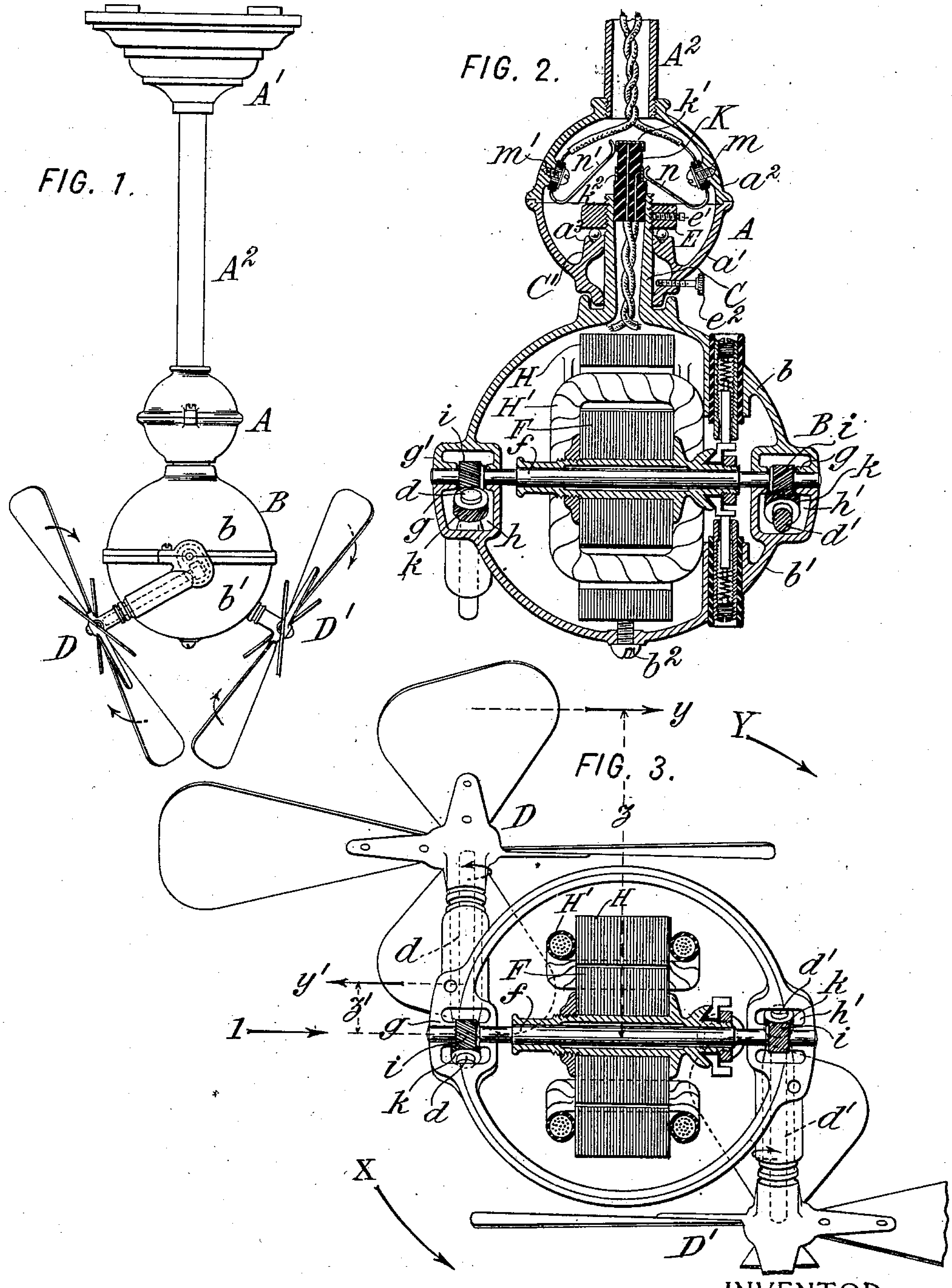
No. 697,588. Patented Apr. 15, 1902.

J. J. WOOD.

ELECTRIC FAN.

(Application filed Aug. 17, 1900.)

(No Model.) 2 Sheets—Sheet 1.



