes and each adapted to be wound up or unwound for exposing more or less of its area, means for winding up and un-

winding said auxiliary planes, and means for moving one end of each of said auxiliary planes vertically in opposite directions or raising and lowering the same.

8. A flying machine comprising a main horizontal plane, a pair of auxiliary planes arranged substantially parallel with the main planes and each adapted to be wound up or unwound for exposing more or less of its area, means for winding up and unwinding said auxiliary planes comprising extending and retracting drums and extending and retracting tackles connecting said drums with the free and fixed ends of said auxiliary planes, and means for raising and lowering one end of each of the auxiliary planes comprising raising and lowering drums and raising and lowering tackles connecting the raising and lowering drums with said extending tackles.

9. A flying machine comprising a main horizontal plane, a pair of auxiliary planes arranged substantially parallel with the main planes and each adapted to be wound up or unwound for exposing more or less of its area, means for winding up and unwinding said auxiliary planes comprising extending and retracting drums and extending and retracting tackles connecting said drums with the free and fixed ends of said auxiliary planes, means for raising and lowering one end of each of the auxiliary planes simultaneously comprising raising and lowering drums movable together and raising and lowering tackles wound around the same in opposite directions and connected with said extending tackles, and means for moving said auxiliary planes vertically in opposite directions comprising drums moving together and tackles wound in opposite directions around each of said last mentioned drums and connected with said raising and lowering tackles.

10. In an aeroplane, and in combination with the sustaining plane or planes of the device, a controlling plane adapted to be presented at either of opposite angles above and below the direction or axis of travel of the device, and means for augmenting and diminishing the functional surface of said controlling plane.

11. In an aeroplane, and in combination with the sustaining plane or planes of the device, a controlling plane adapted to be presented at either of opposite angles above and below the direction or axis of travel of the device, and means for extending and contracting said controlling plane to augment or diminish its functional surface.

12. In an aeroplane, and in combination with the sustaining plane or planes of the device, a controlling plane adapted to be presented at either of opposite angles above and below the direction or axis of travel of the device, and means for furling and unfurling said controlling plane to diminish or augment its functional surface.

13. In an aeroplane, and in combination with the sustaining plane or planes of the device, controlling means at each end, each comprising a plane adapted to be presented at an angle on either side of the direction of travel of the aeroplane, and means under the control of the operator for augmenting and diminishing the functional surface of one of said controlling planes in an angle on one side of said direction of travel while correspondingly augmenting and diminishing the functional surface of the other of said controlling planes in an angle on the opposite side of said direction of travel.

14. A flying machine comprising a main horizontal plane, a pair of auxiliary planes arranged substantially parallel with the main planes and each adapted to be furled or unfurled for exposing more or less of its area, means for furling and unfurling said auxiliary planes, and means for raising and lowering one end of each of said auxiliary planes.

Witness my hand this 27th day of April, 1910.

HENRY MILLER.

Witnesses:
T. W. MINTON,
M. P. RUSH.