July 6, 1948. R. E. SHARPES 2,444,539

PROPELLER MOUNTING

Filed May 11, 1943

4 Sheets-Sheet 1

Fig. 1.

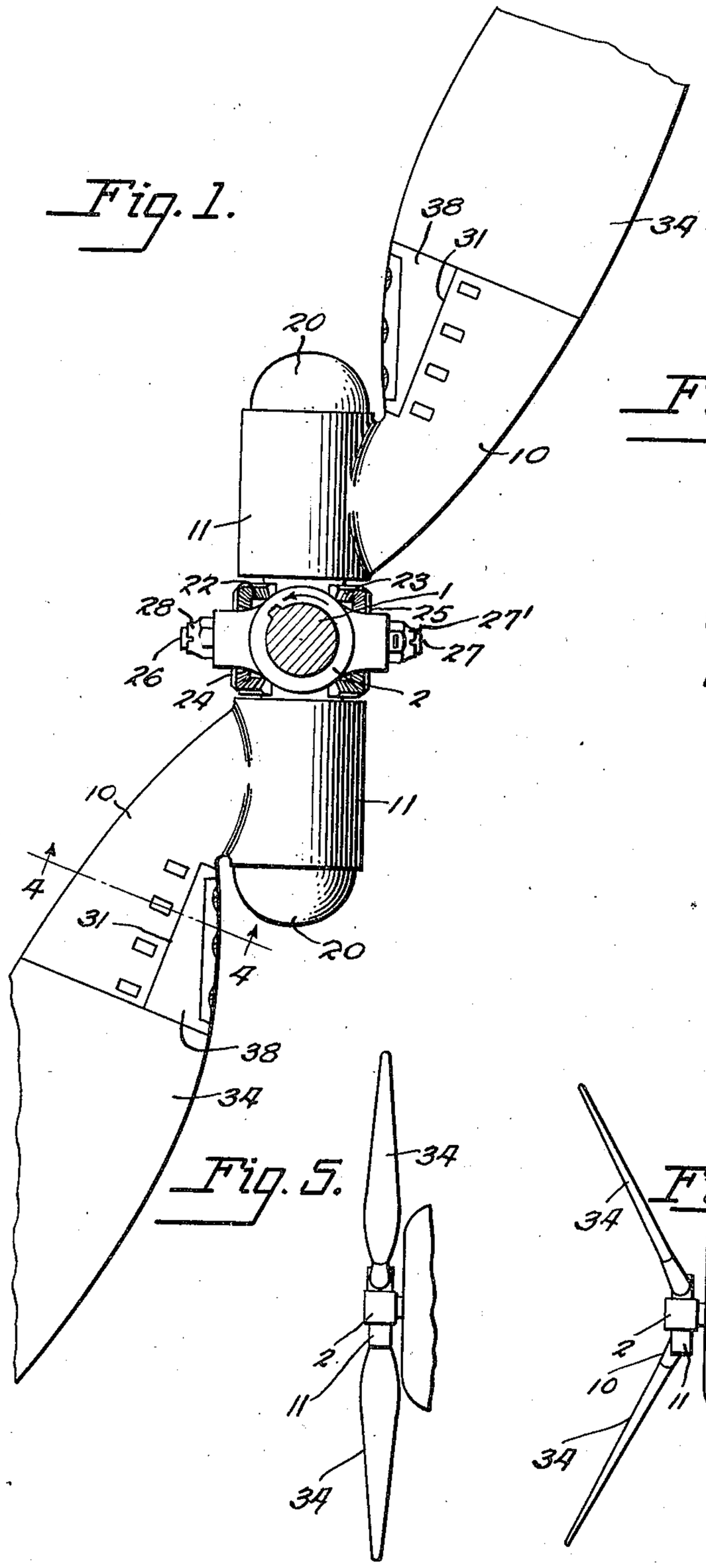

Fig. 2.