WITNESSES:
Domingo A. Usina
Thomas S. Wallace

INVENTOR:
James J. Wood
By Attorneys,
Arthur C. Fraser & Co.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 697,588. Patented Apr. 15, 1902.

J. J. WOOD.

ELECTRIC FAN.

(Application filed Aug. 17, 1900.)

(No Model.) 2 Sheets—Sheet 2.

FIG. 5.

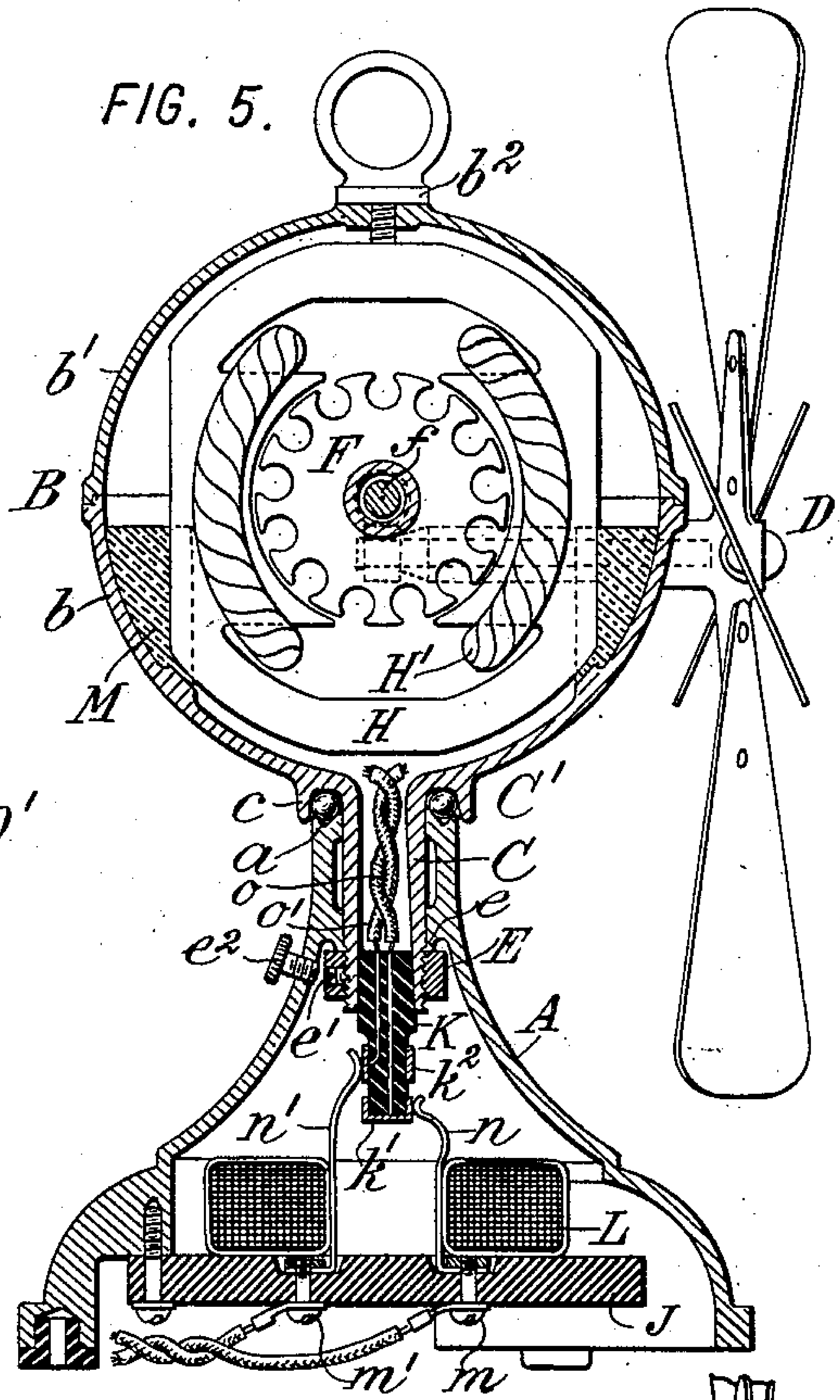


FIG. 4.

