March 16, 1926. 1,576,824

S. HEATH

VARIABLE PITCH PROPELLER

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FIG. 1.

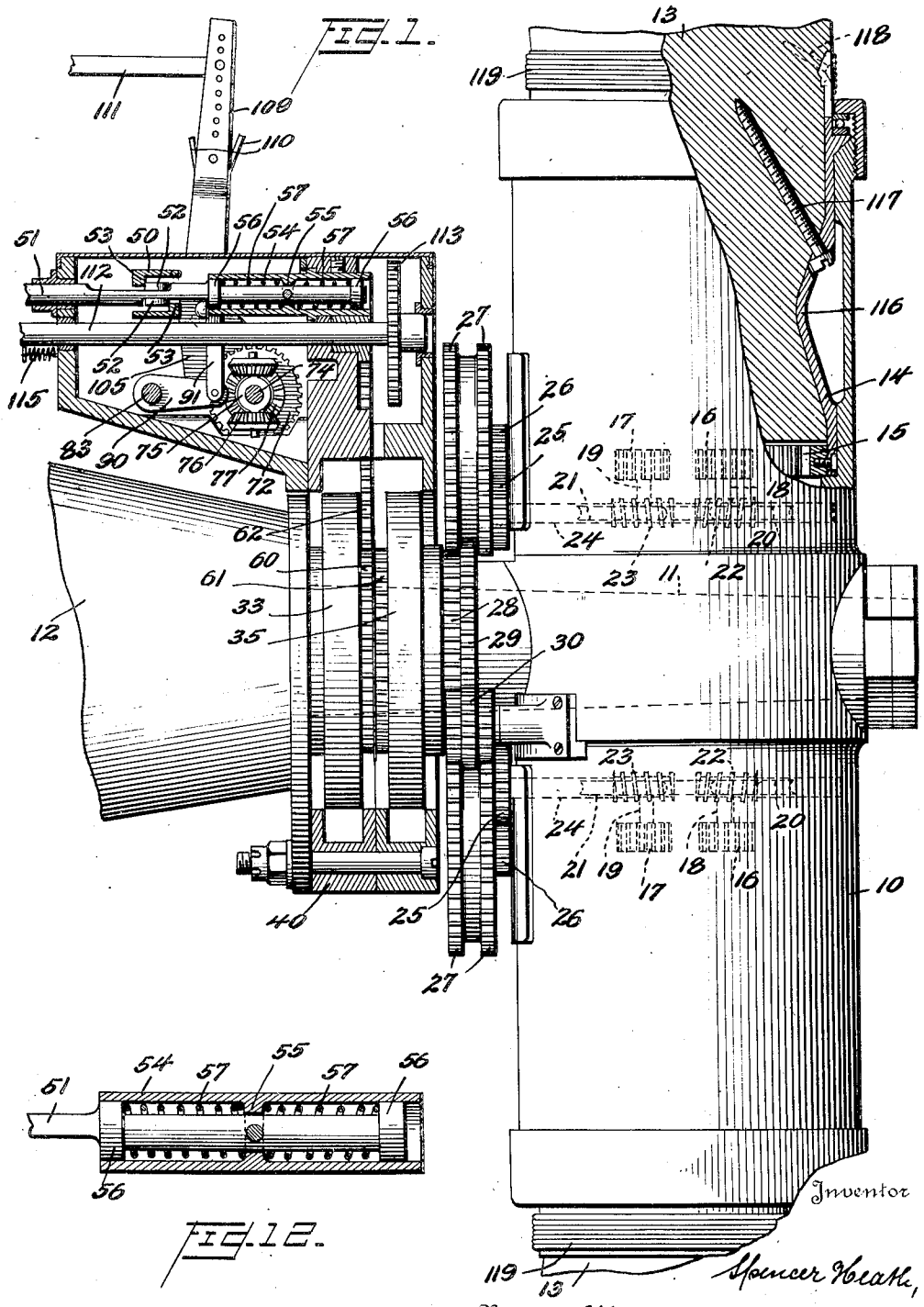


FIG. 12.

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VARIABLE PITCH PROPELLER

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FIG. 2.

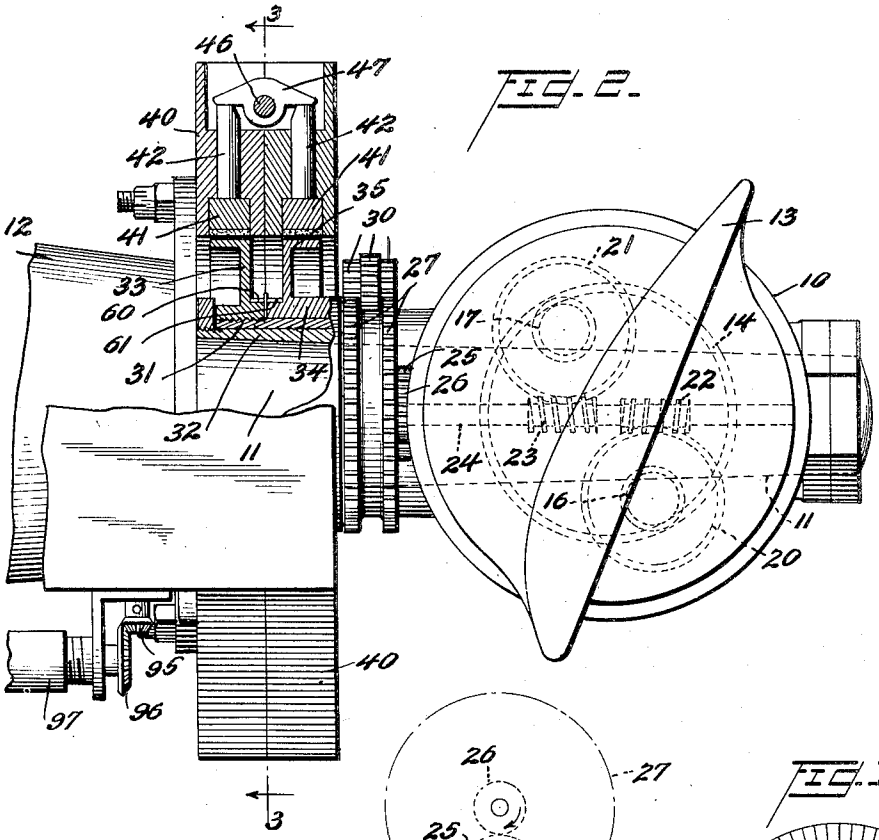


FIG. 9.

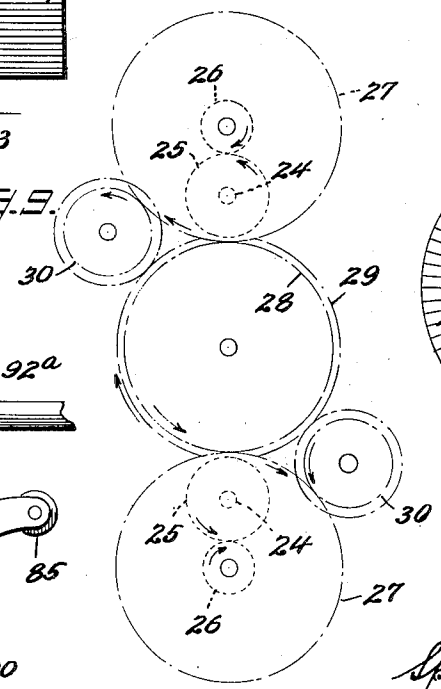


FIG. 10.