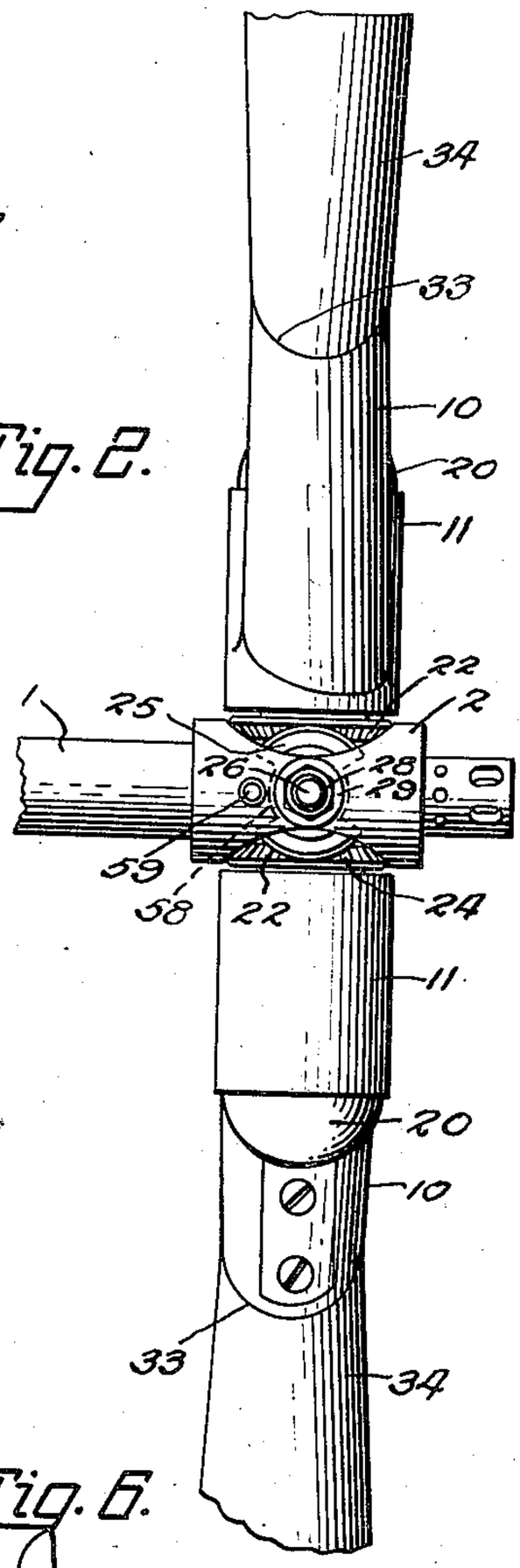

Fig. 5.

Fig. 6.

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Fig. 4.

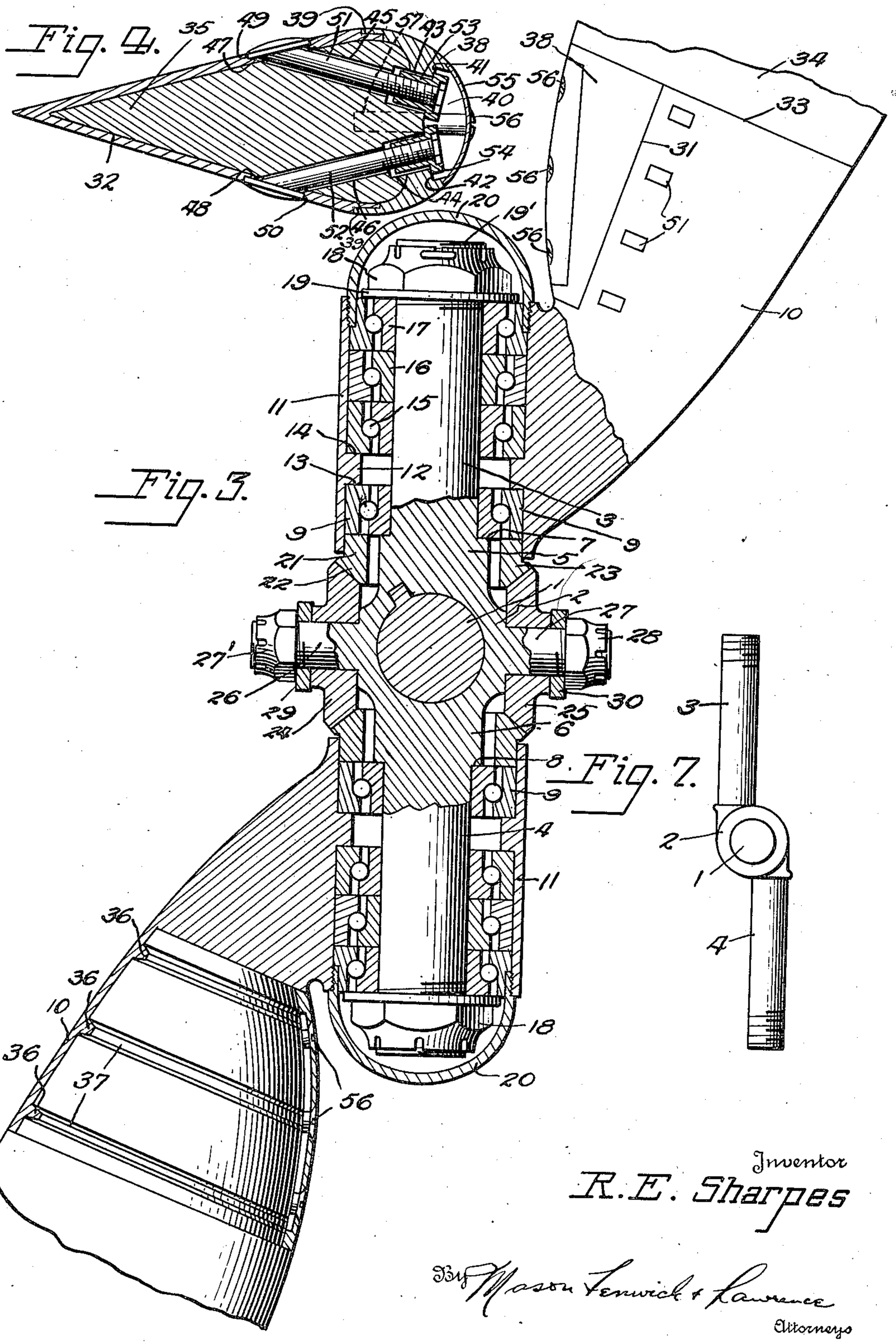

Fig. 3.

Fig. 7.

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Fig. 9.