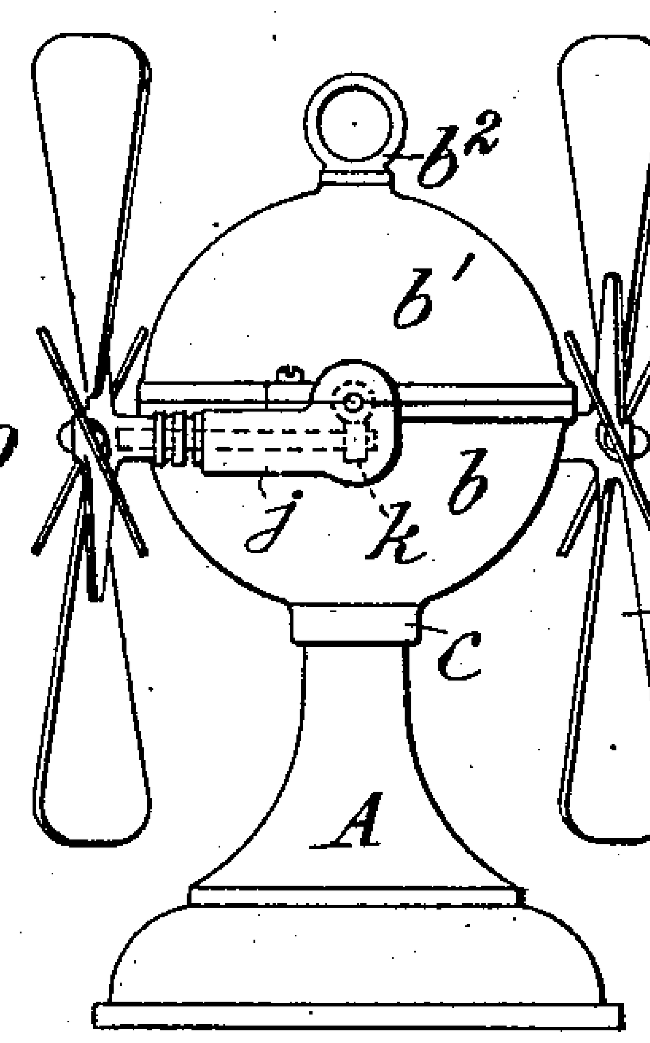


FIG. 7.

