D. P. McLAUGHLIN.

FLYING MACHINE OR AIRSHIP.

APPLICATION FILED JUNE 30, 1909.

991,794.

Patented May 9, 1911.

4 SHEETS—SHEET 1.

Fig. 1.

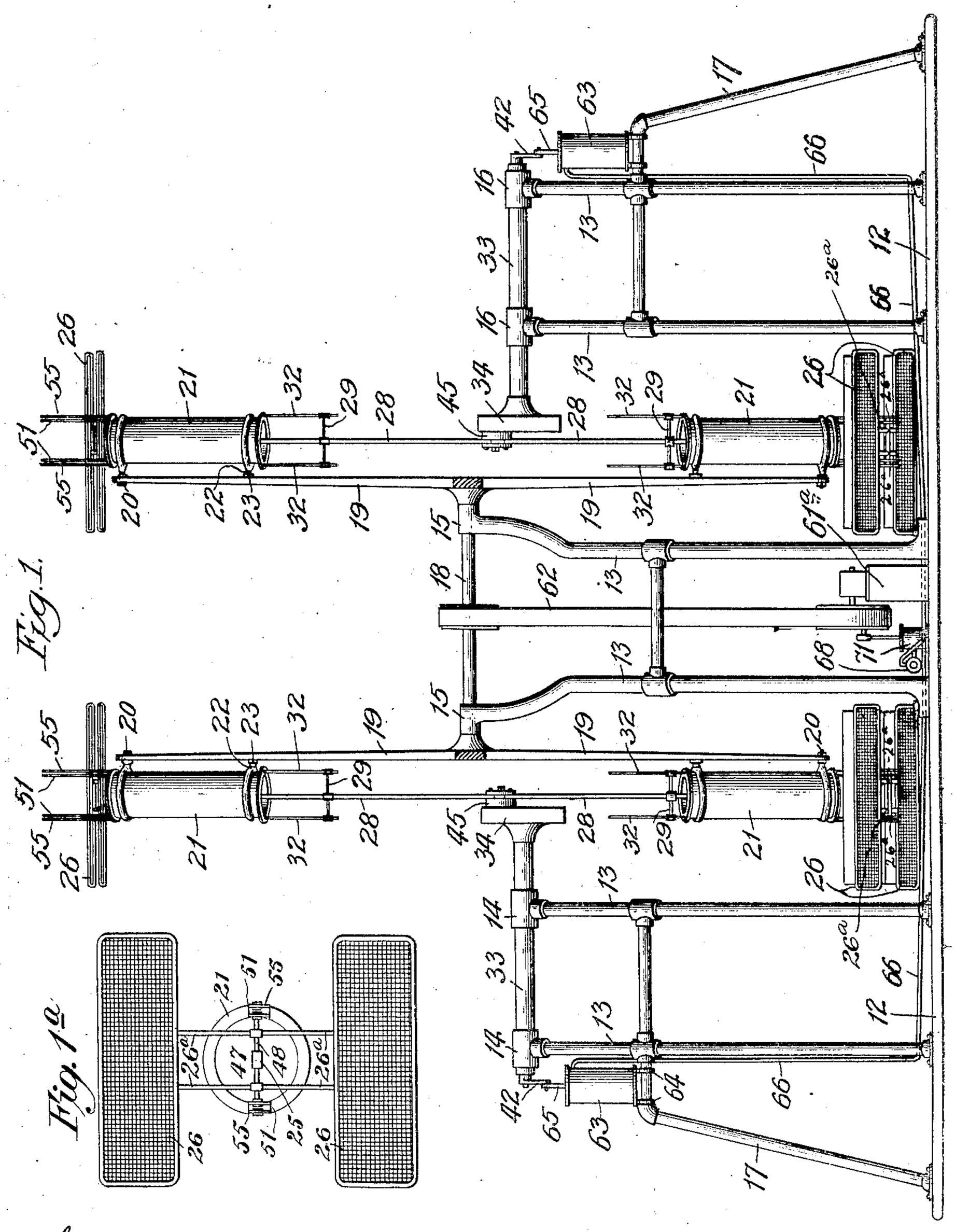

Fig. 1a.