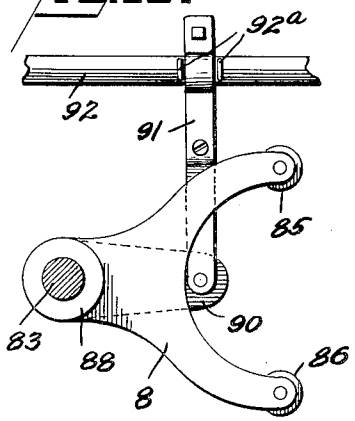
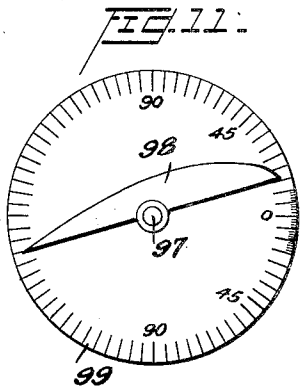


FIG. 11.



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VARIABLE PITCH PROPELLER

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FIG. 3.

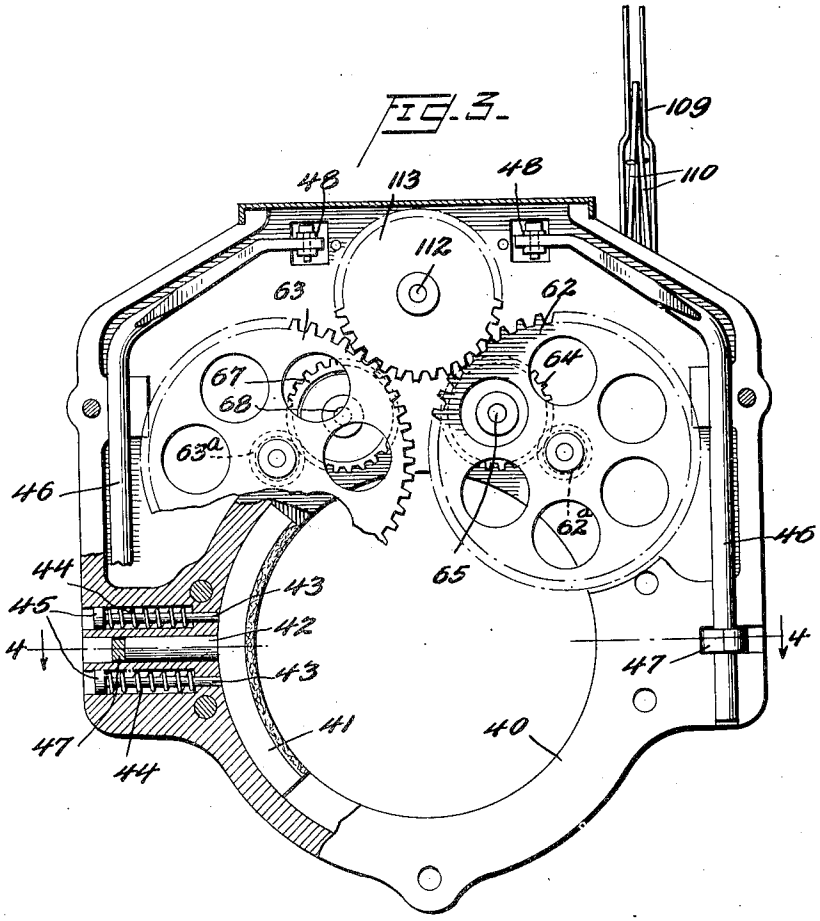
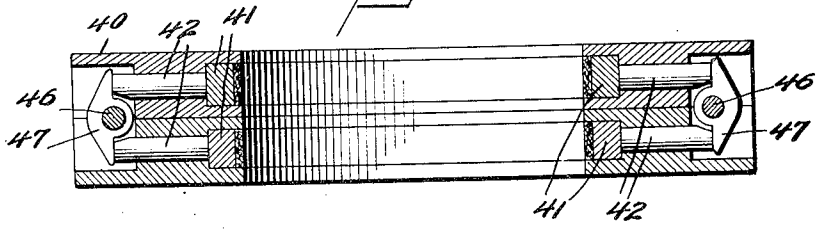


FIG. 4.



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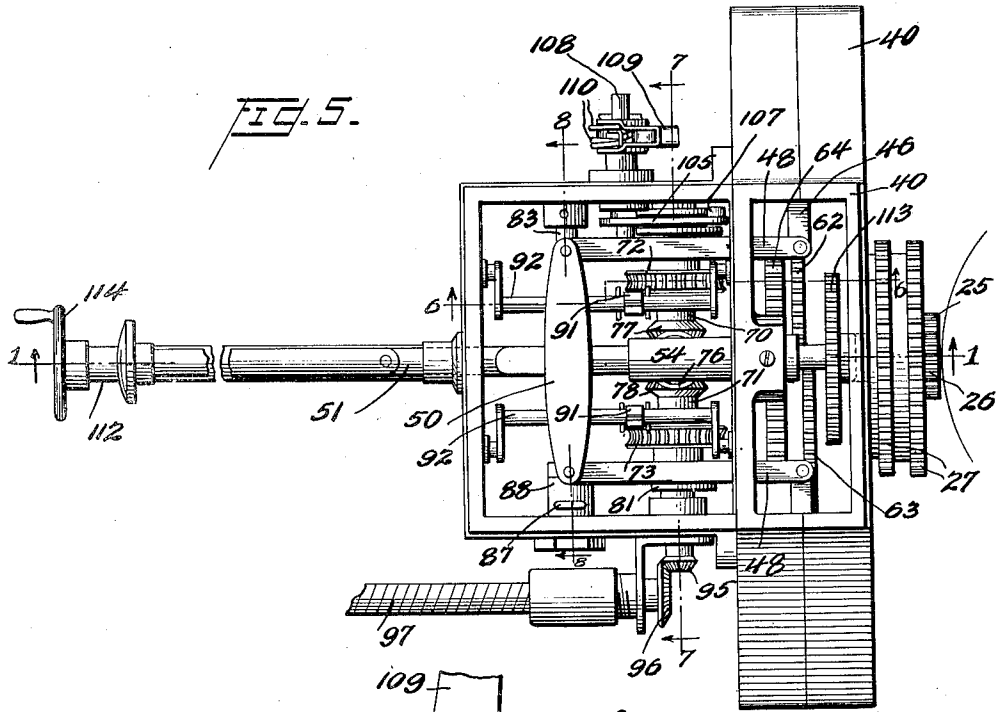
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VARIABLE PITCH PROPELLER

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FIG. 5.