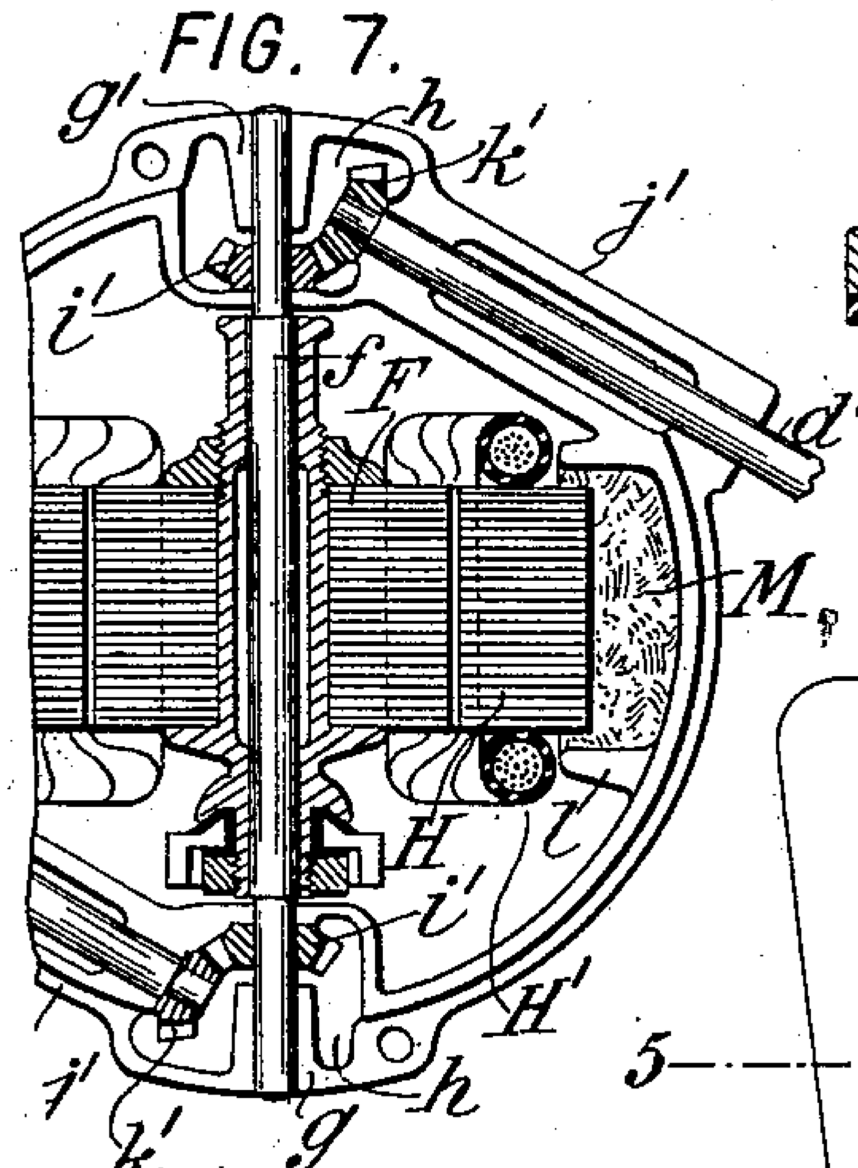
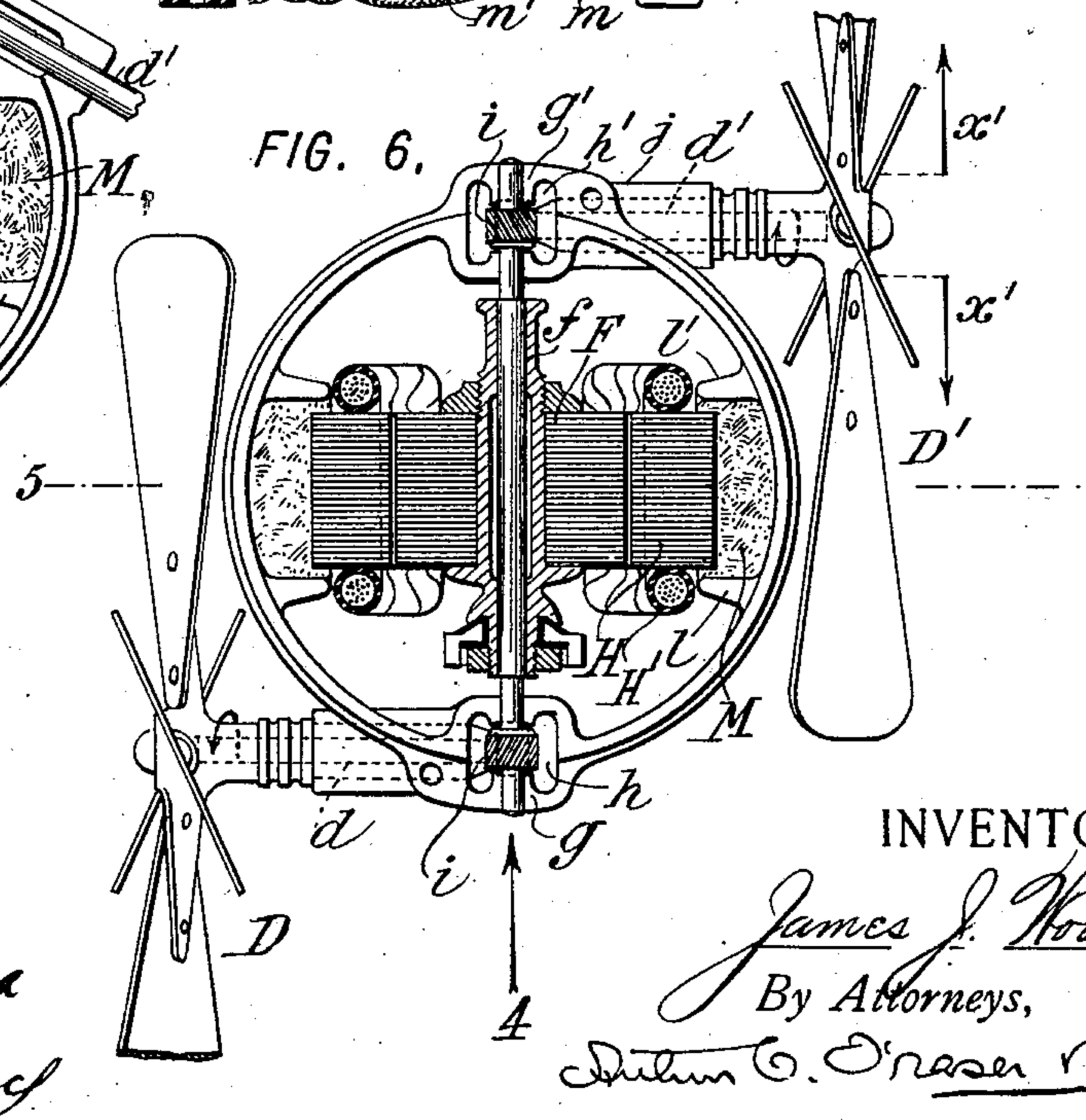