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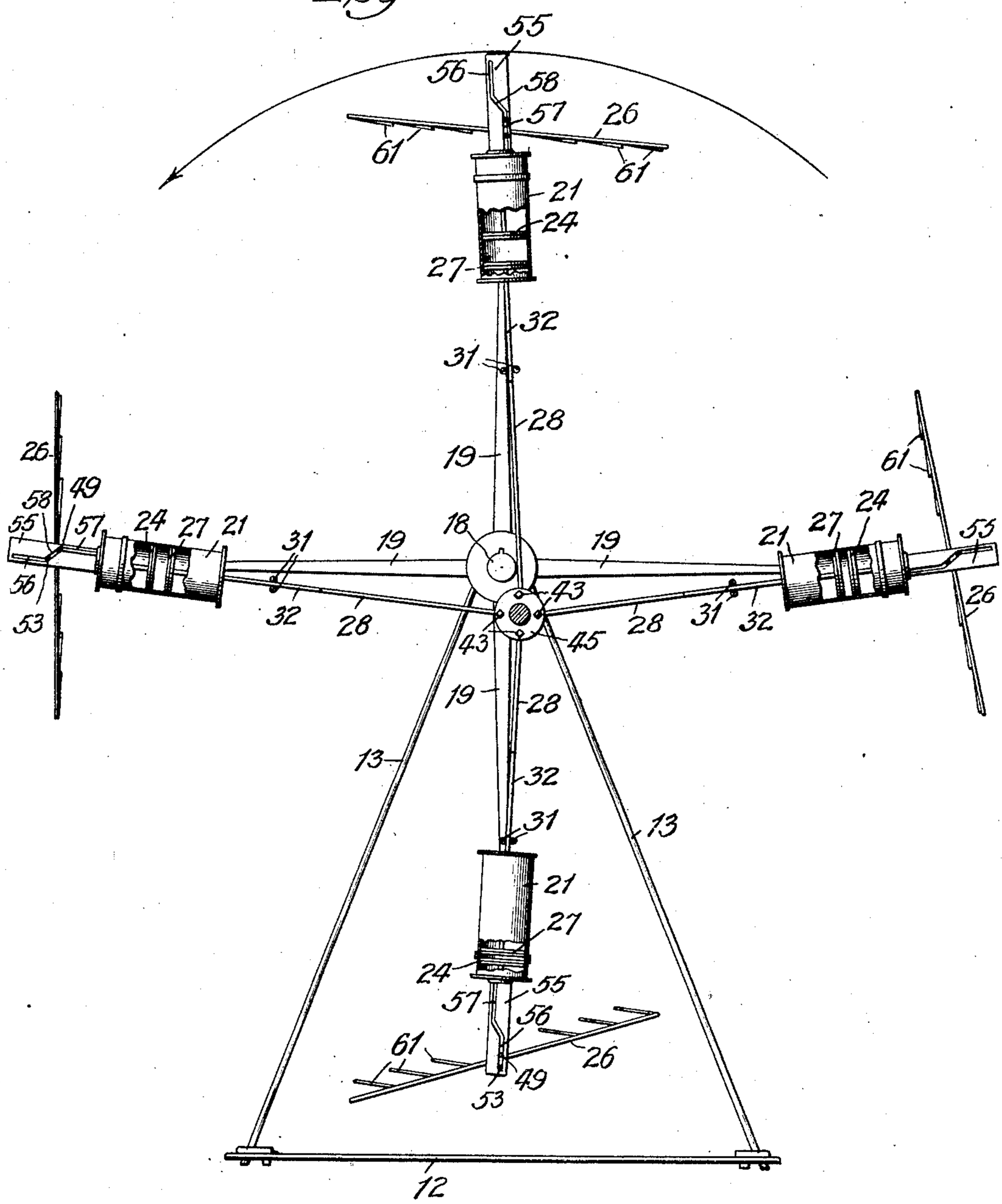
4 SHEETS—SHEET 2.

Fig. 2.



12

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4 SHEETS—SHEET 3.

Fig. 3.

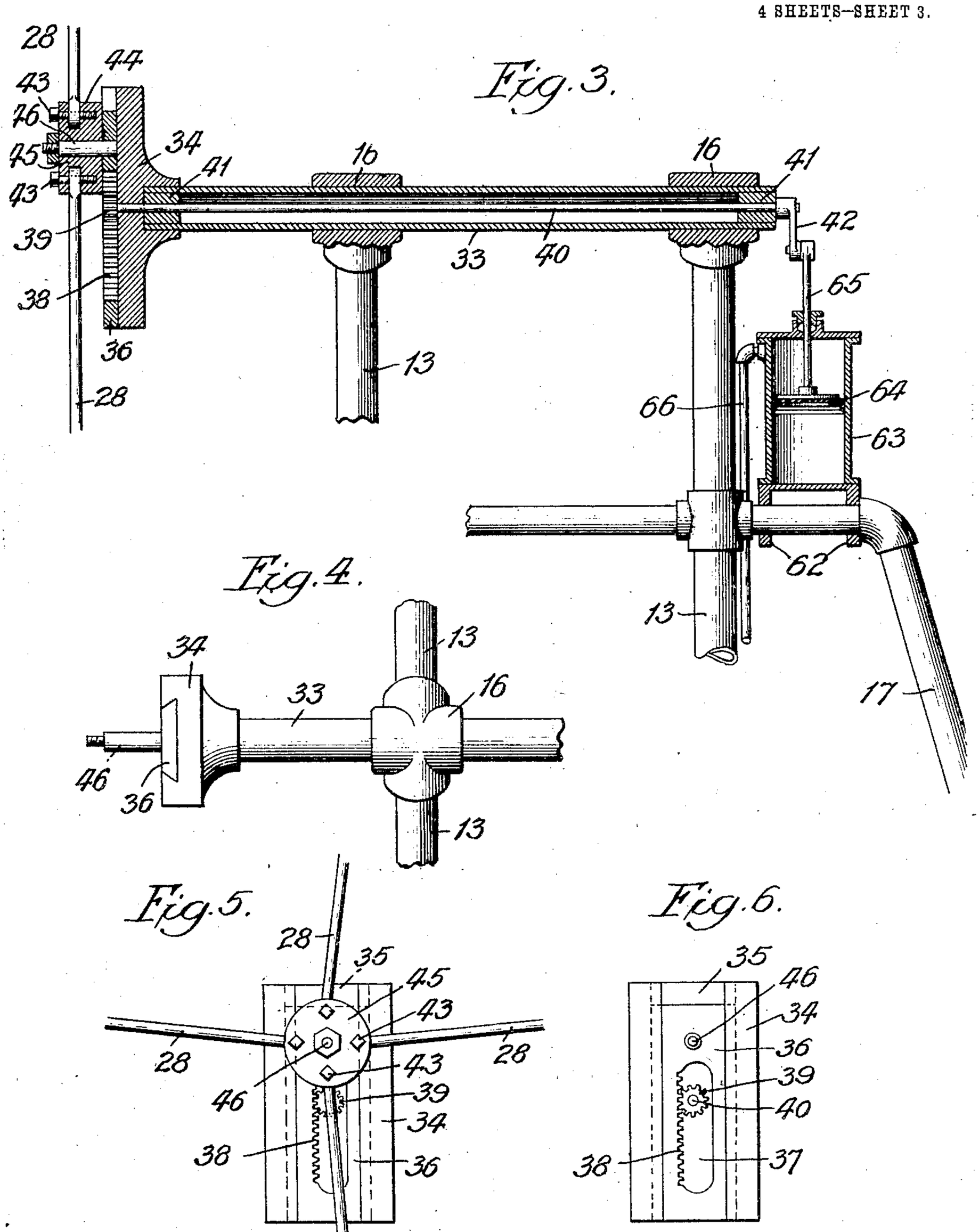

Fig. 4.

