

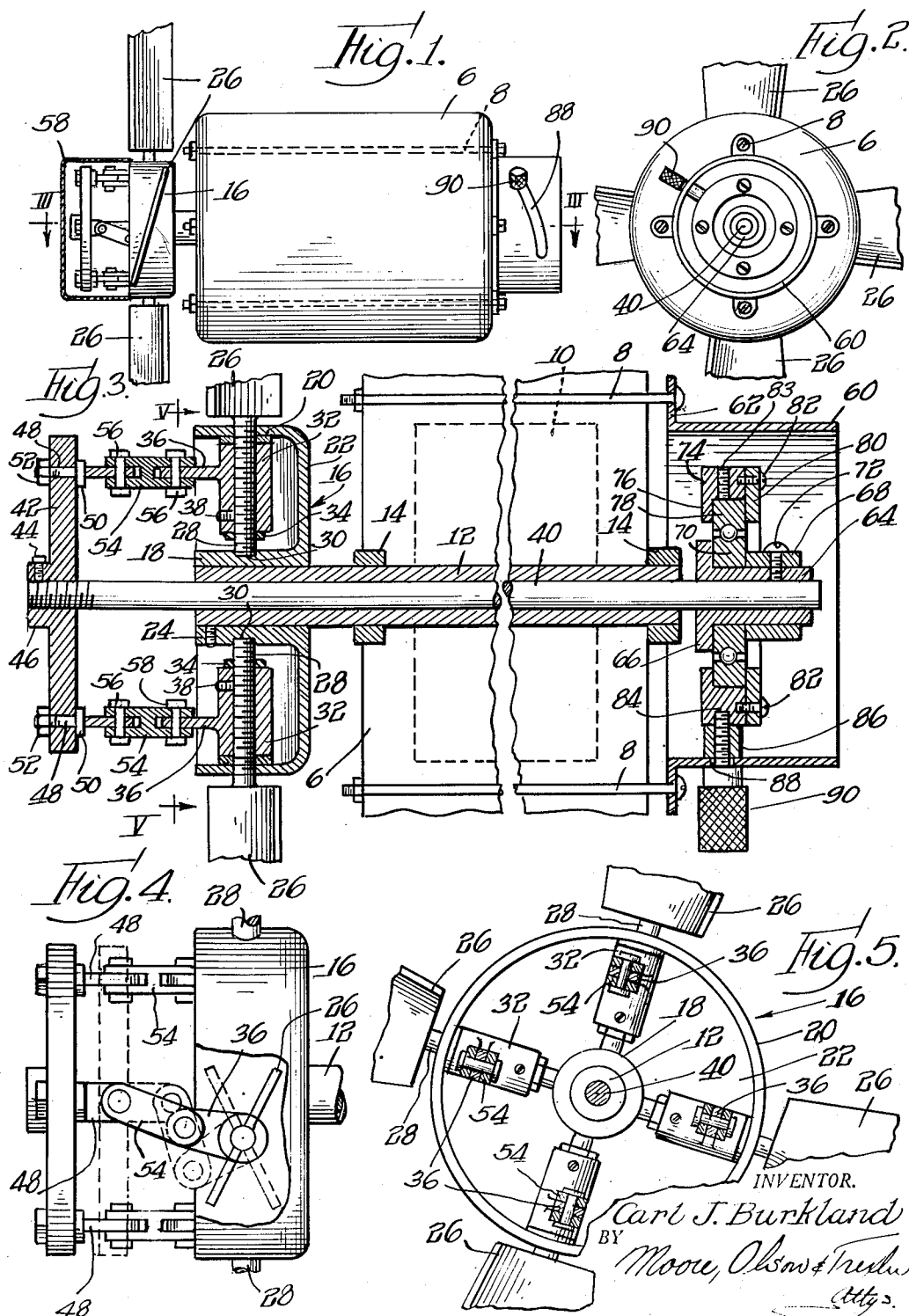
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ELECTRIC FAN

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## UNITED STATES PATENT OFFICE

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## ELECTRIC FAN

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This invention is concerned with an electric fan, and more particularly, with structure for reversing or otherwise varying the pitch of the fan blades.