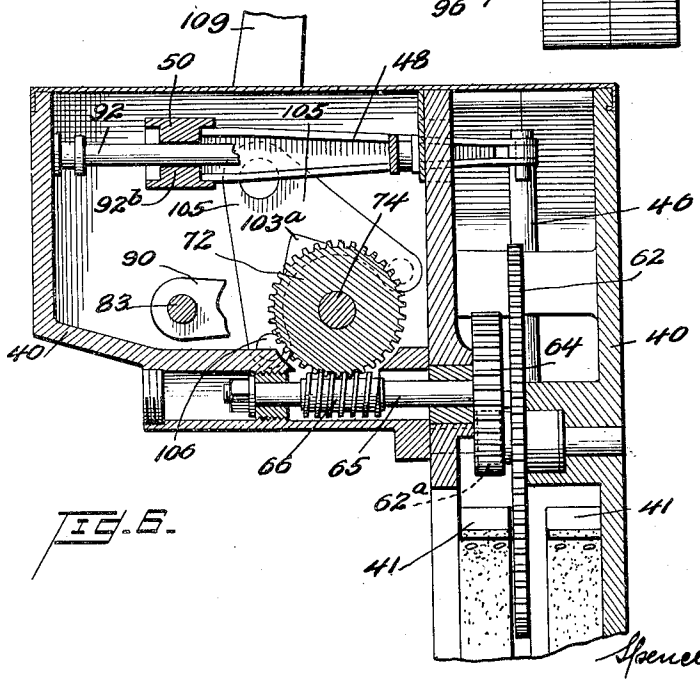


FIG. 6.

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VARIABLE PITCH PROPELLER

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FIG. 7.

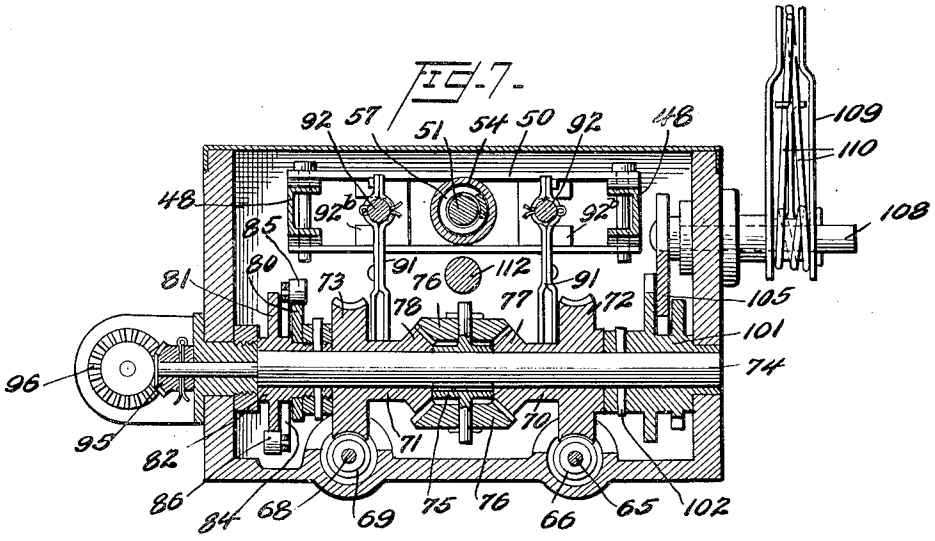


FIG. 8.

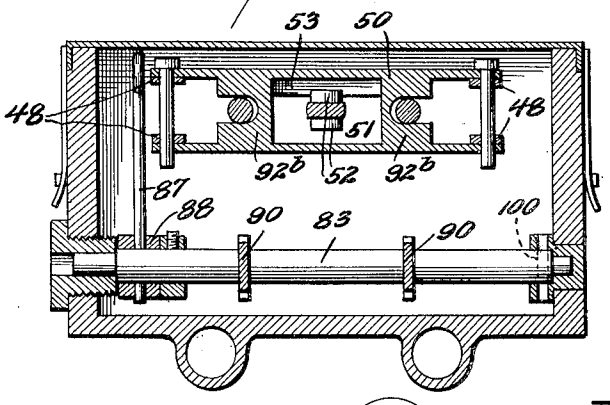


FIG. 13.

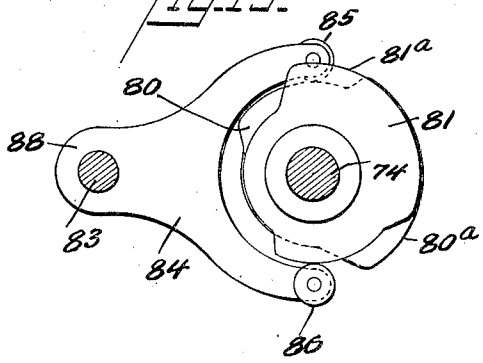
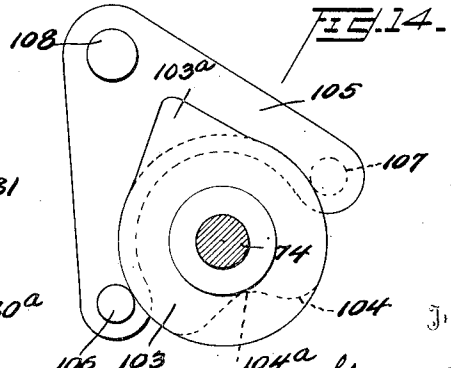


FIG. 14.



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Patented Mar. 16, 1926. 1,576,824

UNITED STATES PATENT OFFICE.

SPENCER HEATH, OF ELKRIDGE, MARYLAND.

VARIABLE-PITCH PROPELLER.

Application filed August 9, 1922. Serial No. 580,734.

To all whom it may concern:

Be it known that I, SPENCER HEATH, a citizen of the United States, and residing at Elkridge, State of Maryland, have invented certain new and useful Improvements in Variable-Pitch Propellers, of which the following is a specification.

This invention relates to variable pitch propellers and more particularly to aerial propellers.

In my prior applications Serial Nos. 308,112, filed July 2, 1919, and 491,202, filed August 10, 1921, there is illustrated and described mechanism operated by power derived from the propeller shaft for angularly adjusting or rotating the blades of a propeller about its own axis and means under the manual control of the operator for causing operation of said adjusting mechanism at will. In such prior construction the rotation or angular adjustment of the blades continues as long as the manually controlled means is kept by the operator in position to cause rotation of the blades.

The present invention aims generally to provide improved mechanism of the kind described in said prior applications and in particular to provide means which will operate automatically to limit the degree of angular adjustment of the blades in either direction, thus permitting the operator to adjust the blades up to a predetermined limit in either direction but automatically preventing adjustment beyond such limits. A further object is to provide improved means for accurately indicating at all times the exact angular position of the blades. A still further object is to provide improved mechanism for controlling the supply of motive fluid to the motor particularly when the blades pass through their position of zero pitch, that is when the plane of the blades coincides with the plane of rotation of the propeller. These and other desirable objects and advantages are obtained by the construction described in the following specification and illustrated in the following drawings forming a part thereof and in which:

Figure 1 is a longitudinal vertical sectional view partly in elevation taken on the line 1—1 of Figure 5, that is, substantially on a vertical plane including the axis of the propeller shaft;

Figure 2 is a plan view partly in section taken on a plane at right angles to the plane of Figure 1;

Figure 3 is a transverse section on the line 3—3 of Figure 2;

Figure 4 is a transverse section on the line 4—4 of Figure 3;

Figure 5 is a horizontal sectional view substantially on the line 5—5 of Figure 1;

Figure 6 is a longitudinal vertical section on the broken line 6—6 of Figure 5;

Figure 7 is a transverse section on the line 7—7 of Figure 5;

Figure 8 is a transverse section on the line 8—8 of Figure 5;

Figure 9 is a diagrammatic view illustrating the arrangement of the gear mechanism for effecting angular adjustment of the blades;

Figure 10 is a detailed view of part of the mechanism for automatically limiting angular adjustment of the blades;

Figure 11 is a view of the indicator for showing the angular position of the blades;

Figure 12 is an enlarged sectional view of part of the manually operated mechanism for adjusting the blades;

Figure 13 is a detached view of the cam mechanism for automatically stopping rotation of the blades after a predetermined adjustment in either direction is reached; and

Figure 14 is a detached view of the cam mechanism for controlling the supply of motive fluid to the motor.