Fig. 5.

Fig. 6.

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4 SHEETS—SHEET 4.

Fig. 7.

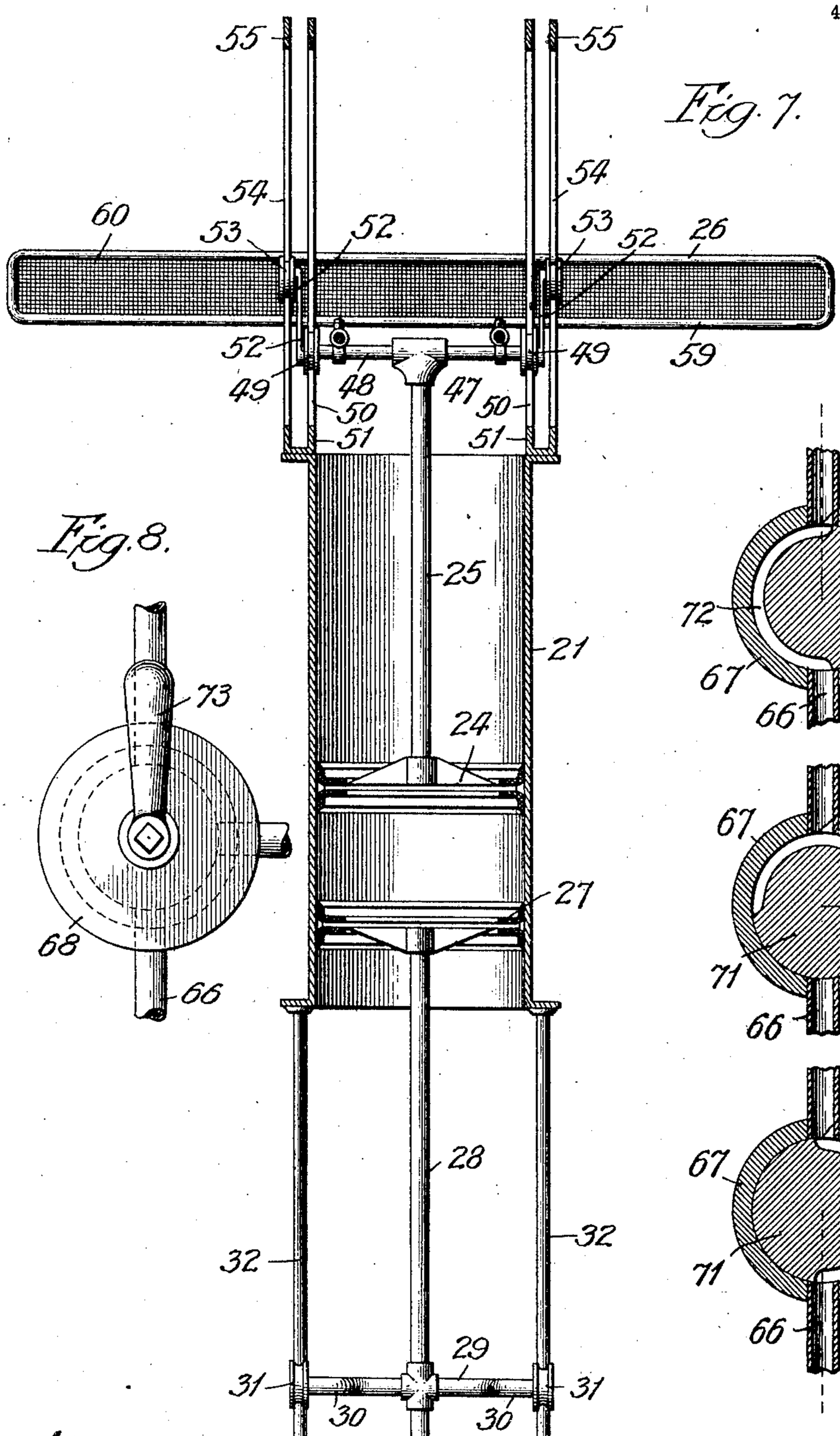


Fig. 8.

Fig. 9.

Fig. 10.

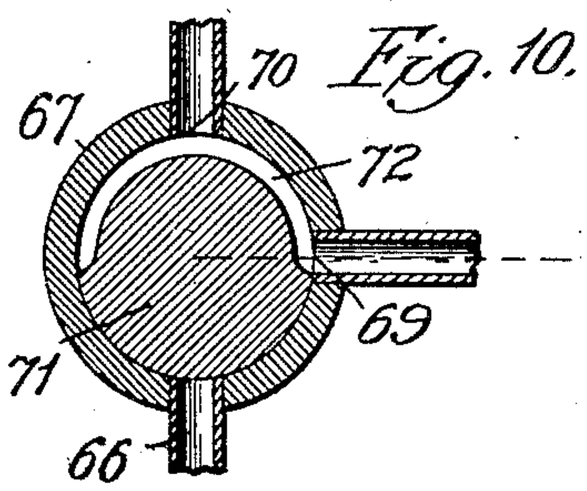
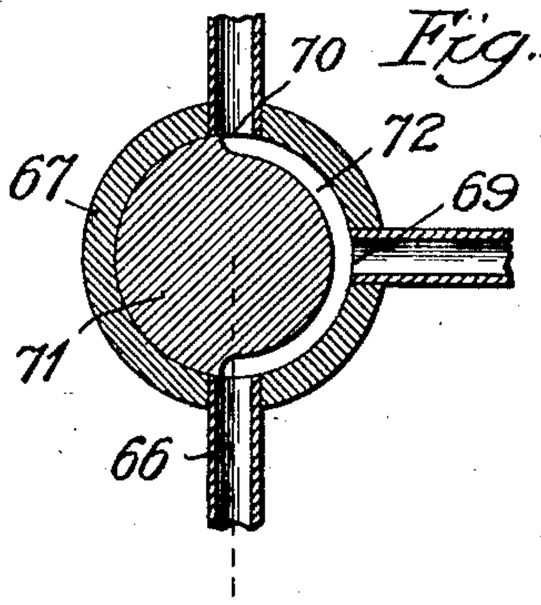


Fig. 11.