Conventional electric fans are provided with fixed blades and are powered by constant speed motors. The air stream that is available from such fans is necessarily fixed in intensity and can be varied in direction only by reversing the position of the fan. Some more expensive fans in permanent installations are provided with reversible motors so that an air stream can be directed either forwardly or reversely of the fan. The available air stream cannot be varied in intensity and has only two possible directions.

An important object of this invention is the provision of an electric fan having blades of variable pitch whereby the intensity of the air stream delivered can be varied over a wide range.

Another object of this invention is the provision of an electric fan having blades of reversible pitch whereby an air stream can be directed either forwardly or reversely of the fan without reversing the direction of rotation of the fan motor and without reversing the orientation of the fan.

A further object of this invention is the provision of an electric fan wherein the pitch of the blades can be varied over a continuous range from an extreme forward to an extreme reverse position while the fan is operating.

Yet another object of this invention is the provision in an electric fan of a pair of concentrically mounted drive shafts shiftable longitudinally relative to one another and carrying blades, the pitch of which is varied by linkage actuated by relative longitudinal shifting of the concentric shafts.

A further object of this invention is the provision in an electric fan of a pair of concentrically mounted drive shafts shiftable longitudinally relative to one another to vary the pitch of the fan blades wherein one of the shafts is fixed longitudinally and the other shaft is shiftable longitudinally by means of a member secured thereto by a ball bearing structure to reduce friction and the member can be locked in any position to maintain the fan blades at any desired pitch.

Other and further objects and advantages of the present invention will be apparent from the following description, when taken in connection with the accompanying drawing, wherein:

Figure 1 is a partial side view of an electric fan embodying the principles of my invention;

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Figure 2 is a view taken from the right end of Figure 1;

Figure 3 is a longitudinal sectional view taken substantially along the line III—III of Figure 1;

Figure 4 is a side view showing the pitch actuating mechanism; and

Figure 5 is a cross-sectional view taken substantially along the line V—V of Figure 3.

An electric fan embodying the principles of my invention comprises the usual motor enclosed in a motor casing 6 and held together by elongated bolts 8 extending longitudinally through the casing. The armature 10 of the motor is mounted on a hollow drive shaft 12 journaled in anti-friction bearings 14 carried by the motor casing 6. The bearings 14 are preferably ball bearings and are adapted to prevent longitudinal movement of the shaft 12, while allowing substantially frictionless rotational movement.

A fan blade carrying member 16 comprising generally a pair of coaxial cylinders 18 and 20 spaced by an end wall 22 is secured to the forward end of hollow drive shaft 12 for rotation therewith by means such as one or more set screws 24. A plurality of fan blades 26 are carried by the member 16. Each blade is secured to or is formed integrally with a stub shaft 28 extending through an aperture in the outer cylinder 20 and having its inner end received in a shallow aperture 30. A cylinder 32 fits on the inner end of each stub shaft 28 abutting the inner surface of the outer cylinder 20 and secured thereon by a nut 34. An arm 36 extends transversely from each cylinder 32, and each cylinder 32 is prevented from rotating relative to the stub shaft on which it is mounted by means of a set screw 38.

An elongated shaft 40 is concentrically mounted within the hollow drive shaft 12 and extends both forwardly and reversely therefrom. A circular plate 42 is secured at the forward end of the shaft 40, by means such as a left hand thread and a set screw 44 threaded into an integral hub 46 of the plate 42. A plurality of pins 48 equal in number to the fan blades are symmetrically disposed about the periphery of the plate 42 and are angularly offset slightly from the fan blades. Each pin is provided with an integral collar 50 which, in cooperation with a nut 52, secures the pin in position in an aperture through the plate 42. Each pin 48 is connected to one of the arms 36 by means of a link 54. Each link 54 is bifurcated at the opposite ends to accommodate an arm 36 and one of the pins 48 and is pivotally connected to this arm and pin by means of a transverse screw, pin or rivet 56.

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A cup-shaped housing 58 is secured to the blade mounting member 16 and covers the plate 42, the structure linking the plate to the fan blades, and the end of the inner shaft 40. The housing 58 may be secured to the blade mounting member or structure 16 by screws, or by any other suitable means.

