J. MARSHALL.

AERIAL MACHINE.

APPLICATION FILED JULY 7, 1911.

1,043,949.

Patented Nov. 12, 1912.

2 SHEETS—SHEET 1.

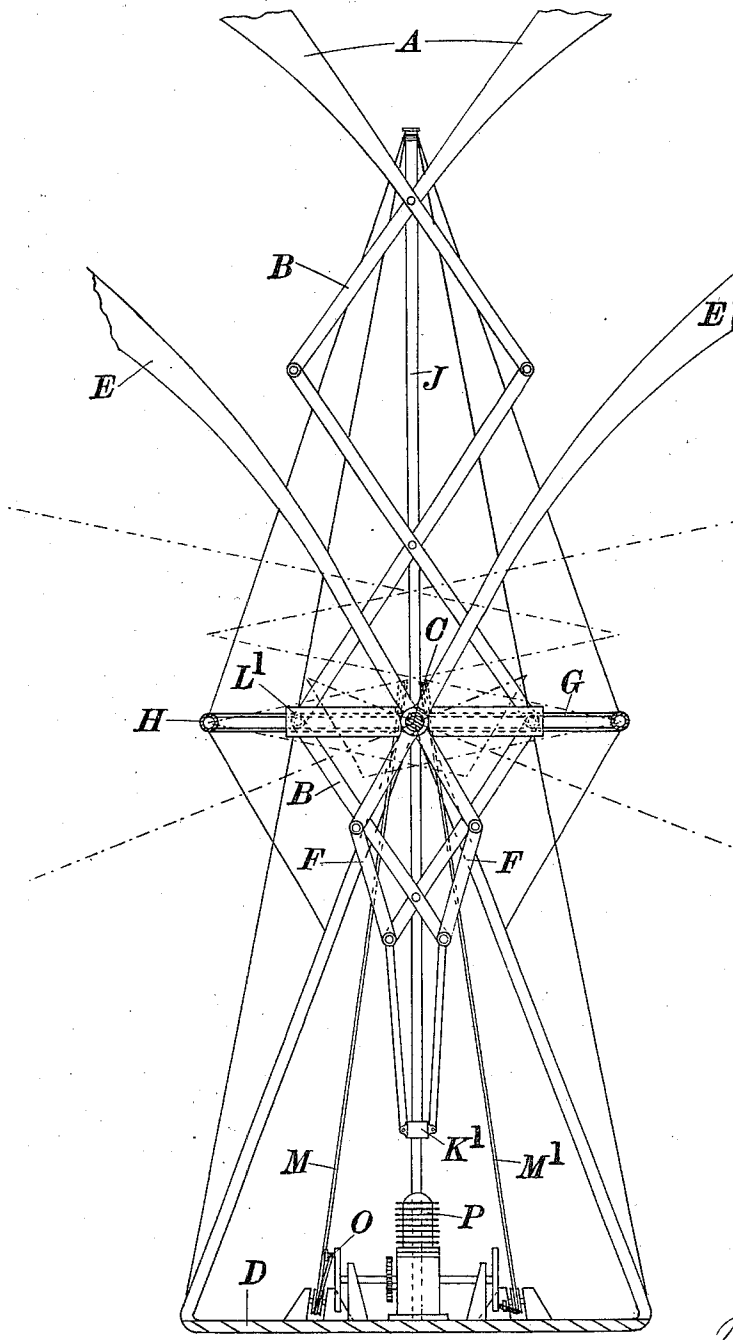

FIG. 1

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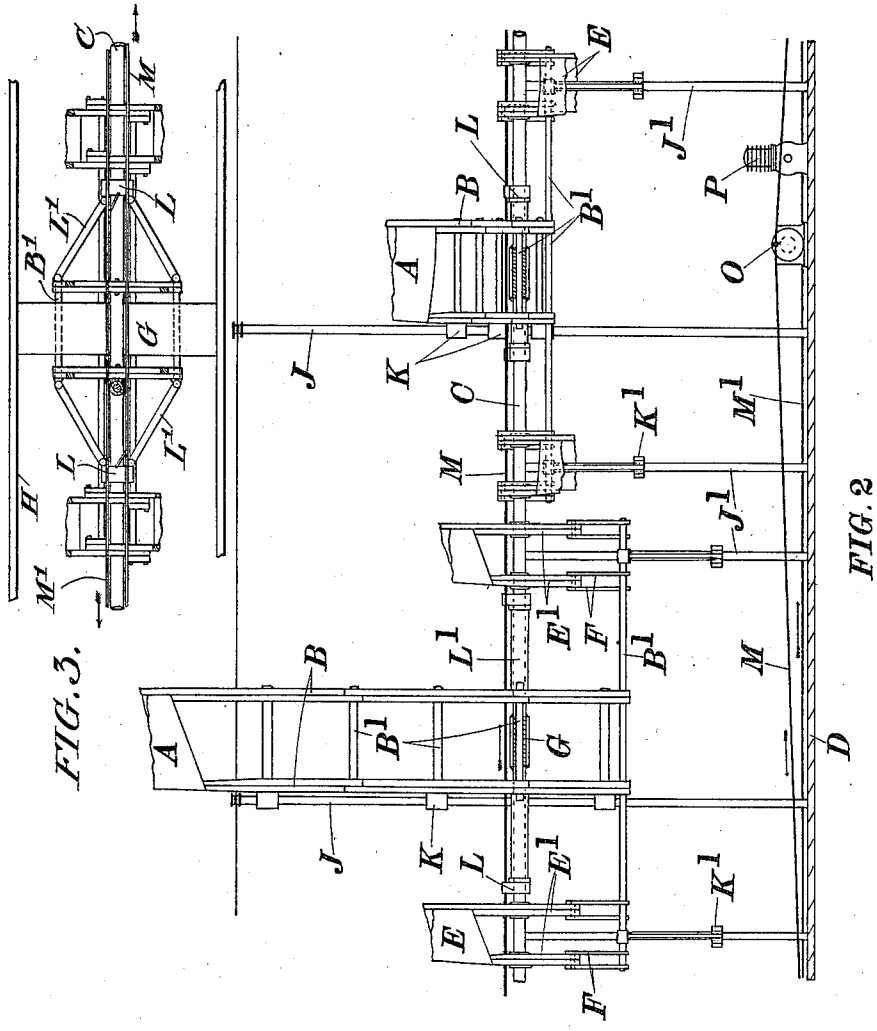