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UNITED STATES PATENT OFFICE.

DANIEL P. McLAUGHLIN, OF CHICAGO, ILLINOIS.

FLYING-MACHINE OR AIRSHIP.

991,794. Specification of Letters Patent. Patented May 9, 1911.

Application filed June 30, 1909. Serial No. 505,230.

To all whom it may concern:

Be it known that I, DANIEL P. McLAUGHLIN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Flying-Machines or Airships, of which the following is a specification.

My invention relates to flying-machines, or air-ships constructed with rotatable propellers in the form of screw-wheels, rotary aeroplanes, rotatable wings or the like, or any other analogous form of means for lifting or propelling the machine, and more particularly to the type of machines commonly known as "heavier than air" machines, in which gas-bags are eliminated and the power for propelling or lifting the machine is self-contained.

A rotary propeller, or screw-wheel, when its power is self-contained, as provided in devices of the character above stated and as hitherto constructed, while developing a lifting force which tends to strain upward in its movement, is nevertheless incapable of producing the maximum force obtainable from propelling devices, as no provision is made for utilizing the inertia of the body with which the air-engaging means are connected, to aid in the lifting of the air-ship, and the same is true where rotary aeroplanes, or any other revoluble device adapted to operate against the air is employed.

My invention contemplates the augmenting of the force exerted by the lifting or propelling means, to the end of causing the object to be lifted in the air to the height desired and thus provision be made for lifting a carrier in the form of an air-ship from the ground to the heights desired by the operation of an air-engaging device alone and, furthermore, it contemplates the augmenting of the power of the air-gripping device when used as a means for propelling the body through the air; my invention operating on the principle of producing a force sufficient to overcome inertia of the body to be moved and exerting such force upon the body to move it. To these ends, I so construct the air-gripping or engaging devices as to cause them to operate intermittently against the air, and while so operating to move in a direction with relation to the object attached thereto at a speed in excess of their movement, as retarded by the air, toward the body, thus using the air below the air-gripping means as a fulcrum, so to speak, upon which the air-gripping means may act; and provide in connection with the means for actuating the air-engaging device, a tensioning or temporary power storage device, which shall operate to store up power, in the nature of temporary tension, during the engagement of the air-engaging means with the air and communicate such tension to the body to overcome inertia thereof, and thereupon move the body, the duration of the engagement of the air-engaging means with the air being maintained, with each operation, sufficiently long to cause the power stored in the storage or tensioning device to overcome the inertia of the body and move it while the air-engaging devices are being resisted by the air in their operation.

My invention may be employed for either lifting the carrier by propelling it upward or moving the carrier forward or backward through the air, or both, but as the principle of operation is the same in either case I have confined illustration thereof to means for lifting the carrier, the accompanying drawings illustrating the invention diagrammatically without regard to proportions of parts.

In the drawings—Figure 1 is a view in front elevation of an air-ship construction embodying the principle of my invention. Fig. 1ª is a detailed plan view of one of the plurality of sets of vanes employed. Fig. 2 is a view in side elevation of the same. Fig. 3 is a view in front elevation of a detail of one of two similar mechanisms for controlling the bodily movement of the air-gripping or engaging devices with relation to the platform of an air-ship, certain parts being illustrated in sectional elevation. Fig. 4 is a top plan view of a detail of the construction illustrated in Fig. 3. Fig. 5 is an end view of the construction illustrated in Fig. 3 viewed from the left-hand side of said figure. Fig. 6 is a view of the same with the connector-block for the piston-rods removed. Fig. 7 is an enlarged view in vertical sectional elevation of one of the four similar air-gripping mechanisms employed. Fig. 8 is a view in front elevation of the triple valve construction for controlling the flow of fluid pressure to the pistons illustrated in Fig. 3 for controlling the stroke of the vane-actuating pistons; and Figs. 9, 10 and 11, sectional views of the valve of Fig. 8

showing the various positions it assumes when manually operated for controlling the movement of the vanes.

The platform of the structure illustrated as representing an air-ship, is indicated at 12, and has rising from it a plurality of suitably braced upwardly-extending, converging frame-members 13, which are united at their upper ends and form pairs of bearings 14, 15 and 16, end frame-members 17 being provided for further strengthening two pairs of the members 13 as illustrated.

Journaled in the bearings 15 is a shaft 18, each end of which beyond the bearings 15, carries radial arms 19 shown as four in number arranged at an angle of 90° to each other as represented, though it will be understood that the number of arms may be varied to suit varying conditions. Pivoted near the outer ends of each arm 19, as indicated at 20, is a cylinder 21 open at its opposite ends and provided near its inner end with a shoe 22 adapted to bear against a bearing-surface 23 secured to the adjacent arm 19. Each cylinder 21 contains a piston 24 having air-tight connection with the inner surface of the cylinder and connected with a piston-rod 25 extending through the outer end of the cylinder 21 and connected, in a manner hereinafter described, with vanes 26. Each cylinder also contains a second piston 27 which is not engaged with the piston 24 and carries a rod 28 projecting through the inner end of the cylinder 21 and provided with a cross-head 29 having yoke-shaped ends 30 in which rollers 31 disposed on opposite sides and bearing against parallel rods 32 carried by the cylinder 21, are journaled. Rigidly fixed in the bearings 14 and 16 are horizontally extending tubes 33, the adjacent ends of which carry heads 34, the outer face of each of which contains a longitudinally extending undercut groove 35 forming a guide for a plate 36 adjustable therein and containing an elongated slot 37, one edge of which is provided with teeth to afford a rack 38. Engaging with these racks thus provided are pinions 39 fixed on the ends of shafts 40 extending centrally through the tubes 33 and journaled in bearing-plugs 41 in the ends of the tubes, the ends of the shafts 40 opposite to those carrying the pinions being provided with cranks 42 adapted to be actuated to rotate the pinions as hereinafter described. The inner ends of the rods 28 are secured as by means of screw-bolts 43 in peripheral recesses 44 contained in blocks 45 journaled upon pins 46 extending laterally from the slides 36 toward their upper ends, the blocks 45 being located below the shaft 18 to be eccentric therewith and preferably a slight distance to one side of a vertical line passing through this shaft, whereby rotation of the shaft 18 and arms 19, as hereinafter described, serves to reciprocate the pistons 27 in the cylinders 21, the parts described being so arranged as to cause the pistons 27 to be moved downward in the cylinders toward the platform at a speed greater than the normal retarded fall of the structure.

