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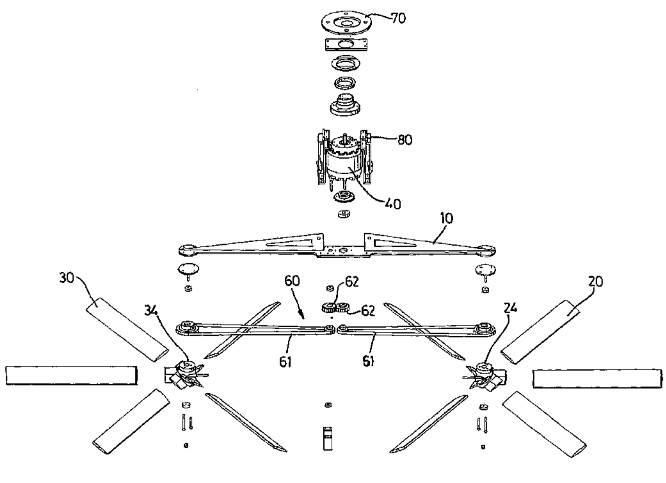
(54) Title: A FAN



(57) Abstract: The invention provides a fan having a beam (10), a first set of blades (20) mounted about a first axis (22) towards a first end of the beam, a second set of blades (30) mounted about a second axis (32) towards a second end of the beam (10), and at least one drive (40) for powering the first and second sets of blades (20, 30) in order to rotate the first and second sets of blades (20, 30) about the first and second axes (22, 32) respectively; wherein the beam is caused to rotate about a third axis (12). Because of the rotation of the beam in addition to that of the sets of blades, such a fan generates air flow over the area of a circle with a diameter equal to the maximum distance between blade tips of the first and second sets of blades. Such an area is significantly larger than that of the two sets of blades alone and is advantageous because air flow can be generated and consequently felt over a larger area.

WO 2006/131735 A1

A FAN

The present invention relates to fans and in particular to ceiling fans.

A number of ceiling fans are known. A standard ceiling fan comprises a single set of blades mounted about a first axis and a drive also mounted about the first axis for powering the single set of blades.

The present invention provides a fan comprising: a beam; a first set of blades mounted about a first axis towards a first end of the beam; a second set of blades mounted about a second axis towards a second end of the beam; and at least one drive for powering the first and second sets of blades in order to rotate the first and second sets of blades about the first and second axes respectively; wherein the beam is caused to rotate about a third axis. Because of the rotation of the beam in addition to that of the sets of blades, such a fan generates air flow over the area of a circle with a diameter equal to the maximum distance between blade tips of the first and second sets of blades. Such an area is significantly larger than that of the two sets of blades alone and is advantageous because air flow can be generated and consequently felt over a larger area.

Preferably the fan includes two sets of blades. However, more than two sets of blades could be provided. For example, two beams arranged perpendicular to one another could be provided and two sets of blades could be provided on each beam giving a total of four sets of blades.

Each set of blades may be provided with a drive positioned close to the respective first and second axes. Alternatively a single drive may be mounted on the beam close to the third axis and the fan may further be provided with a transmission for transmitting power from the drive to the first and second sets of blades in order to rotate the first and second sets of blades about the first and second axes respectively. A design including a single drive is advantageous because the overall weight of the fan is reduced. This is particularly beneficial for a ceiling fan which, by its nature, must be suspended from a ceiling. The overall weight of the fan may also be reduced by manufacturing at least parts of the fan, for example the beam, from a material having a low density such as aluminium. Furthermore, a fan including a single drive generates air flow over a larger area because the portion of each blade close to the hub is not obscured by a drive. Therefore, air is pulled through the fan along the entire length of each blade.

The transmission may comprise a pair of belts.

The transmission may include at least one gear.

The transmission may be arranged such that the first set of blades is rotatable in a first direction and the second set of blades is rotatable in a second direction opposite to the first direction. Such counter-rotation of the first and second set of blades has been found to be advantageous in controlling the speed of rotation of the beam.

The beam may be freely rotatable about the third axis. The beam may be caused to rotate about the third axis by friction such that it is not directly driven by the drive. The friction may occur between a single drive and the transmission.

The beam may be caused to rotate about the third axis through the combined torque reaction resulting from components of friction and load associated with the drive, transmission and blade sets.

The ratio of the angular velocity of the drive to the angular velocity of each set of blades may range from 1:1 to 10:1. Preferably the said ratio is 6:1. For example, the angular velocity of the drive may be 3000 rpm and the angular velocity of each set of blades may be 500 rpm. The ratio defines the rotation speed of the beam. In particular a ratio of 7:1 leads to a slower beam rotation speed than a ratio of 6:1. The ratio of the angular velocity of the drive to the angular velocity of each set of blades may be selected to determine the angular velocity of the beam.

Alternatively, the beam may be caused to rotate by pivoting the first axis so that the first axis is not parallel to the second axis such that a thrust is created which causes the beam to rotate.

Alternatively, the beam may be caused to rotate by mounting each set of blades on its own central hub so that each blade is mounted at an angle relative to a circumference of the central hub, and arranging the blades so that the angle of the blades of the first set of blades is not the same as the angle of the blades of the second set of blades.

Alternatively, the beam may be caused to rotate by rotating the first and second set of blades at different angular velocities.

When each set of blades is driven by a separate motor, the different angular velocities of the sets of blades could be achieved by driving the first set of blades at a higher velocity than the second set of blades. Alternatively, a dynamo could be introduced into the hub of the second set of blades. The dynamo would act as a brake and slow the velocity of rotation of the second set of blades.

Alternatively, the beam may be caused to rotate by providing each set of blades with blades having different sectional profiles.

Alternatively, the beam may be caused to rotate by positioning the first and second sets of blades so that the distance between the first axis and the third axis is more than the distance between the second axis and the third axis.

Alternatively, the beam may be caused to rotate by having more blades in the first set of blades than in the second set of blades. For example, the beam may be caused to rotate by having six blades in the first set of blades and five blades in the second set of blades.