Referring to the drawings in detail, 10 indicates the hub of the propeller which is mounted on the tapered end of the power shaft 11 driven from the motor, generally designated at 12. The hub 10 is formed with sockets for receiving the inner ends of the blades 13, the blades being secured in ferrules 14 rotatably mounted in the sockets of the hub and having internal gears 15 secured to their inner ends. Gear mechanism operated through the internal gears 15 serve to rotate the blades about their axes and thus effect angular adjustment of the same. This gear mechanism is substantially identical with that of my said prior application Serial No. 491,202 and detailed description of the same is unnecessary. Briefly this mechanism comprises pinions 16, 17, which mesh with the internal gears 15, such pinions being mounted on short shafts 18, 19, to which are also secured worm wheels

20 and 21 respectively, which worm wheels mesh with a pair of worms 22, 23 on a shaft 24. The shaft 24 is journaled in the hub and has its end projecting rearwardly outside of the same. On this projecting end is secured a gear wheel 25 which meshes with a pinion 26 rigid with a double gear 27, the gears 26 and 27 being suitably journaled on the hub 10. One part of the gear 27 meshes with a gear 28 which surrounds the shaft 11 and a similar concentrically arranged gear 29 meshes with a compensating pinion or back gear 30 which is journaled on the hub and which in turn meshes with the other part of the gear 27. The gear 29 is secured to a sleeve 31 which is journaled on a tubular extension 32 of the hub 10 surrounding the shaft 11. A rotary brake drum 33 is rigidly secured to the sleeve 31. The gear 28 is rigidly secured to a sleeve 34 which surrounds the sleeve 31 and to which is rigidly secured a rotary brake drum 35. The brake drums 33 and 35 normally rotate with the propeller but as pointed out in my said prior applications when one of said drums is retarded in its rotation relative to the other drum, rotation or angular adjustment of the blades 13 takes place.

One of the improved features of the present construction lies in the means employed for retarding rotation of the drums 33, 35. These drums are arranged in a suitable casing 40 and each is adapted to be engaged by a pair of brake shoes 41 slidably supported in the casing and movable into and out of engagement with the drums. Each brake shoe extends partially around the periphery of one of the drums and to each is secured a stem 42 slidably arranged in the casing 40. Two rods 43 are also secured to each of the brake shoes on opposite sides of the stem 42, these rods being surrounded by coiled springs 44, each arranged in a suitable recess of the casing and confined between a suitable head 45 on the rod and the bottom of the recess. The stems 42 and rods 43 serve as guides for the brake shoes as they move toward and from the drums, the brake shoes being normally held out of contact with the drums by the springs 44. It will be observed that the brake shoes for each drum are disposed on opposite sides thereof which arrangement is of importance in that it prevents lateral thrust against the sleeves 31 and 34 and obviates undue wear on the same.

The brake shoes 41 may be moved into contact with the drums by means of two rocking arms 46, 46 pivotally supported in the casing 40 on opposite sides of the drums and provided with lugs or cam members 47 rigidly secured thereto in position to engage the ends of the stems 42. It will be understood that when the arms 46 are rocked in one direction one pair of brake shoes will be caused to engage the drum 33 and when rocked in the other direction the other pair of brake shoes will be caused to engage the drum 35.

Each of the arms 46 at its upper end is pivotally connected to a rod 48, the opposite ends of which rods are pivotally connected to an equalizing yoke or cross head 50, which yoke is adapted to be moved in opposite directions by a manually operated controlling rod 51 which is axially movable and which extends to a point within convenient reach of the operator. The rod 51 is provided on opposite sides with lugs or shoulders 52 having curved surfaces which are adapted to engage oppositely extending lips 53 on the yoke 50 as the rod is moved in one direction or the other. The yoke 50 is thus pivotally connected with the rod 51 from which it will be understood that pressure applied in either direction to the rod 51 will be equalized on the pair of brake shoes which is actuated thereby. As will be later pointed out, the yoke 50 is capable of movement transversely of the rod 51 to disengage the lips 53 from the shoulders 52.

The end of the rod 51 is slidably mounted in a small casing 54 which intermediate its ends is provided with an internal rib or lug 55 between which and enlargements 56 on the rod are arranged coiled springs 57. These springs serve to restore the rod 51 to its normal position after it has been moved in either direction and pressure upon the same released. By manipulating the rod 51 the operator is thus able to apply the brake shoes to either the drum 33 or 35 to retard rotation of the same and thus cause angular adjustment of the blades in either direction while the propeller is running.

As already noted one of the principal features of the present invention resides in providing means for automatically stopping rotation of the blades about their axes after a predetermined angular adjustment in either direction is obtained. Such means will now be described. Rigidly connected to the rotary drum 33 and arranged concentrically therewith is a gear 60 and a similar gear 61 is secured to and arranged concentrically with the rotary drum 35. A gear 62 journaled in the casing 40 meshes with the gear 60 and a similar gear 63 meshes with the gear 61. A pinion 62^a, rigidly connected to and mounted concentrically with the gear 62, is arranged to mesh with a gear 64 which is rigidly connected to one end of a rigid shaft 65, the other end of this shaft carrying a worm 66 rigidly secured thereto. A pinion 63^a, rigidly connected to and mounted concentrically with the gear 63, is arranged to mesh with a gear 67 which is rigidly connected to one end of a rigid shaft 68 carrying a worm 69 rigidly secured thereto.

The worms 66 and 69 are designed to op-

erate a differential gear mechanism which controls the degree of angular adjustment of the blades, the blade position indicator and the supply of fluid to the motor. This differential mechanism comprises two rotary members 70 and 71 provided respectively with worm wheels 72 and 73 which engage respectively with the worms 66 and 69, the members 70 and 71 being rotatably mounted on a shaft 74 to which is rigidly secured a spider 75 carrying gears 76 which mesh with bevel gears 77 and 78 secured to or formed integral with the members 70 and 71 respectively.

As already pointed out drums 33 and 35 normally rotate with the propeller and through the gear mechanism heretofore described the rotary members 70 and 71 are also caused to rotate with the propeller, these members normally rotating at equal speeds and in opposite directions on the shaft 74. During such normal operation the shaft 74 is not rotated. But when, as heretofore stated, one of the drums is retarded by application of the brake shoes 41, angular adjustment of the blades 13 takes place and simultaneously therewith angular movement or rotation of one of said members relative to the other takes place. This results in rotation of the shaft 74. For reasons hereinafter described the mechanism for effecting operation of the differential gear mechanism is so designed as to cause the shaft 74 to be angularly displaced twice the amount of the angular displacement of the blades, or in other words the shaft 74 rotates at twice the speed of rotation of the blades about their axes.