The outer end of each rod 25 carries a bearing 47 in which a transverse rock-shaft 48 is journaled, the opposite ends of these shafts carrying rollers 49 which operate in parallel inner spaced guides 50 afforded by slotted plates 51 extending upwardly from the cylinders 21, whereby the rods 25 are guided in a straight path during their reciprocation, as hereinafter described. Each of the rock-shafts 48, beyond the rollers 49, carries upwardly extending arms 52 provided near their upper ends with rollers 53 which are confined and operate in cam-shaped guides 54 afforded by slotted plates 55 paralleling the plates 51 and likewise carried by the cylinders 21, the guides 54 being formed with two straight sections 56 and 57 disposed in non-alining planes and connected by an inclined portion 58. Thus when the pistons 24 are moved in the cylinders 21, the shafts 48 will rock and the vanes 26 will be moved to change the angle at which they extend with relation to the arms 19. The vanes 26 illustrated are preferably provided in pairs, one set for each arm 19 connected together by rods 26ª, the body-portion of each vane being formed of a rectangular shaped frame 59 carrying a wire net-work 60 and a series of flaps 61 each of which is preferably formed of flexible material, such as canvas, secured in any desired manner to the body-portion of the vane along one edge to overlap the adjacent flap when they lie flatwise against the net-work, the flaps being so positioned on the body-portions of the vanes as to cause them to lie against the under side of the net-work 60 provided on the frame 59 when the cylinders 21 are at the highest point in their travel and be disposed above such frames when the cylinders are at the lowermost point of their travel.

In the operation of the device, the arms 19 and the mechanism carried thereby are caused to be rapidly rotated in the direction of the arrow in Fig. 2, by any suitable source of power, as by the engine indicated at 61ª supported on the platform 12 and connected with the shaft 18 through the medium of the belt 62. When the cylinders 21 occupy their lowermost position in the circular path of travel the pistons 24 and 27 are spaced but a slight distance apart and confine air between them and the rollers 53 engage the straight portions 56 of the guides as represented of the lowermost one in Fig. 2, in which position the vanes 26 assume an incline position with relation to the arms 19, as represented of the lowermost one in

Fig. 2, whereby the air passing through the net-work of the vanes raises the flaps 61, thus reducing resistance thereto of the air to the minimum. As each cylinder 21 moves from its lowermost position to a position in which it is at the uppermost point of its travel, the piston 24 contained therein is caused to be sucked farther into the cylinder by the suction action produced thereon by the movement of its coöperating piston 27 in moving toward the axis of the shaft 18 at a speed greater than the normal retarded fall of the structure, due to the connection of its rod 28 with the block 45 arranged eccentrically of the shaft 18, and simultaneously therewith the rollers 53 are moved in the cam-slots 54 beyond the portions 58 thereof and toward the shaft 18 to the position represented of the uppermost one in Fig. 2, with the result of tilting the vanes 26 in a direction opposite to that which they occupy when in lowermost position, namely to the position illustrated of the uppermost vane in Fig. 2. When the cylinders 21 move from uppermost position to a position intermediate the uppermost and lowermost positions, the pistons 27 are forced outwardly, thereby permitting the air operating against the vanes 26 to pull the pistons 24 outwardly, thus causing the rollers 53 to move in the cam-guides 54 toward their outer ends and carry the vanes 26 to the position illustrated by the one in the left-hand side of Fig. 2. It will thus be seen that the vanes as soon as they pass the intermediate position represented by the vane in the right-hand side of Fig. 2, in traveling through their circular path, begin to act upon the air, the gradual tilting action of the vanes serving to augment their grip on the air. As the vanes move from the position represented by the one in the right-hand side in Fig. 2 to the position represented by the one in the left-hand side thereof, the force of the air exerted against them tends to draw the pistons 24 connected therewith toward the outer ends of the cylinders, but as during this action the pistons 27 are moved in the cylinders toward their inner ends with the consequent suction action upon the pistons 24, the latter are caused to be sucked into the cylinders toward the shaft 18. The pressure of the air against the vanes while the latter are moving in a rotary path and are being drawn toward the shaft 18 in the cylinders, serves to prevent the pistons 24 from traveling at as fast a speed as the pistons 27, due to the fact that the last referred to pistons travel at a speed toward the shaft 18 in excess of the greatest possible speed at which the vanes may move toward this shaft, and thus the degree of vacuum between the pairs of pistons is increased, with the result of causing the air-pressure against the under side of the pistons 27 to lift the latter upward toward the vanes and consequently lift the platform, the result of operating the pairs of pistons successively as described serving to produce continuous lifting of the platform and, accordingly, the entire structure. Furthermore, by operating the pistons as described, the pistons 27 will be caused to strike the air beneath them with a force sufficient to cause these pistons to rebound on the column of air beneath them and thus with each rebound an impetus in an upward direction is imparted to the pistons 27 and the platform carried thereby, which results in aiding in the lifting action.

As the cylinders rotate about the shaft 18 they will be caused to oscillate upon the arms 19, the roller mechanism 31 provided on the rods 28 serving to positively guide the latter in their reciprocating movement and hold them in proper alinement with the cylinders with which they coöperate.