Alternatively, the beam may be caused to rotate by having all of the blades of the first set of blades of a first length and all of the blades of the second set of blades of a second length which is shorter than the first length.

Alternatively, the beam may be caused to rotate by providing an air deflector close to at least one of the sets of blades so that the direction or course of air entering the set of blades is changed. The air deflector may comprise a vane mounted on the beam close to the at least one set of blades to be affected.

In a first embodiment the present invention provides a fan comprising: a drive; a beam; a first set of blades mounted about a first axis towards a first end of the beam; a second set of blades mounted about a second axis towards a second end of the beam; and a transmission for transmitting power from the drive to the first and second sets of blades in order to rotate the first and second sets of blades about the first and second axes respectively; wherein the beam is freely rotatable about a third axis and is caused to rotate about the third axis without being directly driven by the drive. The beam may be caused to rotate about the third axis by friction which may occur between the drive and the transmission. Alternatively the beam may be caused to rotate about the third axis through the combined torque reaction resulting from components of friction and load associated with the drive, transmission and blade sets.

For all embodiments of the present invention, at least one of the blades may be provided with at least one light source.

The at least one light source may comprise a light emitting diode (LED).

The at least one light source may be controllable such that rotation of the blades causes an image to be displayed. By controlling the state of the at least one light source, moving images could be displayed.

The at least one light source may be powered by an electrical energy generator mounted close to the first or second axis.

In addition, or alternatively, an electrical energy generator may be mounted close to the first or second axis to provide a source of power for any other electrical component.

The electrical energy generator could also act as a brake as described above to reduce the rotational velocity of the second set of blades.

By providing an energy generator close to the first or second axis, it is not necessary to transfer electricity through the drive and the beam to reach the fan blades.

Such an electrical energy generator may be an AC generator comprising a coil and a permanent magnet. In such a case, each set of blades may be mounted on a central hub, a permanent magnet may be mounted on the beam, and a coil may be mounted on a set of blades or the central hub. Alternatively, each set of blades may be mounted on a central hub, a permanent magnet may be mounted on a set of blades or the central hub, and a coil may be mounted on the beam.

Alternatively, the light sources could be provided with energy transferred from wiring on the beam to wiring on the blades via slip rings mounted within the hub of each set of blades.

Alternatively, an AC generator could be introduced close to the third axis so that rotation of the beam relative to the ceiling or rotation of the drive relative to its housing generates electrical energy which could be used to power the drive(s) for the sets of blades or power an electrical light source.

Except in the case where the beam is caused to rotate by positioning the first and second sets of blades so that the distance between the first axis and the third axis is more than the distance between the second axis and the third axis, the distance between the first axis and the third axis may be the same as the distance between the second axis and the third axis.

Except in the case where the beam is caused to rotate by pivoting the first axis so that it is not parallel to the second axis, the first axis may be parallel to the second axis.

Each set of blades may be mounted on a central hub having an axis and each blade may be mounted at an angle relative to a circumference of the central hub. In such a case, each blade may make an angle of, for example, 30 degrees relative to the circumference of the central hub. The angle may be the same along the length of each blade. Alternatively, the angle may change along the length of each blade.

The shape of the blades may be chosen to provide optimum air flow generation. For example, turbine or aerofoil shaped blades could be used. Any number of blades could be provided in each set of blades.

The present invention also provides a method of rotating a beam having a first set of blades mounted about a first axis towards a first end of the beam and a second set of blades mounted about a second axis towards a second end of the beam; comprising: providing a drive; providing a transmission for transmitting power from the drive to the first and second sets of blades in order to rotate the first and second sets of blades about the first and second axes respectively; wherein the beam rotates without being directly driven by the drive.

Figure 1 shows a perspective view of a fan according to a first embodiment of the present invention.

Figure 2 shows an exploded view of the fan of figure 1.

Figure 3 shows a side view of the fan of figure 1.

Figure 4 shows a view along the direction of arrow A in figure 3.

Figure 5 shows a partial cut away side view of the fan of figure 1.

Figure 6 shows a side view of a fan according to a second embodiment of the present invention.

Figure 7 shows a plan view of the fan of figure 6.

Figure 8 shows a perspective view of a fan according to a third embodiment of the present invention.

Figure 9 shows a plan view of the fan of figure 8.

A fan according to a first embodiment of the present invention is shown in figures 1 to 5. The fan includes a beam 10; a first set of blades 20 mounted about a first axis 22 towards a first end of the beam 10; a second set of blades 30 mounted about a second axis 32 towards a second end of the beam 10; and at least one drive 40 for powering the first and second sets of blades 20, 30 in order to rotate the first and second sets of blades 20, 30 about the first and second axes 22, 32 respectively; wherein the beam 10 is caused to rotate about a third axis 12.

The single drive 40 is mounted on the beam 10 close to the third axis 12 and the fan is further provided with a transmission 60 for transmitting power from the drive 40 to the first and second sets of blades 20, 30 in order to rotate the first and second sets of blades 20, 30 about the first and second axes 22, 32 respectively.

The transmission comprises a pair of belts 61 and a pair of gears 62 which act to transmit power from the drive 40 to the first and second sets of blades 20, 30. The belts 61 and gears 62 are arranged so that the first set of blades 20 is rotatable in a first direction and the second set of blades 30 is rotatable in a second direction opposite to the first direction.

The beam 10 is caused to rotate about the third axis 12 by a combined torque reaction resulting from components of friction and load associated with the drive, transmission and blade sets. Therefore, the beam 10 rotates without being directly driven by the drive 40.

The ratio of the angular velocity of the drive 40 to the angular velocity of each set of blades 20, 30 can be altered by selecting an appropriate pair of gears 62. The ratio may range from 1:1 to 10:1 and is preferably chosen to be 6:1 such that when a drive with an angular velocity of 3000 rpm is used, the angular velocity of each set of blades is 500 rpm.