On one end of the shaft 74 there is rigidly secured in any suitable manner two cams 80 and 81, these cams preferably being attached to a hub 82 pinned to the shaft. A rock shaft 83 suitably supported at its opposite ends has secured thereto a forked cam lever 84 which carries oppositely disposed rollers 85 and 86 adapted to bear respectively on the cams 80 and 81. The lever 84 is preferably secured to the shaft 83 by means of a removable pin 87 which is inserted in holes in the hub 88 of the lever and in the shaft 83. Rotation of the cams will therefore rock the shaft 83 in one direction or the other. It will be understood that the cam surfaces of these cams are such as to permit movement of the lever 84 by either cam without interference from the other.

The rock shaft 83 has secured to it at spaced points two arms 90, 90, to the free ends of each of which is pivotally connected the lower end of a link 91, the upper ends of these links being pivotally connected to crank members 92, 92. Preferably the links 91 surround the crank members 92 and are held in position by cotter pins 92^a passing through the members. The ends of the crank members 92 are pivotally supported in any suitable manner and are arranged parallel with and on opposite sides of the operating rod 51. The members 92 are slidably engaged by the yoke 50 preferably being arranged in recesses in blocks 92^b secured between upper and lower portions of the yoke. The crank members 92 thus constitute means by which the yoke 50 is raised or lowered. The lips 53 on the yoke and the shoulder 52 on the rod 51 are so proportioned that when the yoke is raised the upper lip 53 will be disengaged from the upper shoulder 52 if such parts are in contact and when the yoke is lowered the lower lip 53 will be disengaged from the lower shoulder 52 if such parts are in engagement.

It has already been noted that when the yoke 50 is moved in one direction or the other by pressure on the rod 51, rotation of one of the brake drums will be retarded and angular adjustment or rotation of the blades results. But such rotation of the blades is accompanied by rotation of the shaft 74 and cams 80 and 81 which, through the lever 84, rock shaft 83, arms 90 and links 91, raise or lower the yoke 50 sufficiently to disengage the lip 53 thereof from the corresponding shoulder 52 on the rod. The brake shoes 41 are thus automatically relieved of pressure from the operating rod 51 and return to their normal position; the brake drums 33, 35 are free to rotate with the propeller and further angular adjustment of the blades ceases. The operating rod returns to its normal position under the influence of the springs 57 after pressure thereon is relieved. On of the cams 80, 81 is designed to raise the yoke 50 and the other to lower it and the cam surfaces of these cams are, of course, so formed and positioned that such raising or lowering of the yoke will take place when a desired angular adjustment of the blades in either direction is obtained. Thus the high surface 81^a of cam 81 will cause movement of the yoke 50 in one direction at the proper time and the high surface 80^a of cam 80 cause movement of the yoke in the opposite direction at the proper time.

It is sometimes desirable to operate the propeller so that the blades will not be limited in their angular adjustment but free to be rotated through an angle of 360° in either direction. This may be accomplished by withdrawing the pin 87 from the shaft 83 when the cams 80 and 81 will no longer be effective to rock the shaft 83 and raise or lower the yoke 50. When this is done the parts of the mechanism may be kept in proper relative position by inserting the pin 87 through an opening 100 in the opposite end of the shaft and the bearing in which it is mounted.

Referring to the indicating mechanism, it

will be noted that the shaft 74 carries at one end a bevel gear 95 which meshes with a similar gear 96 the latter being connected to a flexible shaft 97 of any desired form which operates the movable member 98 of the indicator 99, the indicator preferably being made as shown in my said prior application No. 491,202 and mounted in a suitable position in sight of the operator. The gear 95 is one-half the size of the gear 96, this being rendered necessary by the fact that the shaft 74 rotates at twice the speed of rotation of the blades in their sockets while the movable member 97 of the indicator is designed to have the same speed of angular movement as the blades. Since the differential mechanism for controlling the indicator of the present construction is located near the brake drums and operated by rigid shafts, all tendency for play or back-lash in the parts for operating the indicator is avoided and the movable member thereof shows at all times the exact angular position of the blades.

The mechanism for automatically controlling the supply of motive fluid to the motor will now be described. On the shaft 74 adjacent the member 70 there is secured a hub 101, the parts being held against relative rotation by a pin 102. A main cam 103 and a supplementary cam 104 are secured to or formed integral with the hub 101, the main cam 103 being circular except for a single high portion 103^a and the cam 104 being circular except for a single depression 104^a. These cams are designed to operate a forked rocking lever 105 the opposite forks of which are provided with rollers 106 and 107 for engaging respectively the cams 103 and 104. The rock lever 105 is rigidly secured to a rock shaft 108 which is journaled in the casing and on which an arm 109 is pivotally mounted the arm preferably being made up of two parallel side members secured in spaced relation. The arm 109 is yieldingly held in position by two spring members 110 which are secured to the shaft 108 and which at their upper ends bear against opposite sides of the arm 109. A rod 111 is connected at one end to the free end of the arm 109 and at its other end is operatively connected to the throttle valve of the engine. It will be seen that when the shaft 108 is rocked in one direction or the other the arm 109 will be moved by one or the other of the yieldable members 110 to automatically throttle or increase the supply of fluid to the engine. The arm 109 being yieldable in either direction will not interfere with manual operation of the engine throttle when desired.

The high portion 103^a of the cam 103 is so shaped as to effect a quick closing of the throttle valve of the motor as the blades approach the position of zero pitch and the cam surface 104^a of the cam 104 effects quick opening of the same after the blades have passed such position. The throttle is thus positively moved in both directions. These cams are, of course, so arranged and timed as to effect such closing and opening of the throttle whenever the blades pass the position of zero pitch. Since the shaft 74 rotates at twice the speed of rotation of the blades about their axes, it follows that the cams 103 and 104 will operate twice during each complete rotation of the blades about their axes to throttle the motor, that is, a single cam surface on each of these cams suffices to effect positive closing and opening of the throttle of the motor each time the blades pass through the position of zero pitch.

In order to permit manual adjustment of the blades about their axes when the propeller is not running, there is provided a shaft 112 to the forward end of which a gear 113 is secured. The shaft 112 is slidably supported in the casing and at its rear end is provided with a handle 114 in convenient reach of the operator for rotating the same and moving it longitudinally. The gear 113 is so positioned that it may be drawn into engagement with the gear 63 and rotated, such rotation causing angular adjustment of the blades. A coiled spring 115 secured to the shaft 112 and to any convenient fixed point serves to normally maintain the gear 113 out of contact with the gear 63.

Briefly referring to the means for fastening the blades 13 in the ferrule 14, it will be seen that the latter is provided with a constricted portion 116 past which the inner ends of the blades are forced. The material of the blades expands after passing such constricted portion and fills the inner ends of the ferrules. To further secure the blades in position, there is provided a series of screws 117 which extend through the wall of the ferrule above the constricted portion 114 and into the material of the blade, these screws being directed outwardly at an angle to the axis of the blade. Another set of screws 118 may be employed which extend through the outer end of the ferrule and into the material of the blades, these screws being inserted at a different angle from the screws 117. A plurality of turns of wire 119 are wound around the outer end of the ferrule and over the heads of the screws 117. The blades are thus effectively secured in the ferrules.

Various modifications in the details of the foregoing construction may of course be made without departing from the spirit of the invention as pointed out in the appended claims and without sacrificing any of the benefits thereof.