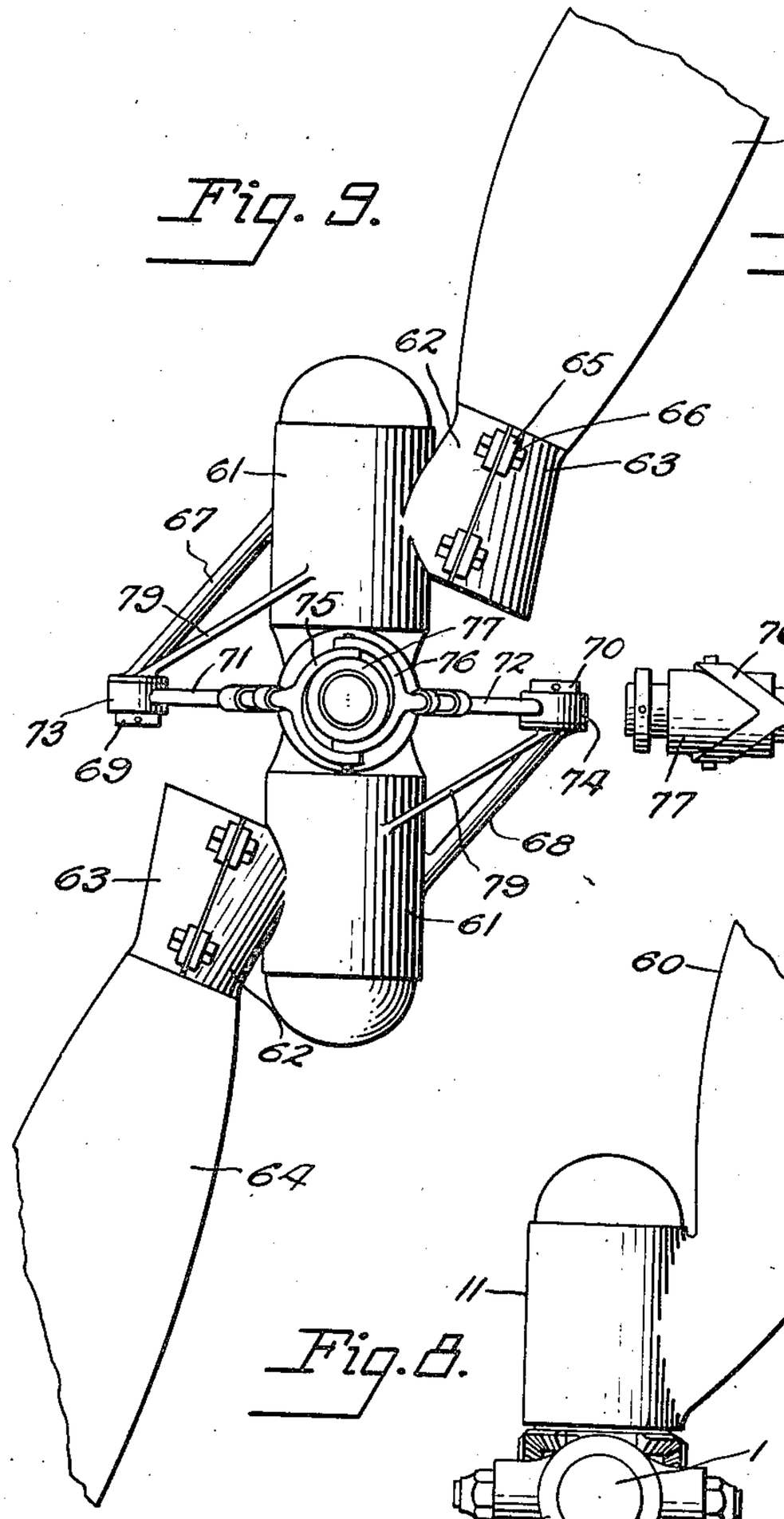

Fig. 10.