The first and second sets of blades 20, 30 are arranged so that the distance between the first axis 22 and the third axis 12 is the same as the distance between the second axis 32 and the third axis 12. In addition, the first axis 22 and the second axis 32 are arranged to be parallel to one another.

Each set of blades 20, 30 is mounted on a central hub 24, 34 having an axis 22, 32 and each blade is mounted at an angle α relative to a circumference of the central hub 24, 34. The angle α is the same along the length of each blade.

Each blade has an aerofoil cross-section and each set of blades includes six identical blades.

The fan is mountable to a ceiling via support 70. Support 70 is directly connected to a housing of drive 40. The beam 10 is connected to mounting 80 which is supported between the housing of drive 40 and support 70 in such a manner that the beam 10 and mounting 80 are free to rotate about the third axis 12.

A fan according to a second embodiment of the present invention is shown in figures 6 and 7. The fan includes a beam 10; a first set of blades 20 mounted about a first axis 22 towards a first end of the beam 10; a second set of blades 30 mounted about a second axis 32 towards a second end of the beam 10; a first drive 42 for powering the first set of blades 20 and a second drive 43 for powering the second set of blades 30 in order to rotate the first and second sets of blades 20, 30 about the first and second axes 22, 32 respectively. The second axis 32 is tilted relative to the first axis 22 and the beam 10 is caused to rotate about a third axis 12 by the thrust created by the second set of blades 30.

The first and second sets of blades 20, 30 are arranged so that the distance between the first axis 22 and the third axis 12 is the same as the distance between the second axis 32 and the third axis 12.

Each set of blades 20, 30 is mounted on a central hub 24, 34 having an axis 22, 32 and each blade is mounted at an angle α relative to a circumference of the central hub 24, 34.

Each blade has an aerofoil cross-section and each set of blades includes six identical blades. The cross-section of each blade changes along the length of the blade as can best be seen from figure 7.

The fan is mountable to a ceiling via support 70. The beam 10 is connected to mounting 80 which is supported on the support 70 in such a manner that the beam 10 and mounting 80 are free to rotate about the third axis 12.

A fan according to a third embodiment of the present invention is shown in figures 8 and 9. The fan includes a beam 10; a first set of blades 20 mounted about a first axis 22 towards a first end of the beam 10; a second set of blades 30 mounted about a second axis 32 towards a second end of the beam 10; a first drive 42 for powering the first set of blades 20 and a second drive 43 for powering the second set of blades 30 in order to rotate the first and second sets of blades 20, 30 about the first and second axes 22, 32 respectively. The second axis 32 parallel to the first axis 22.

The first and second sets of blades 20, 30 are arranged so that the distance between the first axis 22 and the third axis 12 is the same as the distance between the second axis 32 and the third axis 12.

Each set of blades 20, 30 is mounted on a central hub 24, 34 having an axis 22, 32 and each blade of the first set of blades 20 is mounted at an angle α relative to a circumference of the central hub 24. The beam 10 is caused to rotate about a third axis 12 by mounting each blade of the second set of blades 30 at an angle β relative to a circumference of the central hub 34, where the angle β is not equal to the angle α.

Alternatively, angle α is chosen to be equal to angle β and the beam 10 is caused to rotate about the third axis 12 by rotating the first set of blades 20 with a higher angular velocity than the second set of blades 30.

Each blade has an aerofoil cross-section and each set of blades includes six identical blades. The cross-section of each blade changes along the length of the blade as can best be seen from figure 9.

The fan is mountable to a ceiling via support 70. The beam 10 is connected to mounting 80 which is supported on the support 70 in such a manner that the beam 10 and mounting 80 are free to rotate about the third axis 12.

It will of course be understood that the present invention has been described above purely by way of example, and that modifications of detail can be made within the scope of the invention.

CLAIMS

1. A fan comprising:

a drive;

a beam;

a first set of blades mounted about a first axis towards a first end of the beam;

a second set of blades mounted about a second axis towards a second end of the beam; and

a transmission for transmitting power from the drive to the first and second sets of blades in order to rotate the first and second sets of blades about the first and second axes respectively;

wherein the beam is caused to rotate by friction and is not directly driven by the drive.

2. A fan according to claim 1, wherein the friction occurs between the drive and the transmission.

3. A fan according to claim 1, wherein the transmission comprises a pair of belts.

4. A fan according to any preceding claim, wherein the transmission includes at least one gear.

5. A fan according to any preceding claim, wherein the transmission is arranged such that the first set of blades is rotatable in a first direction and the second set of blades is rotatable in a second direction opposite to the first direction.

6. A fan according to any preceding claim, wherein the ratio of the angular velocity of the drive to the angular velocity of each set of blades is from 1:1 to 10:1.

7. A fan according to claim 6, wherein the said ratio is 7:1.

8. A fan according to any preceding claim, wherein at least one of the blades is provided with at least one light source.

9. A fan according to claim 8 wherein the at least one light source is controllable such that rotation of the blades causes an image to be displayed.

10. A fan according to claim 8 or claim 9 wherein the at least one light source is powered by an electrical energy generator mounted close to the first or second axis.

11. A fan according to any of claims 1 to 7 wherein an electrical energy generator is mounted close to the first or second axis.

12. A fan according to claim 10 or claim 11 wherein the electrical energy generator is an AC generator comprising a coil and a permanent magnet.

13. A fan according to claim 12 wherein each set of blades is mounted on a central hub, the permanent magnet is mounted on the beam, and the coil is mounted on a set of blades or the central hub.

14. A fan according to claim 12 wherein each set of blades is mounted on a central hub, the permanent magnet is mounted on a set of blades or the central hub, and the coil is mounted on the beam.

15. A fan according to any preceding claim wherein the distance between the first axis and the drive is the same as the distance between the second axis and the drive.

16. A fan according to any preceding claim wherein the first axis is parallel to the second axis.

17. A fan according to any preceding claim wherein each set of blades is mounted on a central hub having an axis and each blade is mounted at an angle relative to a circumference of the central hub.