The rear end of the inner shaft 40 extends rearwardly from the motor casing 6 and a cylinder 60 is mounted concentrically and in spaced relation therewith. The cylinder 60 is secured to the motor housing by means of a peripheral flange 62 through which the elongated bolts 8 securing the motor together pass. A sleeve 64 having a peripheral flange 66 is mounted on the rear end of the shaft 40 within the cylinder 60. A collar 68 on the sleeve 64 clamps the inner race 70 of a ball bearing structure against the flange 66. A set screw 72 extends through the collar 68 and the sleeve 64 and bears against the shaft 40 to lock these members in proper relative positions. A key (not shown) may be provided to prevent relative rotation of the race 70 and the sleeve 64, although the clamping connection generally will be found sufficient.

A collar 74 having an inwardly directed arcuate flange is positioned over the outer race 78 of the ball bearing structure and is secured in position by a clamping ring 80 affixed to the collar 74 by a plurality of spaced screws 82. Relative rotation of the collar 74 and the outer race 78 is precluded by the clamping connection and by a set screw 83 threaded into the collar 74 and bearing against the race. A threaded rod 84 is threaded into a radial aperture in the collar 74 and also into a longitudinal aperture in the head of a cap screw 86. The shank of the cap screw extends through a substantially diagonally disposed slot 88 in the cylinder 60 with the underside of the head of this screw abutting the inner face of the cylinder. A control knob 90 which preferably has a knurled periphery is threaded on the shank of the cap screw 86, and when tightened, clamps the cylinder 60 between it and the head of the screw 86.

When the fan is operated, the hollow drive shaft 12 is rotated as is the blade mounting structure or member 16. The inner shaft 40 rotates with the outer shaft and a splined connection may be provided between these two shafts for this purpose, although this is unnecessary with small fans as the plate 42 and structure linking this plate to the fan blades will rotate the inner shaft readily. The cylinder 60 extending from the rear of the fan motor is stationary and the collar 74 and outer race 78 of the ball bearing structure is likewise stationary due to the clamping connection between the nut 90 and cap screw 86. If it is desired to change the pitch of the fan blades, it is only necessary to loosen the nut 90 and to revolve it about the shaft 40. The diagonal slot 88 forces the cap screw 86 toward or away from the motor casing 6, depending upon which direction the nut 90 is shifted about the shaft 40 and cylinder 60. The forward or rearward shifting of the cap screw 86 causes the shaft 40 to move longitudinally either forwardly or rearwardly relative to the hollow drive shaft 12. This, in turn, shifts the plate 42 forwardly or rearwardly. Assuming that the plate 42 is shifted rearwardly from the solid line position of Figure 4 to the dashed line position of Figure 4, it will be seen that the pivotal links 54 will act through the arms 36 to rotate the cylinders or sleeves 32 and thus shift the pitch of the blades 26. As shown in Figure 4, the plate

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42 is moved from its extreme forward to its extreme rearward position, thus completely reversing the pitch of the fan blades 26 as shown in solid and in dashed lines. The cap screw 86 can be positioned at any point intermediate the ends of the diagonal slot 88 to provide the blades with a steep or a shallow pitch for delivering an air stream of variable intensity either forwardly or rearwardly of the fan. Tightening of the nut 90 to clamp the cylinder 60 between the nut and the head of the cap screw 86 will lock the fan blades in position with any desirable pitch. The pitch of the fan blades may be altered while the fan is operating so that the blades may be adjusted to give any desirable air stream without the necessity of positioning the blades at any predetermined pitch.

Although a particular form of the invention has been shown and described, it is to be understood that this is for illustrative purposes and that my invention is to be limited only by the spirit and scope of the appended claims.

I claim:

1. An electric fan comprising a motor, a rotatable hollow drive shaft in said motor, a blade mounting member fixed to the forward end of said hollow drive shaft for rotation therewith, a plurality of fan blades extending radially of said hollow drive shaft from said blade mounting member and driven thereby, said fan blades being rotatable about their longitudinal axes, a second shaft concentrically mounted within said hollow drive shaft and extending forwardly thereof, said second shaft being rotatable with said hollow drive shaft and said shafts being freely shiftable axially of one another, an actuating member fixed on the forward end of said second shaft, a plurality of links between said actuating member and the inner ends of said fan blades for shifting the pitch of said blades in response to movement of said actuating member toward or from said blades, a positioning lever extending substantially radially from the rear end of said second shaft and rotatable relative thereto, and means defining a fixed guideway obliquely disposed relative to said second shaft and receiving said positioning lever to shift said second shaft forwardly or rearwardly of said hollow drive shaft as said positioning lever is rotated relative to said guideway.