Having thus described my invention what

I claim as new and desire to secure by Letters Patent is:

1. The combination with a propeller having a blade rotatable about its own axis to change its pitch, of power operated means for so rotating said blade, two independent gear wheels operatively connected to said blade, means for retarding rotation of one of said gear wheels relative to the other to cause relative motion between the same and rotation of said blade about its axis, and mechanism operated by the relative motion of said gear wheels for automatically stopping rotation of said blade after the pitch of the same has reached a predetermined limit.

2. The combination with a propeller having a blade rotatable about its own axis to change its pitch, of power operated means for so rotating said blade, two gear wheels operatively connected to said blade, means for retarding rotation of one of said gear wheels relative to the other to cause relative movement between the same, and mechanism operated by the relative movement of said gear wheels for rendering said power operated means ineffective to further rotate said blade about its axis after the pitch of the same has reached a predetermined limit.

3. The combination with a propeller having a blade rotatable in either direction about its own axis to change its pitch, of power operated means for rotating said blade in either direction, two gear wheels movable relative to each other when said blade is rotated in either direction about its axis, and mechanism operatively connected at all times to both of said gear wheels and operated by the relative motion between the same for automatically stopping rotation of said blade after the same has been rotated a predetermined amount in either direction beyond the position of neutral pitch.

4. The combination with a propeller having a blade rotatable about its own axis to change its pitch, of power operated means for so rotating said blade, manually controlled means for bringing said power operated means into operation, two gear wheels movable relative to each other when said blade is rotated about its axis, and means operatively connected at all times to both of said gear wheels for automatically stopping the rotation of said blade about its axis when the pitch of the same has reached a predetermined amount.

5. The combination with a propeller having a blade rotatable in either direction about its own axis to change its pitch, of power operated means for so rotating said blade, manually controlled means for causing said power operated means to rotate said blade in either direction, and means operated upon rotation of the blade for automatically stopping the rotation of the same when its pitch has reached a predetermined limit, all of said means being positioned entirely on one side of the plane of rotation of the propeller.

6. The combination with a propeller having a blade rotatable in either direction about its axis, a shaft for driving said propeller, a motor for driving said shaft, means for rotating said blade while the propeller is running, and means operating automatically upon rotation of the blade for stopping rotation thereof when the blade has been rotated a predetermined amount in either direction, all of said means being arranged entirely on the same side of the plane of rotation of the propeller as said motor.

7. The combination with a propeller having a blade rotatable about its own axis to change its pitch, of a shaft for driving said propeller, means operated by power derived from said shaft for rotating said blade while the propeller is running, and means also operated by power derived from said shaft for automatically stopping rotation of the blade about its axis when a predetermined degree of pitch is obtained, said last named means comprising two gear wheels surrounding said shaft and movable relative to each other, and mechanism controlled by movement of said gear wheels and arranged at one side of the axis of said shaft and non-rotatable relative to said shaft.

8. The combination with a propeller having a blade rotatable in either direction about its own axis, of a shaft for driving said propeller, means operated by power derived from said shaft for rotating said blade, manually controlled means for causing said power operated means to rotate said blade in either direction, two gear wheels arranged concentrically of said shaft and movable relative to each other when said blade is rotated about its axis, and mechanism controlled by the relative movement of said gear wheels for rendering said manually operated means ineffective when said blade has been rotated a predetermined amount.

9. The combination with a propeller having a blade rotatable about its own axis to change its pitch, of a shaft for driving said propeller, means operated by power derived from said shaft for rotating said blade while the propeller is running, two gear wheels arranged concentrically of said shaft, and mechanism operated by relative movement between said gear wheels for automatically stopping rotation of the blade about its axis when a predetermined degree of pitch is obtained.

10. The combination with a propeller having a blade rotatable about its own axis to change its pitch, of means for so rotating said blade, differential mechanism adapted to act in timed relation with the rotation of

said blade about its axis, means for causing action of said differential mechanism comprising two gears rotatable relative to each other, and means responsive to the action of said differential mechanism for stopping rotation of said blade when a predetermined degree of pitch is obtained.

11. The combination with a propeller having a blade rotatable about its own axis to change its pitch, of power operated means for so rotating said blade, manually controlled means for causing said power operated means to rotate said blade, differential mechanism adapted to act in timed relation with the rotation of said blade, means for causing action of said differential mechanism comprising two gears rotatable relative to each other, and means responsive to the action of said differential mechanism for freeing said power operated means from the action of said manually controlled means when the pitch of the blade reaches a predetermined amount.

12. The combination with a propeller having angularly adjustable blades, of mechanism for angularly adjusting said blades while the propeller is running, differential mechanism operatively connected with said first named mechanism, means for causing action of said differential mechanism comprising two gears rotatable relative to each other, and means responsive to the action of said differential mechanism for limiting the angular adjustment of said blades.

13. The combination with a propeller having angularly adjustable blades, of mechanism for adjusting said blades while the propeller is running, said mechanism comprising stationary and rotary elements normally out of engagement, means controllable at will for bringing said elements into engagement to retard rotation of the rotary element, means operated by the retardation of such rotary element for actuating said adjusting mechanism, and means for automatically disengaging said elements when a predetermined degree of angular adjustment of said blades is reached.

14. A propeller having angularly adjustable blades, means associated with said blades for angularly adjusting the same, an element rotating with the propeller and operatively connected with said adjusting means, a nonrotary device adapted to engage said rotating element to retard rotation of the same and thereby actuate said adjusting means, and means for automatically disengaging said device from said element when the angular adjustment of the blades reaches a predetermined amount.

15. The combination with a propeller having angularly adjustable blades, of mechanism for adjusting said blades in either direction while the propeller is running, said mechanism comprising a pair of elements rotating with the propeller, relatively stationary manually controlled elements normally out of engagement with said rotary elements, means for selectively bringing said manually controlled elements into engagement with one or the other of said rotary elements to retard rotation of the same and thereby actuate said adjusting mechanism, and means for automatically disengaging the elements which are in engagement when a predetermined degree of angular adjustment of said blades is reached.

16. A propeller having angularly adjustable blades, means associated with each blade for angularly adjusting the same, a pair of brake drums normally rotating with the propeller and operatively connected with said adjusting means, a pair of brake shoes for each of said rotating drums, the brake shoes of each pair being oppositely disposed and movable independently of each other, means for yieldingly holding each of said brake shoes out of contact with its respective drum, and manually operated means for selectively moving said pairs of brake shoes into contact with said drums to actuate said adjusting means in one direction or the other.

17. In a propeller having angularly adjustable blades, mechanism for adjusting said blades comprising a pair of rotary drums, a casing in which said drums are arranged, a pair of brake shoes for each of said drums mounted in said casing and movable independently of each other, the brake shoes for each drum being arranged on opposite sides thereof, a spring for yieldingly holding each of said shoes out of contact with its respective drum, and means for simultaneously moving one pair or the other of said brake shoes into contact with one or the other of said drums.

18. A propeller having angularly adjustable blades, means associatel with each of said blades for angularly adjusting the same, a pair of brake drums normally rotating with the propeller and operatively connected with said adjusting means, a pair of brake shoes for engaging each of said drums, the brake shoes for each drum being arranged on opposite sides of the drum and slidable in a rectilinear path toward and from the same, and manually operated means for selectively moving said pairs of brake shoes into engagement with said drums, whereby said adjusting means is actuated in one direction or the other.