18. A fan according to claim 17 wherein each blade makes an angle of 30 degrees relative to the circumference of the central hub.

19. A method of rotating a beam having a first set of blades mounted about a first axis towards a first end of the beam and a second set of blades mounted about a second axis towards a second end of the beam; comprising:

providing a drive;

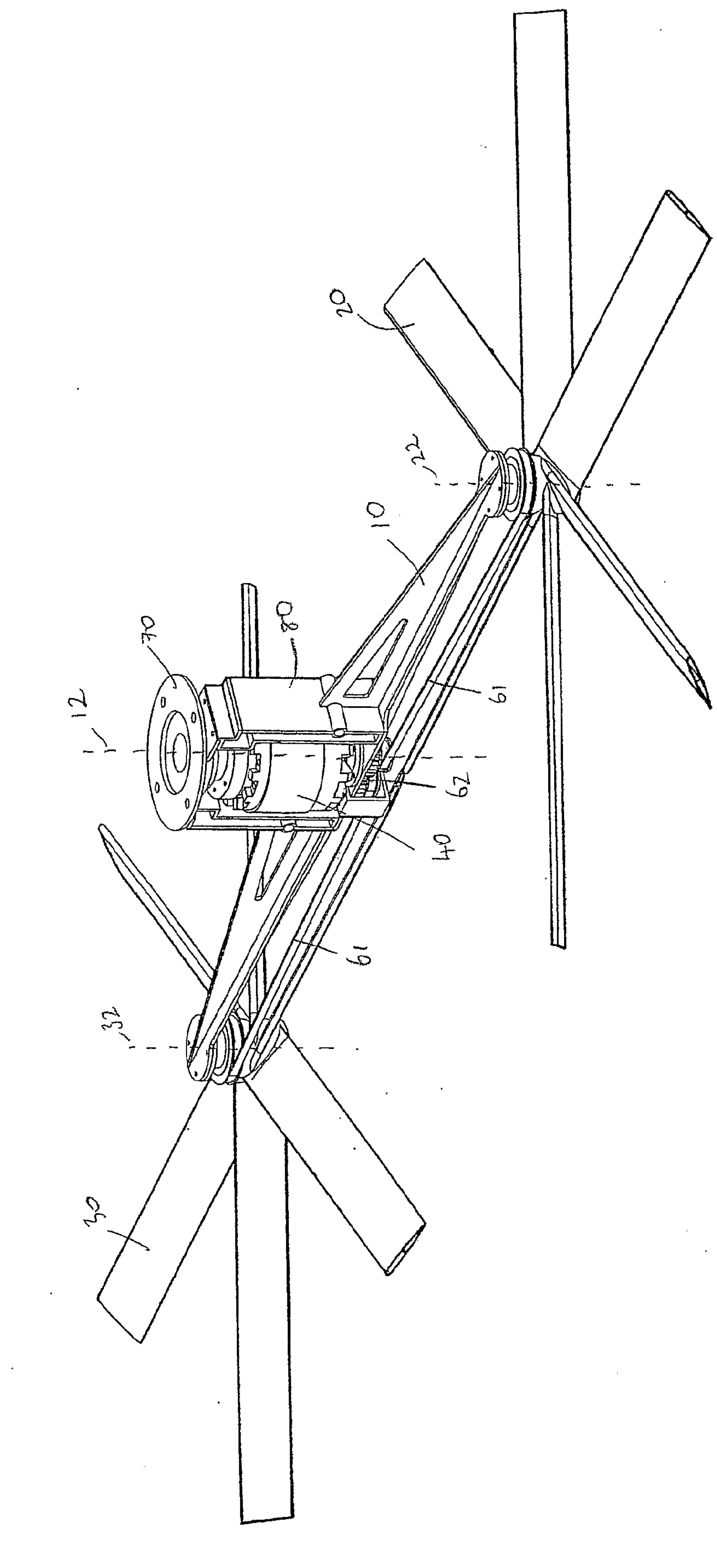
providing a transmission for transmitting power from the drive to the first and second sets of blades in order to rotate the first and second sets of blades about the first and second axes respectively; and

wherein the beam rotates without being directly driven by the drive.

20. A method according to claim 19 wherein friction occurs between the drive and the transmission to cause rotation of the beam.