FIG. 6.



WITNESSES:

Domingo A. Usina

Thomas F. Wallace

INVENTOR:

James J. Wood,

By Attorneys,

Arthur C. Fraser & Co.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

JAMES J. WOOD, OF FORT WAYNE, INDIANA.

ELECTRIC FAN.

SPECIFICATION forming part of Letters Patent No. 697,588, dated April 15, 1902.

Application filed August 17, 1900. Serial No. 27,144. (No model.)

To all whom it may concern:

Be it known that I, JAMES J. WOOD, a citizen of the United States, residing at Fort Wayne, in the county of Allen and State of Indiana, have invented certain new and useful Improvements in Electric Fans, of which the following is a specification.

This invention relates to electric fans, and is especially applicable to those of the propeller type, in which the fan proper is driven directly from the motor-shaft.

In its preferred form my invention provides a stationary support and a rotary support carrying the motor and which is adapted to rotate upon the stationary support. Two fans, preferably of the propeller type, are mounted upon the motor-support, so that their reactive thrusts impart rotation to the latter. Preferably the fan is balanced—that is to say, the motor and its support are so proportioned and mounted that their center of gravity is substantially coincident with the axis of rotation of the support, whereby the reactive thrusts of the fans may rotate the motor-support without objectionable friction. With a suspended fan I prefer to direct the blast from each fan downwardly to a greater or less degree, giving the axis of rotation of each fan such a degree of obliquity to the horizontal as will accomplish the desired result.

My invention also provides certain other features of improvement relating to the construction and mounting of the various parts of the fan, which will be hereinafter fully set forth.

Referring to the drawings, Figure 1 is an elevation of a fan of the suspension type embodying my present invention looking in the direction of the arrow 1 in Fig. 3. Fig. 2 is a vertical mid-section with the fans removed. Fig. 3 is a horizontal mid-section showing the fans in plan. Fig. 4 is an elevation showing my invention as applied to a desk-fan looking in the direction of the arrow 4 in Fig. 6. Fig. 5 is a vertical section thereof on the line 5 5 of Fig. 6. Fig. 6 is a horizontal mid-section of the same, showing the fans in plan; and Fig. 7 is a similar view of a modification, the fans being omitted.

The desk-fan of Figs. 4, 5, 6, and 7 being the simpler I will describe that first.

As shown, I provide a suitable stationary support or base A, which is adapted to rest upon a horizontal surface and is preferably formed with a hollow interior, so that it may be utilized as a casing for the terminals, resistance, (if required,) and other stationary parts of the device. Upon the base is mounted a rotary support B for the motor and fans, which by preference, as shown, comprises a closed casing formed of two hollow hemispherical shells b b', fixed together by bolts or otherwise. In operation the casing B is designed to rotate about a vertical axis under the reactive thrusts of the fans. In order that this rotation may be as frictionless as possible, I preferably form a ball-bearing C′ between the casing and its support. To effect this in the construction shown, I form the casing B with a neck C, which fits down into the base and which is preferably tubular, so as to afford a convenient passage for the electric connections to the motor. The upper end of the base A is formed with a grooved ball race or cone a, and encircling the neck C the casing B is formed with a depending flange c, between which and the cone a the balls are confined. The casing and its support are held against separation by a collar E, which is shown as screwing upon the lower end of the neck C and as bearing against the under side of a suitable shoulder e, formed on the base. The collar E may be fixed in place by a set-screw e', a hole being formed in the base to permit the insertion of a screw-driver. After the collar has been fixed in place the hole may be closed by a suitable screw-plug e^2, Fig. 5. This plug is capable of being screwed in far enough to engage the collar E in case it is desired to prevent rotation of the casing B to cause the fans to deliver each a constant blast in one direction or to retard the rotation of the casing B, as desired.