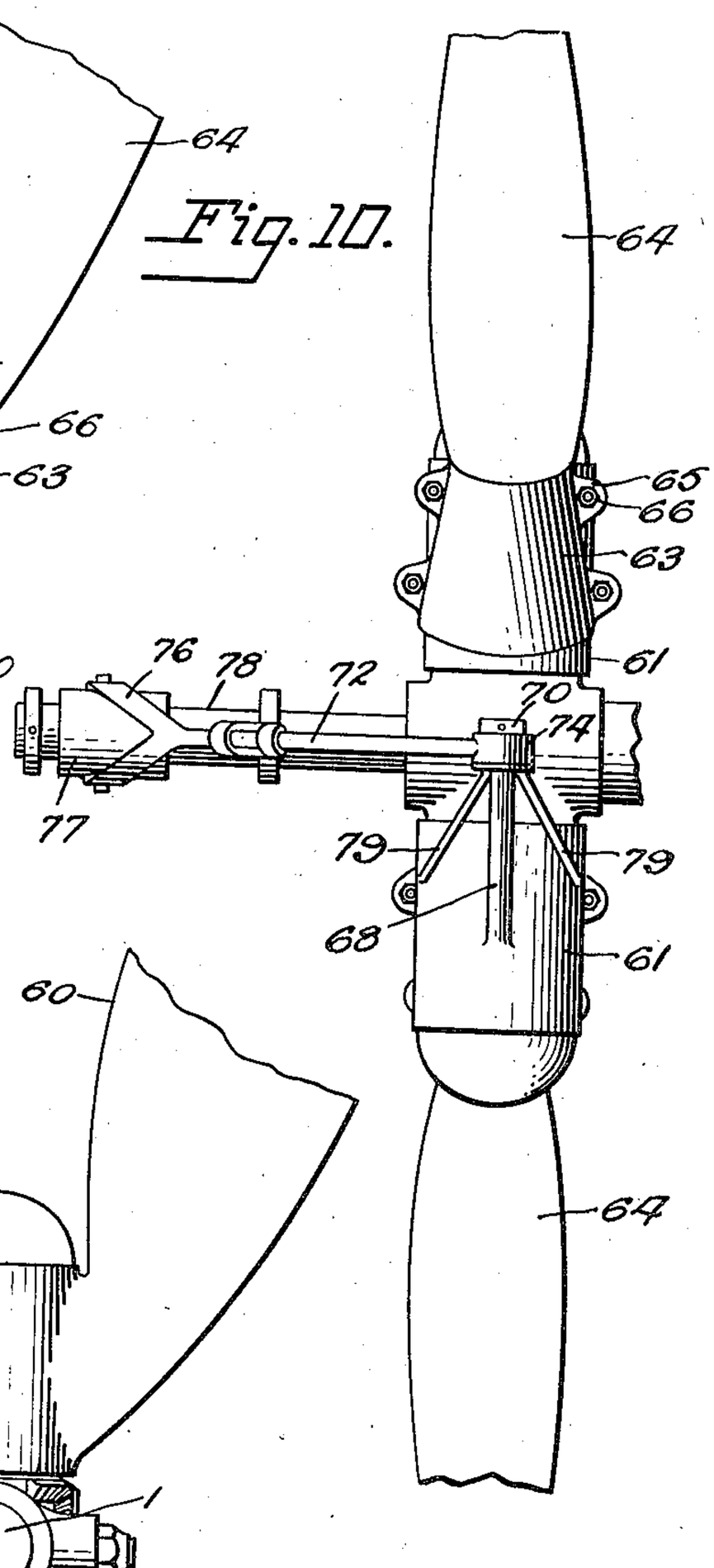

Fig. 8.