2. An electric fan comprising a motor, a rotatable hollow drive shaft in said motor, a blade mounting member fixed on the forward end of said hollow drive shaft for rotation therewith, a plurality of blades extending radially of said hollow drive shaft and carried by said blade mounting member, said blades being rotatable about their longitudinal axes, a second shaft concentrically mounted within said hollow drive shaft and extending forwardly and rearwardly therefrom, said second shaft being rotatable with said hollow drive shaft and said shafts being freely shiftable axially of one another, an actuating member fixed on the forward end of said second shaft, a plurality of links interconnecting said actuating member and said blades for rotating said blades about their axes to determine the pitch of said blades, a fixed cylinder extending rearwardly from said motor concentric with said second shaft and spaced therefrom, said cylinder having a guideway obliquely disposed relative to said second shaft, and a position-determining lever extending substantially radially from said second shaft near the rear end thereof and fitting within said guide-

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way, said position-determining lever being rotatable relative to said second shaft but fixed against movement longitudinally of said shaft whereby rotation of said position-determining lever will shift said lever and second shaft longitudinally relative to said hollow drive shaft to shift the pitch of said blades.

3. An electric fan comprising a motor, a rotatable hollow drive shaft in said motor and extending forwardly therefrom, a blade mounting member secured on said hollow drive shaft forwardly of said motor and rotatable with said shaft, a plurality of blades extending radially of said hollow drive shaft and carried by said blade mounting member, a lever arm on each of said blades, a second shaft concentrically mounted within said hollow drive shaft and extending rearwardly and forwardly therefrom, said second shaft being rotatable with said hollow drive shaft and said shafts being freely shiftable axially of one another, an actuating member secured on the forward end of said second shaft, a plurality of pivotal links interconnecting said actuating member and the lever arms on said blades to pivot said blades about their longitudinal axes and thereby adjust their pitch upon movement of said actuating member toward and away from said blade mounting member, means defining a fixed guideway carried by the rear of said motor with said guideway obliquely disposed relative to said shafts, and a position-determining lever carried by the inner shaft and fitting within said guideway to shift said shafts longitudinally relative to one another to adjust the pitch of said blades upon relative rotation between said guideway-determining means and said position-determining lever.

4. An electric fan comprising a motor, a rotatable hollow drive shaft in said motor and extending forwardly therefrom, a blade mounting member secured on said hollow drive shaft adjacent the forward end thereof, a plurality of blades extending radially of said hollow drive shaft and carried by said blade mounting member, a lever arm on each of said blades, a second shaft concentrically mounted within said hollow drive shaft and extending forwardly and rearwardly therefrom, said second shaft being rotatable with said hollow drive shaft and said shafts being freely shiftable axially of one another, an actuating member fixed on the forward end of said second shaft, a plurality of pivotally mounted links interconnecting said actuating member and the lever arms on said blades to pivot said blades and adjust the pitch thereof, a fixed cylinder extending rearwardly from said motor and radially spaced from said second shaft, said cylinder having a fixed guideway obliquely disposed relative to said shaft, a position-determining lever on said second shaft fixed against movement longitudinally of said second shaft and rotatable relatively thereabout, said position-determining lever fitting within said guideway and shifting said second shaft forwardly and rearwardly of said first shaft to adjust the pitch of said blades upon rotation of said position-determining lever and means for locking said position-determining lever and said cylinder to prevent longitudinal movement of said second shaft.