21. A fan substantially as hereinbefore described with reference to and as shown in the attached drawings.

FIG. 1



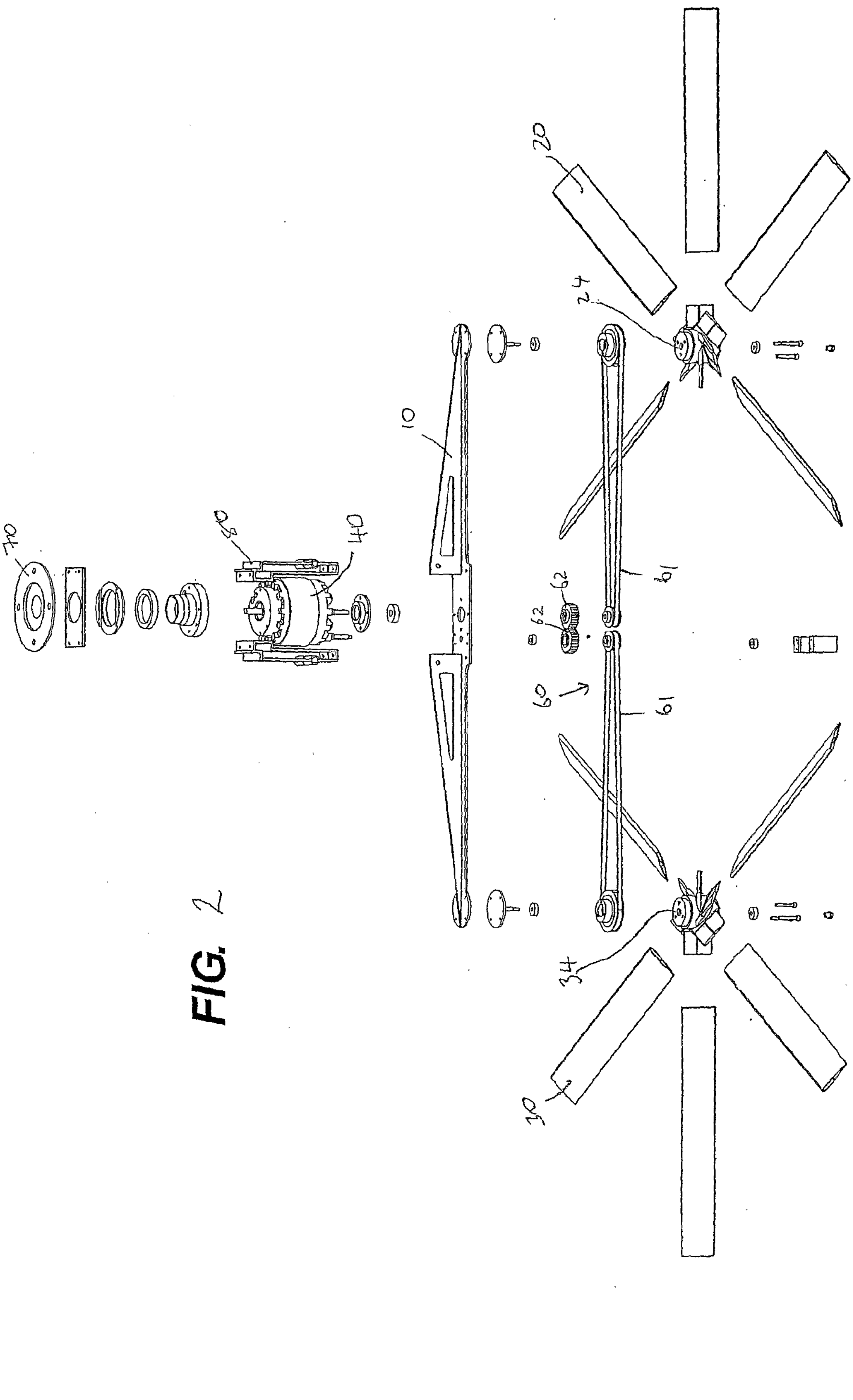