I prefer to provide the vanes 26 in pairs as described to extend on opposite sides of the cylinders 21 in order that the pressure exerted at opposite sides of the cylinders shall be equal, or approximately so, and thus the pull exerted by the vanes be so proportioned on opposite sides of the cylinders as to avoid torsional strains.

As the speed of upward movement of the entire structure is dependent on the speed at which the pistons 27 are drawn bodily toward the platform 12, such speed may be varied by changing the position of the blocks 45 with relation to the shaft 18 to vary its degree of eccentricity, and as a means for producing this result I mount these blocks on the slides 36 operated through the medium of shafts 40 and pinions 39 hereinbefore referred to. Thus by turning the cranks 42, the slides 36 may be moved in the guides 35 and the position of the blocks 45 thus varied with relation to the shaft 18. I prefer to provide fluid-pressure operated means for operating the cranks 42 and holding them in the desired position, and for this purpose have illustrated the following described construction.

Oscillatorily mounted on each frame-member 17, as through the medium of straps 62, is an upwardly extending cylinder 63, the piston 64 of which is pivotally connected with the end of the adjacent crank 42 through the medium of a rod 65, the interiors of these cylinders, near their upper ends, being connected with pipes 66, which lead into the casing 67 of a triple valve 68 having an exhaust port 69 and a port 70 leading to a fluid-pressure pump, such as that represented at 71 and shown as operated through the medium of the engine 61, the ports 69, 70 and the point at which the pipes 66 open into the casing 64 being disposed at an angle of 90° to each other as

represented. The rotary member 71 of the valve contains a groove 72 in its periphery extending about half way around it to permit any two of the ports, or all of them, to communicate with each other.

When it is desired to adjust the blocks 45 farther away from the shaft 18 than that represented in Fig. 1, to vary the speed of movement of the pistons in the cylinders, the rotary member 71 may be normally turned by the lever 73 connected therewith to a position in which the groove 72 registers with the port 70 and the pipes 66 to permit the fluid pressure from the pump 71 to enter the cylinders 63 above the pistons 64, thereby forcing these pistons down and turning the cranks 42 in a direction to cause the racks 38 to move downwardly by reason of the engagement therewith of the pinions 39. This action of the pistons moves the blocks 45 away from the shaft 18 and thus causes a greater stroke to be imparted to the pistons 24 and 27. The blocks 45 may be maintained in the desired position of adjustment by turning the valve to the position indicated in Fig. 10, in which the channel 72 registers with the ports 69 and 70, the opening from the pipe 66 to the interior of the casing 64 being thus closed, and the fluid pressure from the pump 71 thus being free to discharge through the exhaust port 61. When it is desired to decrease the stroke of the pistons 24 and 27, the valve may be turned to the position illustrated in Fig. 11, in which the channel 72 registers with the ports 69, 70, and the opening in the casing 64 communicating with the pipes 66, thus causing both the pump and cylinders 64 to register with the exhaust port 69, the effect of thus operating the valve is that of permitting the pistons 24 and 27 to rise under the influence of the air pressure exerted against the vanes 26 as they are driven outwardly by the air. The valve may be left in the position last described until the blocks 45 have moved to the position for producing the length of stroke desired of the pistons 24 and 27 when the valve may again be turned to the position represented in Fig. 10, and the exhaust from the cylinders 63 arrested. It will be manifest from the foregoing that by providing means for operating the blocks 45 to vary their positions with relation to the shaft 18, that the speed ascent of the entire structure may be controlled by the operator, and when desired its upward movement arrested.

While I have illustrated and described my invention as embodied in a type of machine employing revoluble aeroplanes or vanes, I do not wish to be understood as limiting my invention thereto, as my invention is applicable to machines involving any other form of revoluble air-gripping device.

As hereinbefore stated, the principle of operation of a structure embodying my invention is that of using the air, against which the air-gripping device is operated, as a fulcrum to afford resistance to the air-engaging devices sufficient to produce momentum of the object to be moved in the air. Thus my invention may be utilized for propelling the body of an air-ship, in which case if the type of air-gripping device is such as illustrated, such mechanism would be disposed horizontally, or substantially horizontally, instead of vertically, and thus the fulcrum provided by the air as described would be used for propelling the machine forwardly or backwardly as desired.

It will be manifest that the piston and cylinder mechanisms coöperating with the air-engaging devices and the means for bodily moving these devices with relation to the body while they engage with the air afford connections between the body and such means which are elastic in character and are thus placed under high tension in the operation of the air-engaging devices before the inertia of the body can be overcome, and that they thus operate to temporarily store power during the opposition of such inertia to the force exerted by the air-gripping devices, which power is exerted against the body for overcoming the inertia of the latter during the engagement of the air-engaging devices with the air, thus causing the body to be propelled.

While I prefer to employ the piston and cylinder mechanisms referred to for accomplishing the above stated purpose, I do not wish to be understood as intending to limit my invention to the employment of this form of mechanism, as any other suitable means may be used for this purpose.

What I claim as new, and desire to secure by Letters Patent, is—

1. In an air-ship, the combination of a body, an air-engaging device carried by said body, means for operating said device against the air, means for bodily moving said air-engaging device with relation to said body while in engagement with the air, and means coöperating with said air-engaging device and with said second-named means for temporarily storing the force which is exerted, in opposition to the inertia of said body, by said air-engaging device in operating against the air and being moved bodily with relation to said body, and exerting upon said body the force so stored to overcome the inertia therein and move it with relation to said air-engaging device while the latter is operating against the air.

2. In an air-ship, the combination of a body, an air-engaging device carried by said body for operating against the air to raise the body, means for operating said device against the air, means for bodily moving said air-engaging device with relation to said

body while in engagement with the air, and means coöperating with said air-engaging device and with said second-named means for temporarily storing the force which is exerted, in opposition to the inertia of said body, by said air-engaging device while sustained in operating against the air, and exerting upon said body the force so stored to overcome inertia therein and raise it while said air-engaging devices are operating against the air.