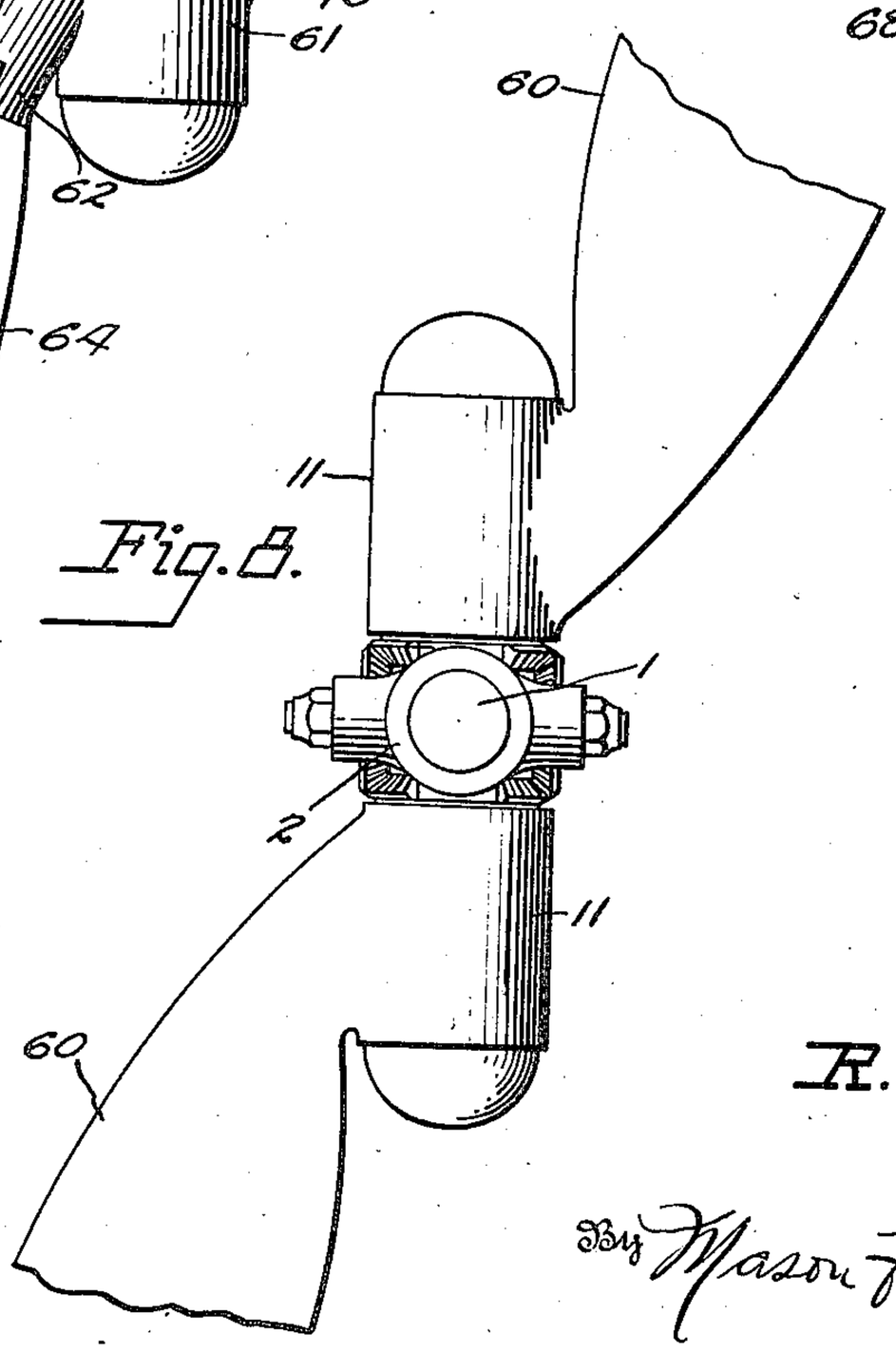

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Fig. 12

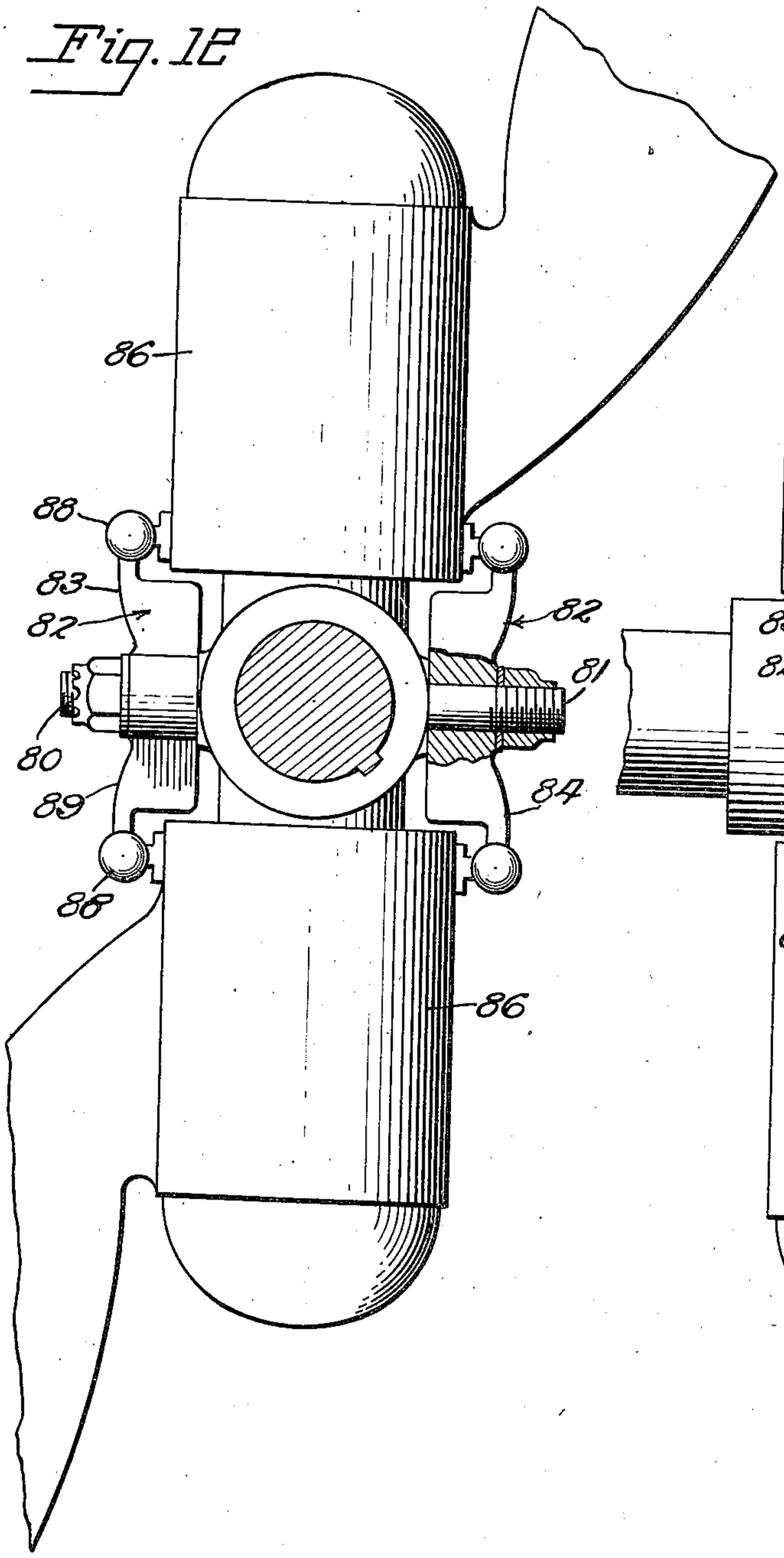
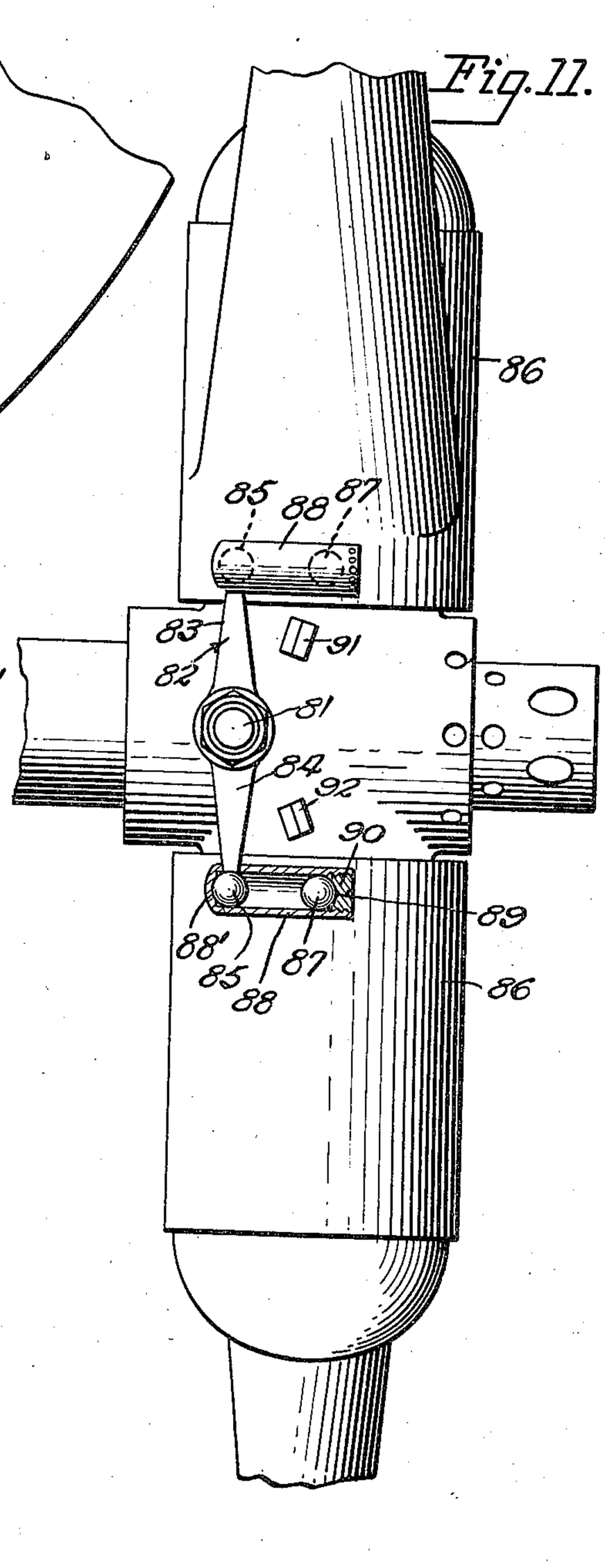