FIG. 3.

FIG. 2.

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JOHN MARSHALL, OF KILNHURST, ENGLAND.

AERIAL MACHINE.

1,043,949. Specification of Letters Patent. Patented Nov. 12, 1912.

Application filed July 7, 1911. Serial No. 637,345.

To all whom it may concern:

Be it known that I, JOHN MARSHALL, a subject of the King of England, residing at Kilnhurst, in the county of York, England, have invented certain new and useful Improvements in or Relating to Aerial Machines, of which the following is a specification.

This invention relates to aerial machines of the ornithoptric type its object being to provide improvements in the construction and operation thereof.

An aerial machine according to this invention is provided with one, two or more sets of wings. Each set comprises two or more pairs of wings of which one pair is hereinafter referred to as the "upper" pair and the remainder as the "lower" wings. In each set the upper wings are carried by the free ended extremities of a lazy tongs device, while the lower wings are also connected to the lazy tongs device and are constrained to be operated simultaneously with the upper wings when the lazy tongs device is opened or closed.

In the accompanying drawings:—Figure 1 is a diagrammatic end view partly in section, showing one set of wings according to this invention in the open or extended position on an aerial machine. Fig 2 is a side view of Fig. 1, (on a smaller scale), also partly in section, showing two sets of wings, one extended and the other closed. Fig. 3 is a sectional plan of the left hand half of Fig. 2.

Like letters indicate like parts throughout the drawings.

In carrying out the present invention the upper wings A of each set are carried by the free ended extremities of a lazy tongs device B. In each set there are preferably two lazy tongs separated by distance pieces B^1 in order to increase the strength and to provide a broader base for the attachment of the wings A. The distance pieces B^1 are conveniently situated at the various pivots of the lazy tongs and the levers thereof may be, and preferably are, pivoted to the distance pieces.

A supporting member C extends through one of the lower openings in the lazy tongs B and similarly passes through the lazy tongs of other sets of wings. A suitable platform or the like D is connected to the supporting member C and arranged below the lazy tongs devices. The lower wings E are pivoted to the supporting member C and extend beyond it, as clearly shown in Fig. 1. Such extended part of each lower wing E is pivoted to a link F whose other end is pivoted to an extension of the distance pieces B^1 at one or the other of the lower free ends of the lazy tongs B. If desired special projections from any desired part, preferably the lower portions, of the lazy tongs device may be substituted for these extended distance pieces.

Each of the lower wings E is shown in Fig. 2 built on two levers E^1, the supporting member C forming the fulcrum for the levers E^1, although other constructions may be adopted if desired.

Guides G are provided to keep the supporting member C in the same plane as the adjacent end pivots of the lazy tongs. These guides are shown secured to the supporting member C with a space for the reception of those distance pieces B^1 which separate the end pivots of the lazy tongs levers which bound the opening in the lazy tongs through which the supporting member passes. The guides are preferably extended beyond the extreme travel of these end pivots and secured to a suitable frame H (not shown in Fig. 2) surrounding the supporting member C and forming part of the body of the machine. Rollers or the like may be employed to reduce friction between the distance pieces and guides or other anti-friction devices may be employed.

Means are provided for keeping the supporting member C central in relation to the lazy tongs device. In the drawings masts J are illustrated for this purpose, the masts being supported on the platform D, rigidly secured to the supporting member C and suitably supported by stays or the like. Sliding connections K are provided between the masts J and the central pivots of the lazy tongs device and it will be appreciated that the masts being rigidly secured to the supporting member C the latter will thereby be maintained central in relation to the lazy tongs device. It will be seen that the masts J will also act as a support to provide the lazy tongs devices with the required rigidity. Rigid supports J^1 are also preferably provided between the platform D and the supporting member C adjacent to the lower wings E and the extended distance pieces B^1

which operate these lower wings are connected to sliding connections K^1 on the supports J^1.