3. In an air-ship, the combination of a body, an air-engaging device carried by said body, means for operating said air-engaging device against the air, means for moving said air-engaging device with relation to said body while operating against the air, and elastic power-storing means coöperating with said air-engaging device and said second-named means, for the purpose set forth.

4. In an air-ship, the combination of its body, cylinder and piston mechanism carried by said body, means connected with said piston for engaging with the air, and a second reciprocating piston operating in said cylinder and serving by suction action to move said air-engaging means bodily with relation to said cylinder, for the purpose set forth.

5. In an air-ship, the combination of its body, cylinder and piston mechanism carried by said body, and movable through a curved path, means connected with said piston for engaging with the air, and a second reciprocating piston operating in said cylinder and serving by suction action to move said air-engaging means bodily with relation to said cylinder, as the latter travels through said path, for the purpose set forth.

6. In an air-ship, the combination of its body, cylinder and piston mechanism carried by said body, means connected with said piston for engaging with the air, a second piston in said cylinder, and means for reciprocating said second piston to move said first-named piston and air-engaging means bodily with relation to said cylinder by suction action, for the purpose set forth.

7. In an air-ship, the combination of its body, a rotatable support carried by said body, air-engiging devices carried by said support and serving when the support is rotated to act against the air, and means for bodily and successively moving said devices radially with relation to the axis upon which said support rotates during the engagement of said air-engaging devices with the air to cause the latter to act against the air as a fulcrum, for the purpose set forth.

8. In an air-ship, the combination of its body, a rotatable support carried by said body, vanes carried by said support and serving when the latter is rotated to operate against the air, and means for bodily moving said vanes radially of the axis upon which said support rotates during the engagement of said air-engaging devices with the air to cause the latter to act against the air as a fulcrum, for the purpose set forth.

9. In an air-ship, the combination of its body, a rotatable support carried by said body, a series of air-engaging vanes carried by said support and serving when the latter is rotated to operate against the air, and means operatively connected with said vanes and serving to move them radially of the axis on which said support rotates while the latter is rotating during the engagement of said air-engaging devices with the air to cause the latter to act against the air as a fulcrum, for the purpose set forth.

10. In an air-ship, the combination of its body, a rotatable support carried by said body, a series of cylinders on said support, a pair of pistons in each cylinder, a vane connected with the piston of each cylinder and serving when the support is rotated to act against the air, and means connected with the other pistons of the cylinders serving to reciprocate said last referred to pistons to operate the vane-equipped pistons to move them and the vanes radially of the axis upon which said support rotates, by suction action, for the purpose set forth.

11. In an air-ship, the combination of its body, a rotatable support carried by said body, a series of cylinders carried by said support and piston mechanisms for the cylinders carrying vanes and connectors, the latter being secured at points non-coincident with the axis upon which the support rotates, for the purpose set forth.

12. In an air-ship, the combination of its body, cylinder and piston mechanisms carried by said body, rotatable means connected with said pistons for engaging with the air, means for bodily moving said pistons with relation to said body to cause said air-engaging means to act against the air as a fulcrum for lifting or propelling the air-ship, and means for regulating the said bodily movement of the pistons, for the purpose set forth.

13. In an air-ship, the combination of its body, cylinder and piston mechanism carried by said body, rotatable means connected with said pistons for operating against the air, rods connected with said pistons, means connected with said rods and serving to reciprocate said pistons, and means for controlling the stroke of said pistons, for the purpose set forth.

14. In an air-ship, the combination of its body, a rotatable support carried by said body, means for rotating said support, means carried by said support for operating against the air, and means for bodily moving said last-named means with relation to said body comprising rods operatively connected with said air-engaging means, and a block eccen-

trically mounted with relation to the axis upon which said support rotates and to which an end of each of said rods is connected.

15. In an air-ship, the combination of its body, a rotatable support carried by said body, cylinders carried by said support, piston mechanism in said cylinders and means for operating against the air, and rods connected with said piston mechanism, the inner ends of the rods being held at a point eccentric with relation to the axis upon which said support rotates.

16. In an air-ship, the combination of its body, a rotatable support carried by said body, cylinders carried by said support, piston mechanism operating in said cylinders, means for operating against the air during the rotation of said support and rods connected with said piston mechanism, a second support on the body, and a block adjustable on said second support connected with the inner ends of said rods and disposed non-coincident with relation to the axis upon which said support rotates, for the purpose set forth.

17. In an air-ship, the combination of its body, a rotatable support carried by said body, means for operating against the air carried by said support, devices operatively connected with said air-engaging means, a second support, a member adjustable on said second support with relation to the axis upon which said first-named support rotates, and rack-and-pinion mechanism connected with said member to adjust the latter with relation to said axis, said devices being connected with said member, for the purpose set forth.

18. In an air-ship, the combination of its body, a rotatable support carried by said body, radially disposed cylinders arranged in spaced relation around said support, a pair of pistons in each cylinder, a vane connected with one piston of each cylinder and serving when said support is rotated to operate against the air, a rod connected with each of the other pistons in each of said cylinders, and means connecting said rods together at their adjacent ends at a point eccentric with relation to the axis upon which said support rotates, for the purpose set forth.

19. In an air-ship, the combination of its body, a rotatable support carried by said body, cylinders pivoted on said support and extending radially of the axis upon which it rotates, a pair of pistons for each cylinder, a vane connected with a piston of each cylinder, a rod connected with the other piston of each of said cylinders, and means for connecting the inner ends of the rods together at a point eccentrically disposed with relation to the axis upon which said support rotates, for the purpose set forth.

20. In an air-ship, the combination of its body, a rotatable support, vanes carried by said support and operating against the air when said support is rotated, means for moving said vanes bodily with relation to said support during their engagement with the air to cause the vanes to act against the air as a fulcrum for lifting or propelling the air-ship, means operating automatically to tilt the vanes to a position in which they will bear against the air with the maximum force when the vanes are operating to propel the air-ship, and means for moving said vanes to a position in which they will offer minimum resistance to the air when returning to operative position, for the purposes set forth.