Fig. 11.



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UNITED STATES PATENT OFFICE

2,444,539

PROPELLER MOUNTING

Roy E. Sharpes, Harrisonburg, Va.

Application May 11, 1943, Serial No. 486,587

5 Claims. (Cl. 170—173)

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This invention relates to variable pitch propellers of the self-operating type, in which the blades are swingably mounted upon axes lying in a plane perpendicular to the axis of rotation of the propeller, and with the longitudinal axes of the blades at an acute angle to said axes whereby the blades swing forwardly of said plane responsive to the forward air thrust, decreasing the pitch, and swing back toward said plane responsive to centrifugal force, increasing the pitch, the position and consequent pitch of the blades at any time being a function of the resultant effect of these two opposing forces.

One of the objects of the invention is to provide an integral hub construction including stub shafts constituting the axis of swing of the blades either radially disposed or offset with respect to the axis of the drive shaft.

Another object of the invention is to provide a blade, the base or root end of which is provided with a housing, either integral or attached, forming a journal about the hub stub shafts, with interposed bearings and adequate provisions resisting the centrifugal thrust.

A further object of the invention is to provide a propeller blade construction as described, in which the pitch equalizer mechanism or a part thereof is carried by the housing.

Still another object of the invention is to provide a sectional propeller blade, the base or root section comprising a socketed member with a lateral opening into which the outer section or blade proper may be laterally inserted, with means for securing said outer section compressively in said socket.

Other objects of the invention will appear as the following description of preferred and practical embodiments thereof proceeds.

In the drawings which accompany and form a part of the following specification, and throughout the several figures of which the same characters of reference have been used to denote identical parts:

Figure 1 is a front elevational view of a propeller embodying the principles of the subject invention, the outer portions of the blade being broken away;

Figure 2 is a side elevation;

Figure 3 is a vertical cross-section through the

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hub and adjacent portions of the propeller blades;

Figure 4 is a cross-section taken along the line 4—4 of Figure 1;

Figures 5 and 6 are side views in elevation showing respective positions of the propeller blades, Figure 5 showing the position induced by centrifugal force in which the blades are in the plane of rotation of the propeller and the pitch at a maximum, and Figure 6 showing the blades under the influence of the forward air thrust, in which position the pitch is at a minimum;

Figure 7 illustrates a slight modification of the hub shown in Figure 3, in which the stub shafts are offset on opposite sides of a diametrical plane through the axis of the drive shaft;

Figure 8 shows a slightly modified form of the invention in which the blades, including the housing, are each an integral member;

Figures 9 and 10 illustrate, respectively, a front and side elevation of a modified form of the invention, the blade tips being omitted;

Figures 11 and 12 illustrate a further modification of the invention, Figure 11 being a side elevation, and Figure 12 being a front view partly in section.

Referring now in detail to the several figures, and first adverting to that form of the invention illustrated in Figures 1 to 4, the numeral 1 represents the drive shaft which rotates in the direction of the arrow shown in Figure 1. A hub 2 is suitably fixed to the drive shaft, said hub being formed with the integral stub shafts 3 and 4. In the illustrated form of the invention the stub shafts extend in diametrically opposite directions with their axes in a line perpendicularly intersecting the axis of the drive shaft. As shown, the base portions 5 and 6 of said stub shafts are of larger diameter than the outer portions providing shoulders 7 and 8 which afford a seat for the bearings 9.

Each blade is provided with a root member or socket 10 which includes a housing 11 adapted to be journaled about the stub shaft 3 and the axis of which housing forms an acute angle with the median longitudinal axis of the blade. The housing 11 preferably has an interior collar 12 forming an inner shoulder 13 adapted to rest upon the bearing 9, and an outer shoulder 14

affording a seat for the lowermost of a column of bearings 15, 16 and 17. The number of bearings in said column may be optional. Said bearings closely surround the stub shaft. The outer end of the stub shaft 3, as shown, is threaded and receives a castellated nut 18 seated upon a washer 19 which rests upon the uppermost bearing. The nut 18 is suitably locked by a cotterpin 19' or other locking device. The centrifugal thrust of the rotating blade is transmitted through the collar 12 of the housing 11 against the stack of bearings 15, 16 and 17, being resisted by the nut 18 and washer 19. To retain oil or grease in the bearings, the housing is preferably closed by a cap 20. The construction as above described is duplicated for each of the blades and stub shafts.