19. A propeller having angularly adjustable blades, means associated with each blade for angularly adjusting the same, a pair of brake drums normally rotating with the propeller and operatively connected with said adjusting means, means for retarding rotation of either of said brake drums relative to the other, said means comprising a casing, a separate brake shoe for each of said drums

slidably mounted in said casing, a brake shoe actuating device mounted in said casing, means for moving one of said brake shoes into contact with one of said drums to retard rotation of the same when the said device is moved in one direction, and means for moving the other brake shoe into contact with the other drum to retard rotation of the same when the device is moved in the other direction, whereby said adjusting means is actuated in one direction or the other, and manually operated means for moving said device in opposite directions.

20. A propeller having angularly adjustable blades, means associated with each of said blades for angularly adjusting the same, a pair of brake drums normally rotating with the propeller and operatively connected to said adjusting means, means for retarding rotation of either of said brake drums relative to the other, said means comprising a separate brake shoe movable into and out of contact with each of said drums, manually operated means for selectively moving said brake shoes into contact with said drums to retard rotation of the same, whereby said adjusting means is actuated in one direction or the other, and means for automatically moving the brake shoe which is in contact with the drum out of contact therewith when the angular adjustment of the blades reaches a predetermined amount.

21. A propeller having angularly adjustable blades, means associated with each of said blades for angularly adjusting the same, a pair of brake drums normally rotating with the propeller and operatively connected to said adjusting means, a pair of brake shoes adapted to selectively engage said drums to retard one relative to the other and thus operate said adjusting means, and means responsive to the angular displacement of one of said drums relative to the other for effecting disengagement of the brake shoe and drum which are in contact, when the angular adjustment of the blades reaches a predetermined amount.

22. A propeller having angularly adjustable blades, means associated with said blades for angularly adjusting the same, a pair of brake drums normally rotating with the propeller and operatively connected with said adjusting means, a separate brake shoe for engaging each of said drums to retard rotation of the same and operate said adjusting means, an axially movable manually operated controlling rod for said brake shoes, mechanism operated by movement of said rod in one direction for causing one of said brake shoes to engage one of said drums, and mechanism operated by movement of said rod in the other direction for causing the other brake shoes to engage the other drum, whereby said adjusting means is actuated in one direction or the other.

23. A propeller having angularly adjustable blades, means associated with said blades for angularly adjusting the same, a pair of brake drums normally rotating with the propeller and operatively connected with said adjusting means, means for retarding rotation of either of said brake drums relative to the other, said means comprising a separate brake for each of said drums, a manually operated control device for said brakes, mechanism operated by movement of said device in one direction for causing one of said brakes to engage and retard one of said drums, mechanism operated by movement of said device in the other direction for causing the other of said brakes to engage and retard the other drum, whereby said adjusting means is actuated in one direction or the other, and means for automatically effecting disengagement of said device from said brake operating mechanism when the blades have been adjusted a predetermined amount in either direction.

24. A propeller having angularly adjustable blades, means associated with said blades for angularly adjusting the same, a pair of brake drums normally rotating with the propeller and operatively connected with said adjusting means, a separate brake for each of said drums, a manually operated control device for said brakes, mechanism operated by movement of said device in one direction for causing one of said brakes to engage one of said drums, mechanism operated by movement of said device in the other direction for causing the other of said brakes to engage the other drum, whereby said adjusting means is actuated in one direction or the other, means for automatically effecting disengagement of said device from said brake operating mechanism when the blades have been adjusted a predetermined amount in either direction, and spring means for returning said device to its initial position after the same is disengaged from the brake operating mechanism.

25. A propeller having an angularly adjustable blade, means associated with said blade for angularly adjusting the same, a pair of brake drums normally rotating with said propeller and operatively connected with said adjusting means, a pair of brake shoes for contacting with each of said drums, the shoes of each pair being arranged on opposite sides of the drum with which they contact, a yoke, an operating rod for moving said yoke in opposite directions, and means connected to said yoke and operable by the movements thereof in opposite directions to cause one pair or the other of said brake shoes to engage one or the other of said drums, whereby said adjusting means is actuated in one direction or the other.

26. A propeller having an angularly ad-

justable blade, means associated with said blade for angularly adjusting the same, a pair of brake drums normally rotating with said propeller and operatively connected with said adjusting means, a pair of brake shoes for contacting with each of said drums, the shoes of each pair being arranged on opposite sides of the drum with which they contact, a yoke, an operating rod for moving said yoke in opposite directions, means connected to said yoke and operable by the movements thereof in opposite directions to cause one pair or the other of said brake shoes to engage one or the other of said drums, whereby said adjusting means is actuated in one direction or the other, and means for automatically disengaging said yoke from said operating rod when adjustment of said blade in either direction reaches a predetermined amount.

27. Mechanism for angularly adjusting the blades of a propeller including, in combination, a pair of drums normally rotating with the propeller, a pair of brake shoes for each drum disposed on opposite sides thereof, manually operated means for causing the oppositely disposed brake shoes of each pair to contact with their respective drum, and means for equalizing the pressure of such oppositely disposed brake shoes against their respective drums.

28. Mechanism for angularly adjusting the blades of a propeller including in combination, a pair of drums normally rotating with the propeller, a pair of brake shoes for each drum disposed on opposite sides thereof, an equalizing yoke having one end connected to the brake shoes on one side of said drums and the other end connected to the brake shoes on the other side of said drum, said connections being such as to cause the pressure applied to said yoke to be equalized on the brake shoes of each pair, and a manually operated rod pivotally engaging an intermediate portion of said yoke for applying pressure thereto in one direction or the other.

29. Mechanism for angularly adjusting the blades of a propeller including, in combination, a pair of drums normally rotating with the propeller, a pair of brake shoes for each drum, a yoke connected to said brake shoes, a slidably mounted operating rod for said yoke, means on said rod for detachably engaging said yoke and moving the same in opposite directions as the rod is moved in opposite directions whereby angular adjustment of the blades in one direction or the other is produced, and means operatively connected to said drums for disengaging said rod from said yoke when a predetermined adjustment of the blades in either direction is obtained.

30. A propeller having angularly adjustable blades, means associated with said blades for angularly adjusting the same, a pair of brake drums normally rotating with said blades and operatively connected to said adjusting means, a pair of brake shoes for each drum, manually operated means for moving one or the other of said pairs of brake shoes into contact with one or the other of said drums to adjust said blades, said last named means including a yoke, a manually operated control rod for moving said yoke in one direction or the other, said rod being detachably connected to said yoke, differential mechanism operatively connected to said drums, and means responsive to the action of said mechanism for disconnecting said yoke from said rod when a predetermined angular adjustment of said blades is reached.

31. The combination with a propeller having angularly adjustable blades, of mechanism for angularly adjusting said blades while the propeller is running, differential mechanism operatively connected with said first named mechanism, means responsive to the action of said differential mechanism for limiting the angular adjustment of said blades, and a device by which said last mentioned means may be rendered non-responsive to the action of said differential mechanism, to thereby permit unlimited angular adjustment of the blades.

32. The combination with a propeller having an angularly adjustable blade, of means for adjusting the same at will including a pair of rotatable elements, an indicator having a pivotally movable member for showing the angular position of said blade, differential mechanism operatively connected to said indicator, a pair of worms for operating said mechanism, a rigid shaft rigidly connected at one end to each of said worms and extending into proximity to said rotatable elements, a gear wheel rigidly secured to the other end of each of said shafts, and means operated by said rotatable elements for rotating said gear wheels.