5. An electric fan comprising a motor, a rotatable hollow drive shaft in said motor and extending forwardly therefrom, a blade mounting member on said hollow drive shaft including a pair of spaced concentric cylinders intercon-

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nected at one end by a transverse wall and open at the other end, the outer of said cylinders being provided with a plurality of arcuately spaced apertures and the inner of said cylinders being provided with a plurality of recesses aligned radially with said apertures, a plurality of fan blades, a rod extending longitudinally from the inner end of each of said fan blades, each of said rods traversing the space between said cylinders and being received in one of said apertures and one of said recesses, abutment of said rods in said recesses preventing inward movement of said rods, a locking member on each of said rods within the outer of said concentric cylinders preventing outward movement of said rods, a second shaft concentrically mounted within said hollow drive shaft and extending forwardly therefrom, an actuating member secured on the forward end of said second shaft forwardly of said blade mounting member, a plurality of links interconnecting said actuating member and said rods for rotating said rods to adjust the pitch of said fan blades upon movement of said actuating member toward or away from said rods, and means for shifting said second shaft and said hollow drive shaft longitudinally relative to one another.

6. An electric fan comprising a motor, a rotatable hollow drive shaft in said motor and extending forwardly therefrom, a blade mounting member on said hollow drive shaft including a pair of spaced concentric cylinders interconnected at one end by a transverse wall and open at the other end, the outer of said cylinders being provided with a plurality of arcuately spaced apertures and the inner of said cylinders being provided with a plurality of recesses aligned radially with said apertures, a plurality of fan blades greater than two, a rod extending longitudinally from the inner end of each of said fan blades, each of said rods traversing the space between said cylinders and being received in one of said apertures and one of said recesses, abutment of said rods in said recesses preventing inward movement of said rods, a locking member on each of said rods within the outer of said concentric cylinders preventing outward movement of said rods, a lever arm on each of said locking members, a second shaft concentrically mounted within said hollow drive shaft for rotation therewith and shiftable freely axially thereof and extending forwardly and rearwardly therefrom, an actuating member on said second shaft mounted forwardly of said mounting member, a plurality of links interconnecting said actuating member and said lever arms to rotate said rods upon movement of said actuating member toward or away from said rods to adjust the pitch of said fan blades, a substantially cup-shaped housing interfitted with the outer of said concentric cylinders and enclosing the forward end of said second shaft, said actuating member, said pivotal links, and said lever arms, means on the rear of said motor defining a fixed guideway obliquely disposed relative to said shafts, and a position-determining lever mounted on said second shaft and fixed against movement longitudinally of said second shaft, said position-determining lever fitting within said guideway and shifting said second shaft upon rotation thereof relative to said guideway-defining means.

7. An electric fan comprising a motor, a rotatable hollow drive shaft in said motor and extending forwardly therefrom, a blade mounting member on said hollow drive shaft including a

pair of spaced concentric cylinders interconnected at one end by a transverse wall and open at the other end, the outer of said cylinders being provided with a plurality of arcuately spaced apertures and the inner of said cylinders being provided with a plurality of recesses aligned radially with said apertures, a plurality of fan blades greater than two, a rod extending longitudinally from the inner end of each of said fan blades, each of said rods traversing the space between said cylinders and being received in one of said apertures and one of said recesses, abutment of said rods in said recesses preventing inward movement of said rods, a locking member on each of said rods within the outer of said concentric cylinders preventing outward movement of said rods, a lever arm on each of said locking members, a second shaft concentrically mounted within said hollow drive shaft for rotation therewith and shiftable freely axially thereof and extending forwardly and rearwardly therefrom, an actuating member on said second shaft mounted forwardly of said mounting member, a plurality of links interconnecting said actuating member and said lever arms to rotate said rods upon movement of said actuating member toward or away from said rods to adjust the pitch of said fan blades, a substantially cup-shaped housing interfitting with the outer of said concentric cylinders and enclosing the forward end of said sec-

ond shaft, said actuating member, said pivotal links, and said lever arms, a cylinder fixed on the rear of said motor concentric about said second shaft and spaced from said second shaft, said cylinder having a guideway obliquely disposed relative to said second shaft, a position-determining member on said second shaft adjacent the rear end thereof, said position-determining member being fixed against movement longitudinally of said second shaft and rotatable relative thereto, said position-determining member fitting within said guideway and shifting said second shaft forwardly and rearwardly of said hollow drive shaft upon rotation of said position-determining member about said second shaft, and radially shiftable means for locking said position-determining member in said guideway to maintain constant the pitch of said fan blades.

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