Pitch equalizing mechanism is provided comprising a fitting 21 fixed at the inner end of each housing, comprising gear segments 22 and 23 on opposite sides which mesh with gears 24 and 25 journaled on pins 26 and 27, which as shown, are integral with the hub, the gears 24 and 25 being secured by nuts 27' and 28 screwed on to the ends of the pins 26 and 27, suitable washers 29 and 30 intervening. The gears 24 and 25 are segmental, as indicated in Figure 2, recesses 58 being formed between the segments, one of which is employed in connection with a stop pin 59 fixed to the hub to establish a maximum and minimum limit to the pitch adjustment of the propeller blades.

In the illustrated embodiment of the invention, two blades are shown. It is to be understood by those skilled in the art that the number of blades is immaterial and that the angular displacement of the stub shafts is dependent upon the number of blades.

In operation, assuming that the motor is climbing so that the load on the propeller is at its maximum, the R. P. M. of the motor will be reduced so that centrifugal force will diminish and the forward thrust of the air will swing the propeller blades forwardly, reducing the diameter of the propeller. The pitch will also be diminished, decreasing the load and permitting the engine to speed up so that the power of the engine will be correspondingly increased. As the airplane levels off and the load correspondingly diminishes, centrifugal force will act to draw the blades back towards a plane perpendicular to the drive shaft of the propeller, increasing the diameter of the propeller and increasing the pitch of the blades. This will tend to reduce the R. P. M. of the motor and reduce its power output accordingly. Thus, the pitch changes automatically according to the load, and the R. P. M. of the engine for any given throttle opening is maintained substantially constant.

Referring to Figure 7, a slightly modified form of hub construction is shown, in which the stub shafts 3 and 4 are offset from the hub 2 on opposite sides of a plane passing through the axis of the hub. This arrangement has the advantage that the median longitudinal axes of the blades pass more nearly through the axis of the drive shaft, giving a better balance of the stresses to which the propeller is subjected.

Referring again to Figures 1 to 4, inclusive, the socket member 10 is open laterally on the side adjacent the leading edge, the line of opening being indicated at 31 in Figure 3. The interior of the socket member is wedge-shaped toward the trailing edge, as shown at 32 in Figure 4. The

chamber within the socket member is narrower adjacent the upper end 33 thereof, than at the base. The blade proper 34 of the propeller is insertable laterally through the opening 31, and is shaped to conform to the contour of the socket chamber. It is wedge-shaped toward the trailing edge, as shown at 35 in Figure 4, and wider at its lower end than in the zone of the top of the socket member 10 in a plane perpendicular to the view shown in Figure 3.

Furthermore, the interior of the socket member 10 is provided with the parallel tapered ridges 36 and the root of the propeller blade proper is formed with corresponding grooves 37. In mounting the propeller blade 34 within the socket member 10, it is pushed in laterally through the opening 31, the grooves 37 riding upon the ridges 36, until the wedge-shaped portion 35 snugly fits the wedge-shaped portion 32 of the socket chamber. The propeller blade 34 cannot become displaced in an endwise direction because of the interdigitation of the ridges 36 and grooves 37, and in view of the fact that the lower end of the propeller is wider than the opening through the upper end of the socket member. When the blade 34 is thus in position to be tightened, the opening 31 is closed by a cap 38. The meeting edges of the socket member 10 and the cap 38 are formed with lapping flanges 39 slidable in inside and outside rabbets on the respective cap and socket member. The ends of said flanges are spaced from the ends of the respective rabbets when the cap is first placed in position, and are drawn together in the operation of tightening the cap and compressively securing the propeller blade 34. The outer face of the cap is formed with a recess 40, the bottom of which has the form of two planiform surfaces 41 and 42 intersecting at an obtuse angle. Pairs of outwardly divergent bores 43 and 44 are formed through the cap in said planiform surfaces at spaced longitudinal intervals. The blade 34 is formed with divergent bores 45 and 46 which register with the bores 43 and 44 when the cap is in place. The socket member is provided with apertures 47 and 48 registering with the bores 45 and 46. The outer opposite faces of the socket member 10 are provided with counterbores 49 and 50, registering with the bores 47 and 48. Inclined headed bolts 51 and 52 pass through the registering bores in the socket member blade 34 and cap 38, the heads being seated in the counterbores 49 and 50. The outer ends of the bolts 51 and 52 are threaded and receive the skirted nuts 53 and 54, the heads of which nuts rest against the planiform surfaces 41 and 42 and the skirts of which are received in the bores 43 and 44. The last named bores, as well as the bores 45 and 46 in the propeller blade are larger in diameter than the respective nuts and bolts so as to permit movement of the cap and propeller blade when the nuts are tightened. The inner surface of the cap 38 is made to conform to the shape of the adjacent surface of the root portion of the blade 34. When the nuts 53 and 54 are tightened, the cap is forced towards the socket member 10, and in turn, forces the propeller blade into wedged firmness in the socket member.

For streamlining effect, the recess 40 is closed by a curved plate 55, the curvature of which corresponds to the adjacent contour of the cap 38. The plate is secured by a series of screws 56, which fasten into threaded sockets 57 formed in the longitudinal central portion of the cap.

It is obvious that with the above construction the lateral thrust of the blade is always in the direction of the closed integral part of the socket member 10 and not against the cap, that the blade is rigidly and compressively held against the possibility of relative vibration between itself and the socket member and that it is impossible for the blade to be loosened or displaced through centrifugal force.

It is contemplated that the blade 34 may be made of metal, wood, plastic or any other eligible material.

Referring now to the modification of the invention shown in Figure 8, this differs from the form already described, in that the housing 11 and the entire propeller blade 60 are one integral member.