A sliding block L or the like is arranged on the supporting member C on each side of each of the lazy tongs devices B and is connected by links L^1 (forming a toggle joint) to the end pivots of the lazy tongs levers on a level therewith, that is to say to those pivots which are constrained by the guides G. The sliding blocks L are connected to one of two ropes or cables M, M^1 passing along the supporting member C and over suitably disposed pulleys to the platform D, where they are reciprocated in opposite directions by cranks O or by eccentrics or other reciprocating apparatus driven by a motor P preferably through a reducing gear. The sliding block L on one side of each lazy tongs device is connected to one rope M and the block on the other side to the other rope M^1 so that the power is thus supplied simultaneously to each set of lazy tongs. In the drawings the blocks L are shown at one end of their travel their respective lazy tongs devices being shown in the corresponding extreme positions, but the cranks O are shown in an intermediate position for the sake of clearness. The links L will also assist the masts J and supports J^1 in keeping the supporting member C central in relation to the lazy tongs devices.

The wings A and E being arranged to "feather" on the upstroke, the parts being in the position shown in the drawings and the connections being made as described above it will be appreciated that rotation of the motor P will cause the ropes M and M^1 to reciprocate in opposite directions and to move the sliding blocks L of the set of wings shown on the left-hand of Fig. 2 toward one another. Such movement of the blocks L will cause this lazy tongs device to be closed, both the upper wings A and the lower wings E beating downward and exerting a lift on the machine. At the conclusion of the closing movement of this lazy tongs device the parts will be in the position shown at the right-hand side of Fig. 2 and indicated by chain lines in Fig. 1. Simultaneously with the closing of the lazy tongs device on the left of Fig. 2 the other device illustrated in that figure will be opened out to lift both the upper wings A and the lower wings E by reason of the blocks L connected to this set being separated by the same movement of the ropes M and M^1. It will be observed that the velocity of the upper wings A will be greater than that of the lower wings E owing to the greater distance they traverse in the same time, although the lower wings may be, and in the construction illustrated in the drawings are, arranged to sweep through a greater angle. It is preferred to proportion the number or area of the upper and lower wings and the other factors governing the amount of lift so that the lift exerted by the lower wings is approximately equivalent to that of the upper pair.

Where two or more sets of wings are employed, the connections between the sliding blocks L and the ropes M, M^1 may be made so that the period at which any set of wings beats may be timed as desired in relation to that of any other set and in this manner some of the wings may always be moving downward and thus a continuous and steady lift may be exerted on the machine.

Horizontal movement may be imparted to the machine by arranging the wings to be inclined on the upstroke and to be more or less horizontal on the downstroke, as shown in Fig. 2 where the wings on the left-hand side are inclined for the upward movement and those on the right-hand side are approximately horizontal on the completion of the downstroke. This variation in the inclination of the wings may be effected by making the trailing edges more flexible than the entering edges and fixing the wings at the requisite angle to give the desired result when in operation. In this case propulsion will be imparted to the machine on the upstroke of the wings, and also slightly on the downstroke if the trailing edges of the wings rise above the entering edges as they are shown to do slightly on the right-hand side of Fig. 2.

It will be seen that the power required to extend the lazy tongs will be less than that for closing them, but if the connections between the blocks L and ropes M and M^1 be so made that one half of the sets of wings are always on the downstroke the load on the motor will be constant and the period of extending the lazy tongs device will be the same as that of closing them.

What I claim and desire to secure by Letters Patent is:—

1. In an ornithoptric aerial machine the combination of a lazy tongs device, means for opening and closing said device, a pair of wings secured to one extremity of said device, a second pair of wings independently pivoted to the machine and an operative connection between the second pair of wings and the lazy tongs device constraining both pairs of wings to be simultaneously operated.

2. In an ornithoptric aerial machine the combination of a lazy tongs device, a pair of wings secured to one extremity thereof, a supporting member passing through one of the openings in said device, guides keeping the supporting member and the adjacent end pivots of the lazy tongs device in the same plane, means for keeping the supporting member central in relation to

such end pivots, a second pair of wings pivoted to the supporting member and operatively connected to the lazy tongs device and means for opening and closing the lazy tongs device.

3. In an ornithoptric aerial machine the combination of a lazy tongs device, a pair of wings secured to one extremity thereof, a supporting member passing through one of the openings in said device, guides keeping the supporting member and the adjacent end pivots of the lazy tongs device in the same plane, means for keeping the supporting member central in relation to such end pivots, a second pair of wings pivoted to the supporting member and operatively connected to the lazy tongs device, a sliding block on the supporting member on each side of the lazy tongs device, toggle links between the sliding blocks and the adjacent end pivots of the lazy tongs device and means for reciprocating the sliding blocks in opposite directions for the purpose set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOHN MARSHALL.

Witnesses:
RICE K. EVANS,
ARTHUR W. GREENWOOD.