33. The combination with a propeller having an angularly adjustable blade, of means for adjusting the same at will including a pair of rotatable elements, differential gear mechanism, an indicator having a pivotally movable member for showing the angular position of said blade, a flexible shaft connected to the movable member of said indicator and to said differential mechanism, a pair of rigid shafts extending from said differential mechanism into proximity to said rotatable elements, a worm rigidly secured to one end of each of said shafts for operating said differential mechanism, a gear wheel rigidly secured to the other end of each of said shafts, and gear wheels operated by said rotatable elements with which said first named gear wheels engage.

34. The combination with a propeller having an angularly adjustable blade, of means

for adjusting the same including a pair of rotatable elements, a casing in which said elements are mounted, a pair of rigid shafts also mounted in said casing and operatively connected to said rotatable elements, a differential gear mechanism, a worm rigidly secured to the end of each of said rigid shafts for operating said differential mechanism, an indicator having a pivotally movable member for showing the angular position of said blade, and a flexible shaft connected to said differential mechanism and said movable member of the indicator for operating the latter.

35. A construction of the kind described comprising in combination, a propeller having angularly adjustable blades, means for adjusting said blades at will including a pair of rotatable elements arranged rearwardly of the propeller blades, a differential gear mechanism arranged rearwardly of said rotatable elements, an indicator arranged rearwardly of said differential mechanism and having a movable member for showing the angular position of the blades, two rigid shafts extending from said differential mechanism to said rotatable elements and operatively connected to each, and a flexible shaft extending from said differential mechanism to said movable member of the indicator.

36. The combination with a propeller having angularly adjustable blades, of means for adjusting the same at will comprising two gear wheels, means for retarding rotation of one of said gear wheels relative to the other at will, and means operated by the relative dislacement between said gear wheels for actuating said adjusting means and for limiting the extent of such adjustment in either direction.

37. The combination with a propeller having angularly adjustable blades, of a shaft on which said blades are mounted and a motor for driving said shaft, means for angularly adjusting said blades while said shaft is running, a device for controlling the supply of motive fluid to the motor, cam means operated by power derived from said shaft for positively moving said device in one direction to restrict the supply of motive fluid to the motor as the blades approach the position of zero pitch and for positively moving the same in the opposite direction as the blades move away from said position, said cam means being operated in timed relation with the angular adjustment of the blades.

38. The combination with a propeller having a blade rotatable about its own axis, of a shaft on which said blade is mounted and a motor for driving said shaft, means for rotating said blade about its axis while the propeller is moving, a device for controlling the supply of motive fluid to said motor, a rotatable cam having a single cam surface for operating said device in a direction to throttle the supply of motive fluid to the motor, and means for causing said cam to rotate at twice the speed of rotation of the blade about its axis, whereby throttling of the motive fluid will occur twice during each rotation of the blade.

39. The combination with a propeller having a blade rotatable about its own axis, of a shaft on which said blade is mounted and a motor for driving said shaft, means for rotating said blade about its axis while the propeller is running, a device for controlling the supply of motive fluid to said motor, a lever for operating said device, cam means operated by power from said shaft for positively moving said lever in a direction to cause said device to restrict the flow of motive fluid to the motor when the blade approaches the position of zero pitch, and for positively moving said lever in the opposite direction when the blade moves away from such position.

40. The combination with a propeller having angularly adjustable blades and a shaft on which said blades are mounted, of a motor for driving said shaft, means for angularly adjusting said blades, means for restricting the flow of motive fluid to said motor as the blades during adjustment approach the position of zero pitch, said last named means including a cam having a single throw or cam surface and mechanism for rotating said cam at a speed double the speed of angular adjustment of the blades.

41. The combination with a propeller having angularly adjustable blades and a shaft on which said blades are mounted, of a motor for driving said shaft, means for angularly adjusting said blades, a device for controlling the supply of motive fluid to said motor, a cam having a single throw or cam surface for moving said device in a direction to restrict the supply of motive fluid to the motor as the blades approach the position of zero pitch, a cam for moving said device in the opposite direction as the blades move away from said position, and mechanism for rotating said cams at a speed double the speed of angular adjustment of the blades, whereby throttling of the motive fluid will occur twice during adjustment of the blades through an angle of 360°.

42. The combination with a propeller having angularly adjustable blades, of a motor for driving said propeller, means for angularly adjusting said blades, a device for controlling the supply of motive fluid to said motor, a pivotally supported lever for moving said device in opposite directions, yieldable means for maintaining said lever in normal position, mechanism operated in timed relation with the angular adjustment of the blades for causing said yieldable

means to move said lever in a direction to restrict the supply of motive fluid to the motor as the blades approach the position of zero pitch and for moving the same in the opposite direction as the blades move away from said position.

43. The combination with a propeller having angularly adjustable blades, of a shaft on which said propeller is mounted, means operated by power derived from said shaft for angularly adjusting the blades while the propeller is running, and manually operated means for angularly adjusting said blades while the propeller is not running.

44. The combination with a propeller having angularly adjustable blades, of mechanism for adjusting the same at will said mechanism comprising two gear wheels normally rotating in the same direction with the propeller, means for retarding rotation of either of said gear wheels at will to cause relative movement between the same, means operated by the relative movement between said gear wheels for operating said adjusting mechanism, and differential mechanism also operated by the relative movement between said gear wheels for limiting the extent of adjustment of said blades.

45. The combination with a propeller having angularly adjustable blades, of a shaft on which said propeller is mounted, mechanism for adjusting said blades, said mechanism comprising two brake drums surrounding said shaft, a gear wheel connected to each of said brake drums, means cooperating with said brake drums for retarding rotation of either of said gears at will to cause relative rotation between the same, means operated by the relative rotation between said gears for operating said adjusting means, and differential mechanism also operated by the relative movement between said gear wheels for limiting the extent of angular adjustment of said blades.

46. The combination with a propeller having angularly adjustable blades, of means for angularly adjusting said blades at will, said means comprising two gear wheels normally rotating with the propeller, means for retarding rotation of either of said gear wheels at will to cause relative movement between the same, means operated by the angular movement of said gear wheels for adjusting said blades, and mechanism for automatically stopping angular adjustment of the blades after the same has reached a predetermined limit in either direction.

47. The combination with a propeller having angularly adjustable blades, of means for adjusting the same at will comprising two gear wheels normally rotating with the propeller, means for retarding rotation of either of said gear wheels relative to the other to produce relative movement between the same, manually controlled means for retarding rotation of either of said gear wheels, means operated by the relative movement between said gear wheels for adjusting said blades, and differential mechanism for rendering said manually controlled means inoperative when the adjustment of said blades reaches a predetermined limit in either direction.

48. The combination with a propeller having angularly adjustable blades, of means for adjusting the same at will comprising two gear wheels normally rotating with the propeller, means for retarding rotation of either of said gear wheels at will relative to the other to produce relative movement between the same, means operated by the relative movement between the gear wheels for adjusting said blades, a differential shaft, differential mechanism controlled by the relative movement between said gear wheels for operating said shaft, and means controlled by the operation of said shaft for limiting the extent of adjustment of said blades in either direction.

In testimony whereof I hereunto affix my signature.

SPENCER HEATH.