In that form of the invention illustrated in Figures 9 and 10, the housing 61 is integrally formed with one of the matching members 62 of a socket 63 which embraces the root end of the propeller blade 64. The socket members 62 are provided adjacent their plane of separation with flanges 65, having registering bolt holes and being brought together in clamped relation to the root end of the propeller blade by means such as the nuts 66. The chamber of the socket 63 is larger at the bottom than at the top, and the root end of the propeller blade 64 is correspondingly shaped, whereby the propeller blade is restrained from displacement through centrifugal force.

The pitch equalizing mechanism in this form of the invention is constituted by the arms 67 and 68 integral with the respective housings 61, or fixedly secured thereto, which extend inclinedly and at their ends carry the bearing pins 69 and 70, which pins intersect a common plane through the axis of the drive shaft. A pair of links 71 and 72 have eyes 73 and 74 at their outer ends journaled on said bearing pins and at their opposite ends the links 71 and 72 and yokes 75 and 76 pivotally interconnected to one another and to a sleeve 77, which slides along the fixed guide 78 coaxial with the drive shaft. As shown, the arms 67 and 68 are braced by the rods 79, rigidly secured to the housings 61 and to said arms adjacent their free ends.

Referring now to that form of the invention shown in Figures 11 and 12, the gear type of equalizer previously described may have the objection that all meshed gears are subject to a certain amount of lost motion or backlash, the presence of which might defeat precise pitch equalization of the blades, resulting in vibration. The structure described in Figures 11 and 12 provides a pitch equalized in which lost motion is entirely absent.

The hub is furnished with axially aligned cylindrical bosses 80 and 81 on opposite sides of the drive shaft and perpendicular to the turning axes of the propeller blades. Said bosses serve as journals for the identical rocking levers 82, each of which has diametrically opposed arms 83 and 84 terminating in ball ends 85. The rotatable housings 86 at the root of the propeller blades are each provided with a spherical head 87, and the balls 85 at each end of the rocking lever and the adjacent spherical heads 87 are connected by a link 88 having spherical seats 88' and 89 bearing against the respective ball ends and spherical heads. One of said seats is formed in a nut 90 screwing into one end of the link 88, by which means the links may be adjusted to draw snugly against the embraced ball end and spherical head, obviating any lost motion.

The arms 83 and 84 of the rocking lever 82 are formed with deep webs extending close to the surface of the hub and cooperating with stops 91 and 92 fixed to the hub which establish maximum and minimum pitch limits.

The equalizing mechanism is duplicated on both sides of the hub as shown whereby it is kept in tension and lost motion prevented.

It will be understood to those skilled in the art that I have produced a simplified and efficient variable pitch propeller of the self-operating type, amply safeguarded against the disruptive and vibratory strains to which a propeller is inherently subjected, and that the details of construction and arrangement of parts are by way of example and not to be construed as limiting the scope of the invention as defined in the appended claims.

1. Propeller construction comprising a blade, a socket member for securing the root end of said blade, said socket member having a lateral opening on the leading side for the lateral introduction of the blade, and a cap for closing said opening engageable with said root end, the chamber of said socket member being wedge-shaped toward the trailing edge, the root end of said blade being shaped to fit said socket chamber, and bolts passing through said cap, blade and socket member for drawing said cap compressively against said blade and wedging the latter in said socket member.

2. Propeller blade construction comprising a blade, a socket member for securing the root end of said blade, said socket member having a lateral opening in the leading side for the lateral introduction of the blade, and a cap for closing said opening engageable with said root end, the chamber of said socket member being wedge-shaped toward the trailing edge, the root end of said blade being shaped to fit said socket chamber, said cap having an external recess the bottom wall of which has convergent planiform surfaces, bolts passing through bores opening in said surfaces normal thereto extending through said cap, blade and the sides of said socket member, the heads of said bolts being countersunk in said socket member, and nuts on said bolts thrusting against said planiform surfaces of said cap recess for drawing said cap compressively against said blade and wedging the latter in said socket member.

3. Propeller blade construction as claimed in claim 2, including a plate closing said cap recess, secured to said cap.

4. Propeller blade construction as claimed in claim 2, said blade and socket member having transverse interdigitating grooves and ribs.

5. Propeller construction including a blade, comprising a socket member for securing the root end of said blade, said socket member having a hub connection at one end and a root end receiving chamber at the other, said chamber being wedge shaped toward the trailing end, the wedge shaped portion of said chamber being defined by integral convergent walls which terminate in a plane extending transversely of said chamber, closer to the leading end than to the trailing end, and parallel to the neutral axis of said blade, said walls defining a lateral opening facing the leading end for the lateral introduction of the root end of the blade, the latter being shaped to fit said socket chamber, a plate closing said opening engageable with said root

end, and means for drawing said plate and socket member together against said root end whereby it is wedgingly pressed against the convergent walls of said chamber.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,455,442	Leparmentier	May 15, 1923
1,638,695	Leitner	Aug. 9, 1927
1,834,350	Schroeder	Dec. 1, 1931
1,834,351	Schroeder	Dec. 1, 1931
1,851,874	Seppeler	Mar. 29, 1932
1,907,504	Chilton	May 9, 1933
1,943,210	De Lavaud	Jan. 9, 1934
2,097,643	Raggio	Nov. 2, 1937
2,134,661	Everts	Oct. 25, 1938
2,146,334	De Caria	Feb. 7, 1939
2,250,826	Everts	July 29, 1941
2,253,013	Birch	Aug. 19, 1941
2,294,867	Bottrill	Sept. 1, 1942

FOREIGN PATENTS

Number	Country	Date
27,021	Great Britain	Dec. 2, 1911
149,843	Great Britain	Aug. 26, 1920
287,985	Italy	Aug. 21, 1931
491,155	Great Britain	Aug. 26, 1938
684,120	France	June 21, 1930