FIG. 2

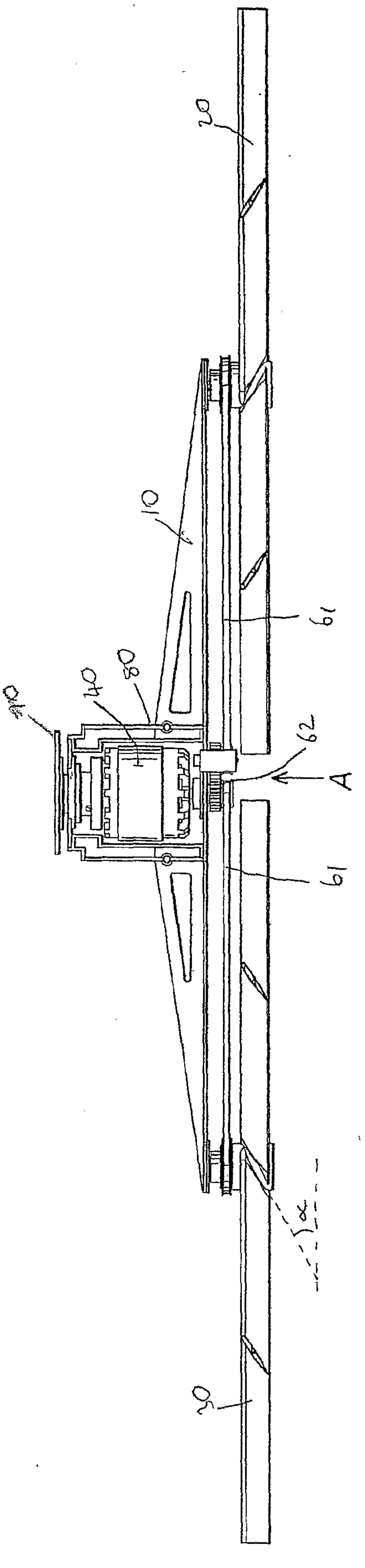


FIG. 3

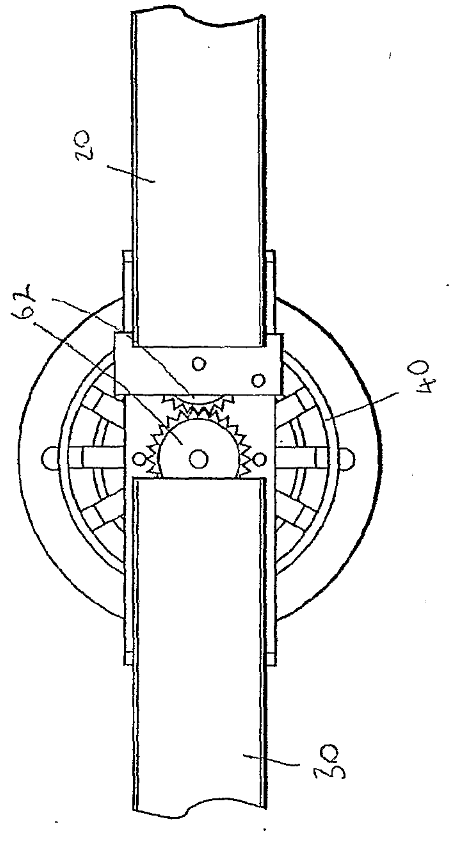
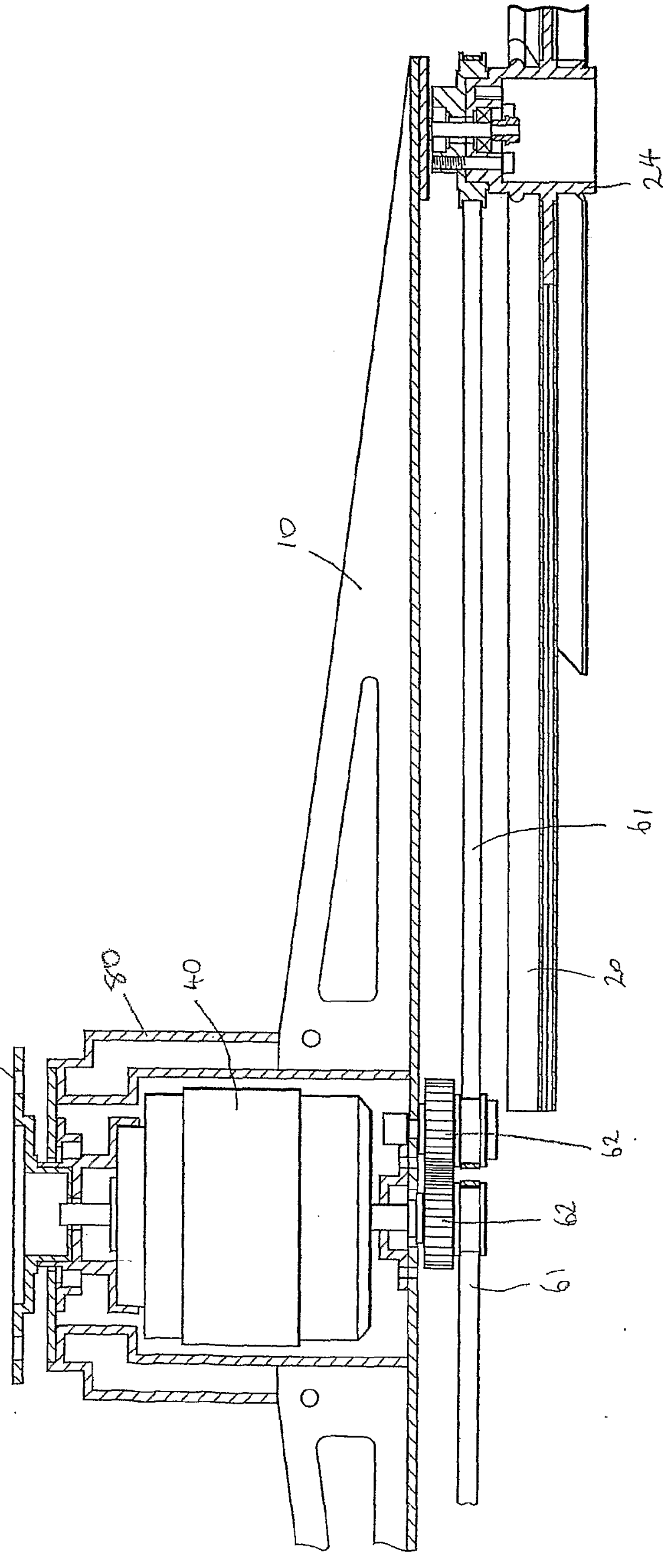