21. In an air-ship, the combination of its body, a rotatable support carried by said body, a circular series of vanes carried by said support and serving when the support is rotated to engage with the air, means for bodily moving said vanes toward the axis of said support while the support is rotating, said vanes being formed of a skeleton-frame carrying flaps hingedly connected thereto, and means for automatically tilting the vanes on said support in opposite directions for causing the flaps to lie against said frame while the vanes are traveling through a portion of their curved path and to be lifted at their free edges away from said frame by the air passing therethrough when traveling through another portion of their curved path, for the purpose set forth.

22. In an air-ship, the combination of its body, a rotatable support carried by said body, reciprocatory mechanism connected with said support and extending radially thereof, means for reciprocating said mechanism, a series of vanes arranged on opposite sides of the axis upon which said support rotates and connected with said reciprocatory mechanism and serving when said support is rotated to operate against the air and be moved bodily with relation to said body and radially thereof during their engagement with the air to cause them to operate against the air as a fulcrum for lifting or propelling the air-ship.

23. In an air-ship, the combination of its body, a rotatable support carried by said body, cylinders connected with said support and piston mechanism therein, vanes connected with said piston mechanism and serving when said support is rotated to operate against the air, means for bodily moving said vanes radially of the axis upon which said support rotates while the latter is rotating, and means operating automatically to tilt said vanes in opposite directions with relation to said support while the latter is rotating, for the purpose set forth.

24. In an air-ship, the combination of its body, a rotatable support carried by said

body, cylinder and piston mechanisms extending radially of the axis upon which said support rotates, cam-shaped guides carried by said cylinders, vanes connected with said piston mechanisms and serving when said support is rotated to operate against the air, means for imparting movement to said piston mechanisms to cause them, and the vanes carried thereby, to move with relation to the axis upon which said support rotates, and means connected with said vanes and operating in said cam-guides for tilting the vanes in opposite directions with relation to the support upon which they are carried, for the purpose set forth.

25. In an air-ship, the combination of its body, a rotatable support carried by said body, a circular series of radially-extending cylinders carried by said support, a pair of spaced pistons in each of said cylinders, cam-shaped guides carried by each cylinder, a vane connected with one of the pistons of each cylinder, means connected with the other pistons of said cylinders operating to reciprocate said last referred to pistons in the cylinders during the rotation of said support, and means connected with said vanes and operating in said cam-guides for tilting said vanes in opposite directions with relation to said support, for the purpose set forth.

26. In an air-ship, the combination with its body, a rotatable support, a circular series of radially disposed cylinders carried by said support, a pair of pistons in each of said cylinders, a vane pivotally connected with one of the pistons of each of said cylinders, rods connected with the other pistons of said cylinders and having the points of attachment for their inner ends non-coincident with the axis upon which said support rotates, and arms secured to said vanes and operatively engaging said cam-slots, for the purpose set forth.

27. In an air-ship, the combination of its body, a cylinder supported to rotate in an endless path, a pair of pistons disconnected from each other in said cylinder, a pair of vanes carried by one of said pistons spaced apart and arranged to extend on opposite sides of the cylinder, and means connected with the other of said pistons for moving the latter and its companion piston with relation to said body, for the purpose set forth.

28. In an air-ship, the combination of its body, an open-ended cylinder connected with said body, a pair of pistons disconnected from each other in said cylinder, air-gripping means connected with one of said pistons, and means connected with the other of said pistons for moving the latter in said cylinder at a speed greater than the possible speed at which said air-gripping means and the piston connected therewith can travel bodily with relation to said body, for the purpose set forth.

29. In an air-ship, the combination of its body, an open-ended cylinder supported to travel in a rotary path, a pair of pistons disconnected from each other in said cylinder, air-gripping means connected with one of said pistons, and means connected with the other of said pistons for moving the latter in said cylinder at a speed greater than the possible speed at which said air-gripping means and the piston connected therewith can travel bodily with relation to said body, for the purpose set forth.

30. In an air-ship, the combination of its body, a rotatable support carried by said body, air-engaging devices carried by said support and serving when the support is rotated to act against the air, and means supported on said body and operating eccentrically with relation to the axis of said support for moving said air-engaging devices radially of said axis and bodily with relation to said body, to cause said air-engaging means to act against the air as a fulcrum for lifting or propelling the air-ship, for the purpose set forth.

31. In an air-ship, the combination of its body, a rotatable support carried by said body, arms radiating from said support, air-gripping means movably supported on said arms, a second support, and rods connected with said second support at a point eccentric with the axis upon which said first-named support rotates and engaging at their outer ends with said air-engaging devices, whereby in the rotation of said rotatable support said air-engaging devices operate to move bodily with relation to said rotary support while engaging the air and operate against the air as a fulcrum for producing lifting or propelling of the air-ship.

32. In an air-ship, the combination of its body, a rotatable support on the body, arms radiating from said support, cylinders carried by said arms, pistons in said cylinders, air-engaging means connected with the pistons in said cylinders, a second support, and rods connected with said support and disposed eccentrically to the axis upon which said rotatable support rotates and operatively connected at their outer ends with said pistons, whereby rotation of said rotatable support causes said air-engaging means to be moved bodily with relation to said rotatable support when they are in engagement with the air and operate upon the latter as a fulcrum for lifting or propelling the air-ship.

33. In an air-ship, the combination of a body, an air-engaging device in the form of a vane carried by said body, means for moving said vane in a curved path to cause it to grip the air, means for bodily moving said vane with relation to said body while en-

gaging with the air, and elastic power-storing means cooperating with said air-engaging devices and said second-named means, for the purpose set forth.

34. In an air-ship, the combination of a body, a rotatable support carried by said body, vanes carried by said support and operating, when the latter is actuated, to grip the air, means for operating said support, means for bodily moving said vanes with relation to said body while moving in a curved path, and elastic power-storing means coöperating with said air-engaging devices and said second-named means, for the purpose set forth.

DANIEL P. McLAUGHLIN.

In presence of—
RALPH SCHAEFER,
JOHN WILSON.