FIG. 4

FIG. 5



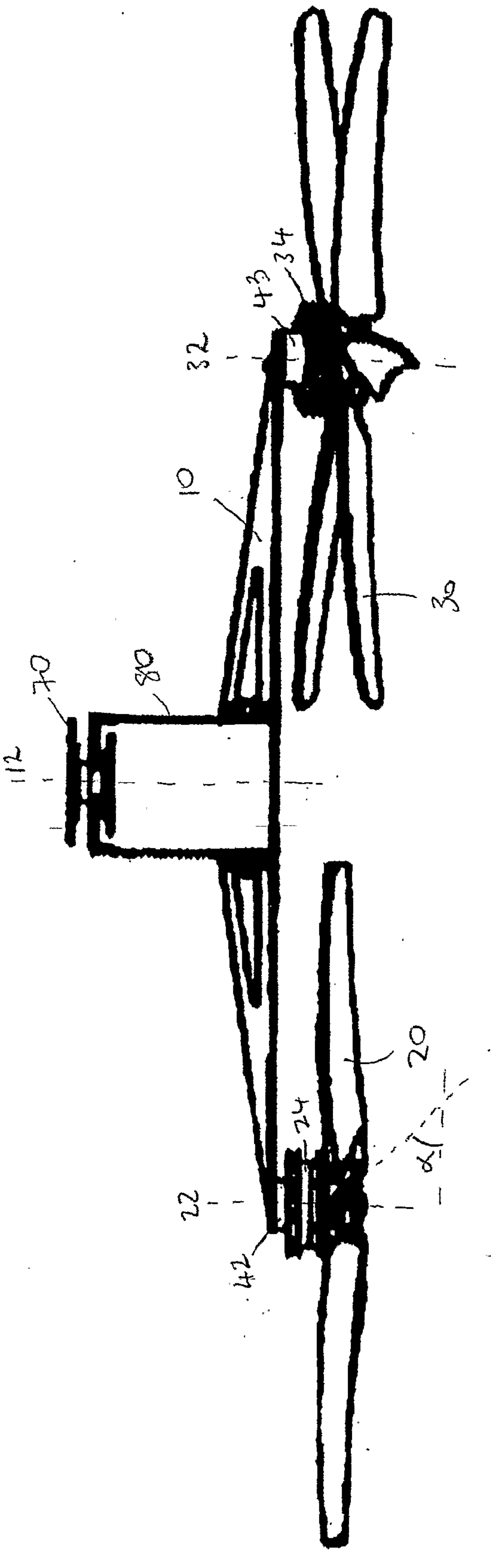


FIG. 6

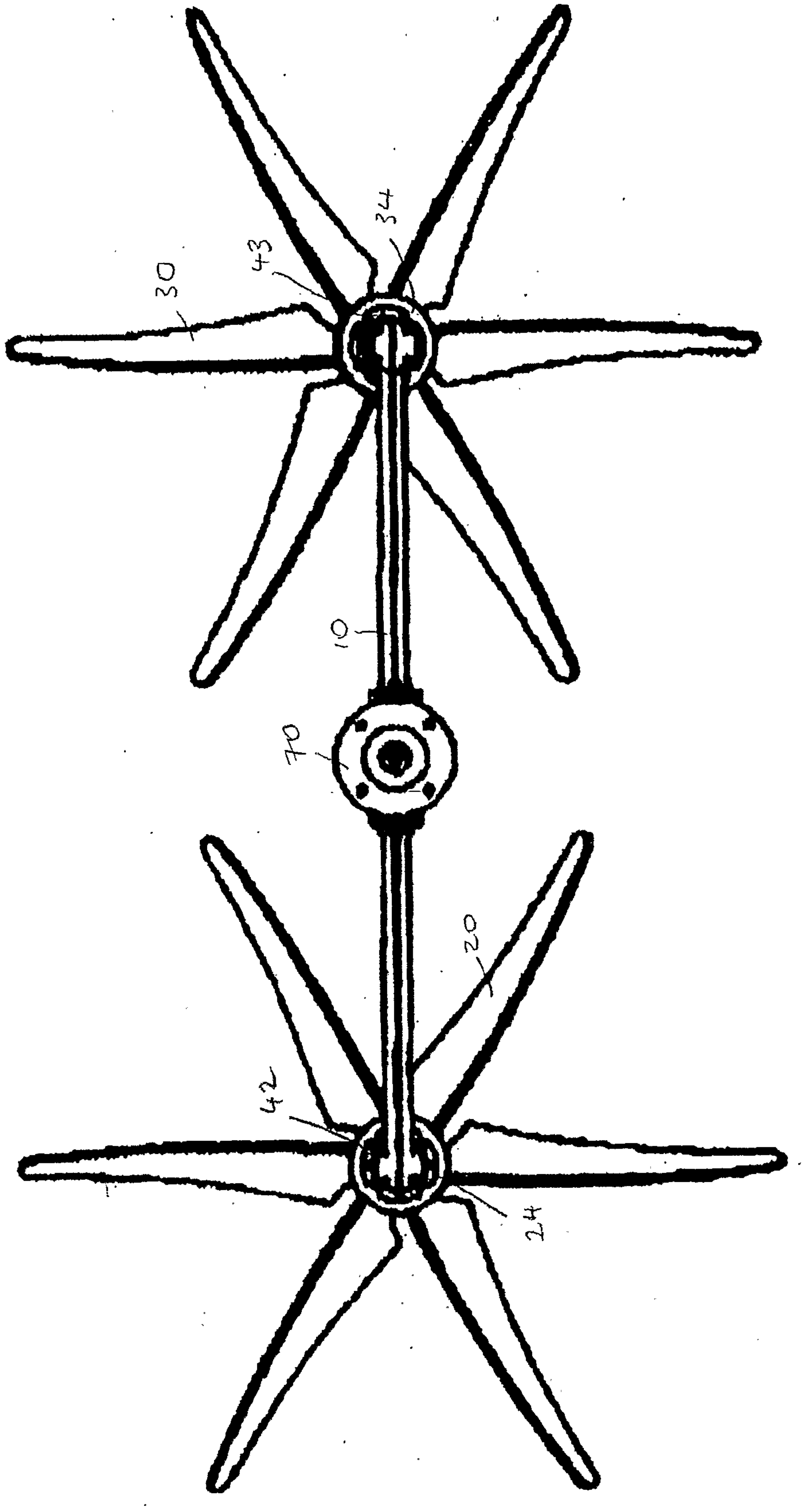


FIG. 7

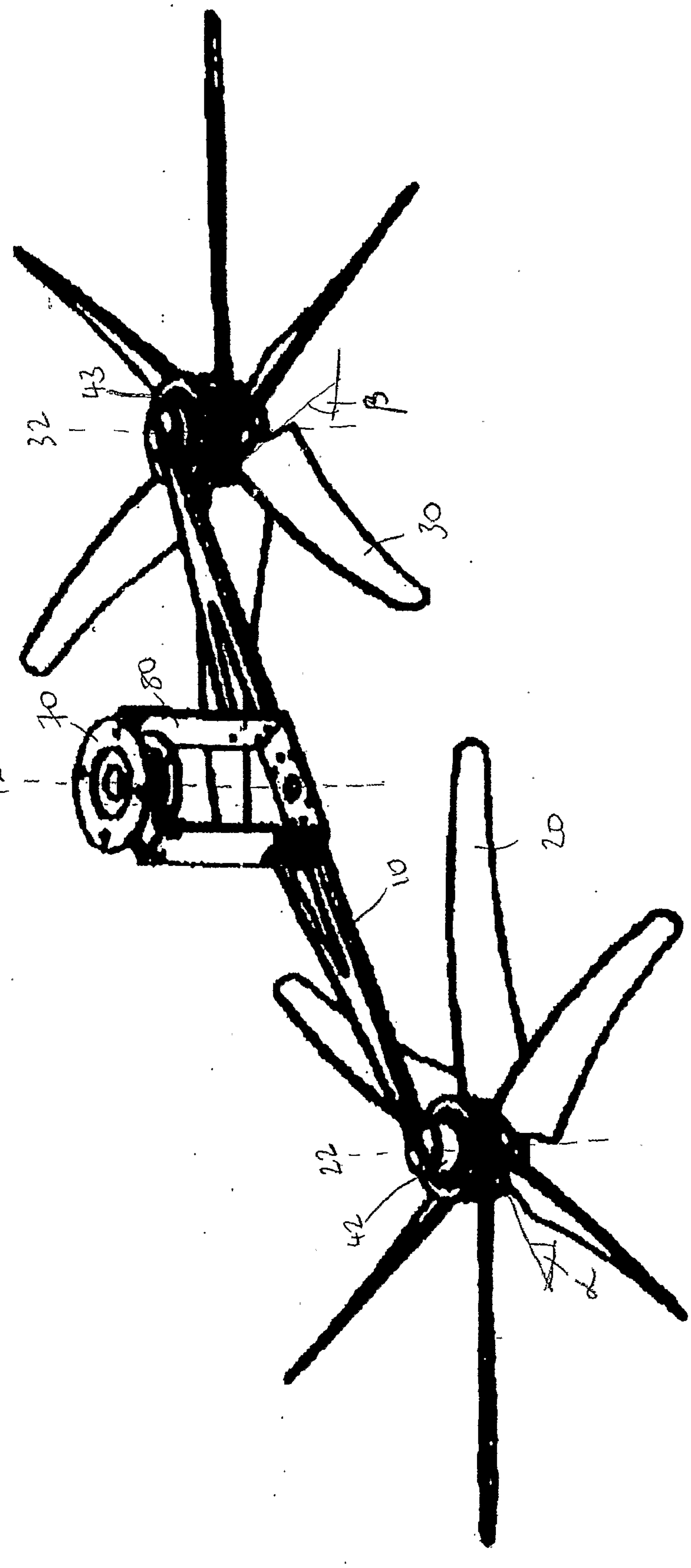


FIG. 8

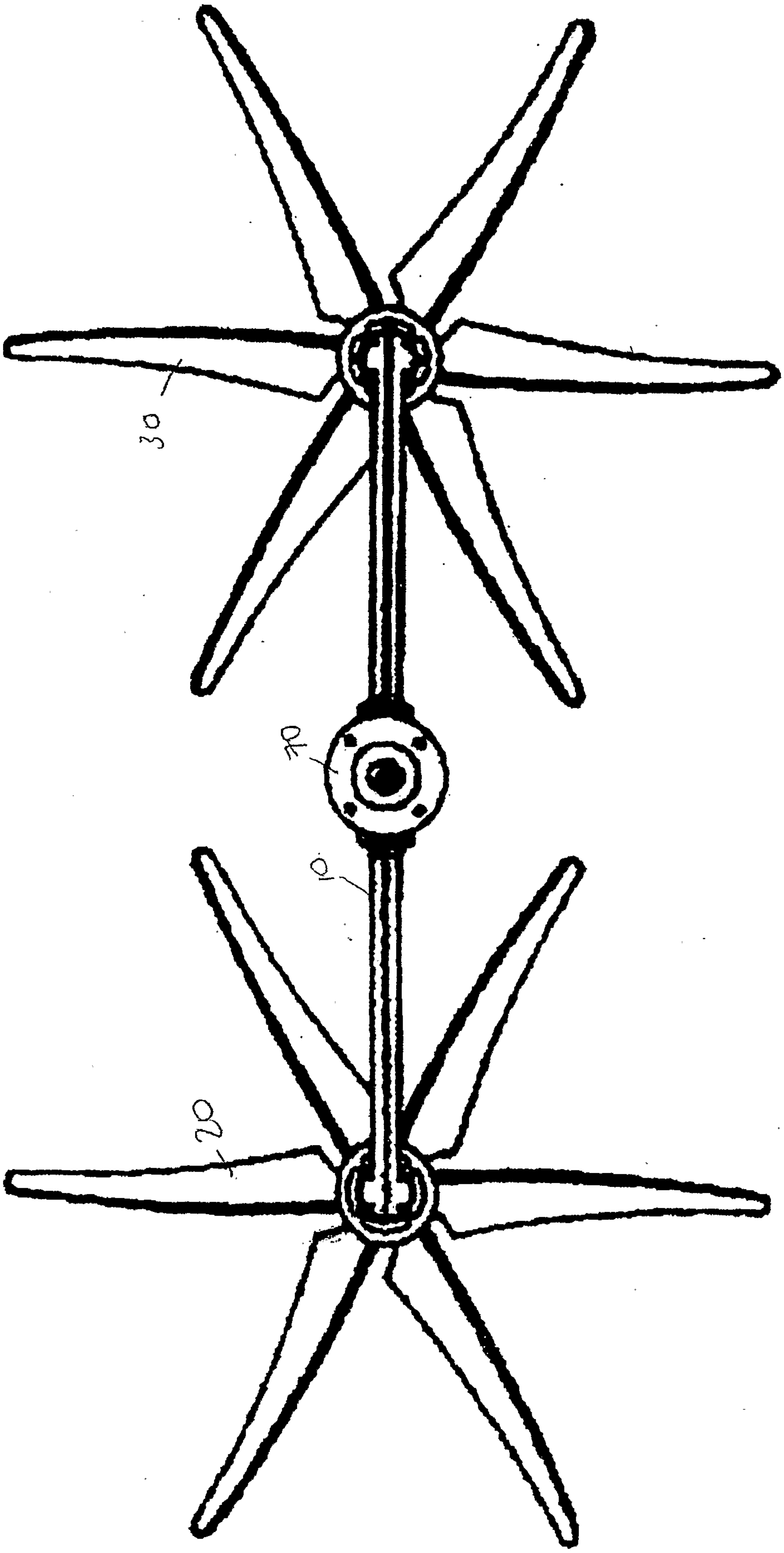


FIG. 9

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2006/002088

A. CLASSIFICATION OF SUBJECT MATTER
INV. F04B17/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F04D F04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 455 660 A (COOPER H) 7 July 1891 (1891-07-07) page 1, line 70 - page 2, line 78; figures 1,2,6,9	1-20
A	US 6 364 638 B1 (LIU CHING WEN) 2 April 2002 (2002-04-02) the whole document	1-20
A	US 2004/191065 A1 (CHEN CHIA-TEH) 30 September 2004 (2004-09-30) the whole document	1-20
A	US 2005/100463 A1 (GAJEWSKI MARK ET AL) 12 May 2005 (2005-05-12) the whole document	1-20

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
9 August 2006	17/08/2006

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Avramidis, P

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/GB2006/002088

Patent document cited in search report		Publication date	Patent family member(s)			Publication date
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