Any suitable motor may be employed, that shown being of the ordinary type, and comprising the usual armature F, rotating in a relatively stationary field, the field-magnet comprising a frame H and coils H′, as is common. The shaft f of the armature rotates in suitable bearings g g', formed in the shells b b', (see Fig. 6,) and surrounding these bearings I provide suitable oil-chambers h h', which are formed partly in the shell b and partly in b'.

I prefer to provide two oppositely-arranged fans D D', which are mounted upon shafts d d', rotating in bearings formed in or carried by the support or casing B. The fan-shafts are geared to the motor-shaft, preferably on opposite sides of the latter, or where but one fan is used at one side of said motor-shaft, so that the thrusts of the fans act against the support B in directions out of line with or tangential to the axis of rotation of the latter, so as to rotate the support. I prefer to use helical gears for driving the fan-shafts from the armature-shaft. The column of air produced by each fan moves with a twisting movement as well as a forward movement. In order that the direction of movement of the air produced by one fan shall be maintained by the other, it is necessary that the twisting effect of the two fans be in the same direction—that is to say, they should both rotate in the same direction as you face them. Otherwise the two fans as they succeed each other in position destroy in a large measure the movement of the column of air set up by each other. I have found that unless the two fans rotate in the same direction as you face them much better results are obtained when but one fan is used. In order to accomplish this result and maintain the fan-shafts in substantially the same plane as the armature-shaft, it is practically essential that helical gears be used. The same result can be accomplished by bevel-gears, but is much more complicated. At each end of the armature-shaft, therefore, I fix a helical gear i, which gears rotate within the oil-chamber and engage corresponding gears k, Fig. 4, on the fan-shafts.

The fans D and D' have their blades inclined in the same direction, and consequently rotate in the same direction as one faces them, or in opposite directions in plan, as shown by the arrows in Fig. 6. Both gears k are on the under side of the gears i, and consequently the teeth of the latter incline in opposite directions, whereby the reactions against the armature-shaft balance each other and prevent any end thrust thereof. The bearings j of the fan-shafts are preferably integral with the lower shell b of the casing, as shown.

Fig. 7 shows a modification of my fan in which bevel-gears are used instead of helical gears. The bevel-gears i' and k' on the armature and fan shafts, respectively, produce rotation of the latter in opposite directions as one faces them. In order to obtain a blast of air in the direction away from the motor, the inclinations of the blades of the different fans will be in opposite directions. The fan-shafts rotate within bearings j', which are inclined toward the armature-shaft and are formed partly in each of the shells of the casing. By this arrangement the fans are brought closer toward the center of the casing, so that the maximum space required for the operation of the fan is reduced.

My invention provides in its preferred form a fan which is practically balanced—that is to say, the construction and arrangement are such that the center of gravity of the motor-casing and its supported parts falls within the bearing C', preferably as nearly coincident as possible with the axis of rotation of the casing. The advantages of such balancing are apparent. To effect this it is desirable that the motor, its casing and fans, should be symmetrically constructed and arranged. The motor is hence mounted centrally in the casing, and the fans, with their shafts and bearings, correspond with each other in size, weight, and relative arrangement.

For mounting the motor firmly and centering the armature-shaft accurately I use the construction described and claimed in my application for patent for improved construction of electric motors filed April 23, 1900, Serial No. 13,897. In this construction, l and l' are lugs or webs on the inside of one of the shells, and between which is a filling M, of Babbitt metal or the like, which has been molded in place around the field-magnet frame, as shown. Passing through the end of the opposite shell is a set-screw b^2, which prevents the frame from jarring free from its mounting.

The electric connections to the fan may be made in any suitable way. As shown, the support A has fixed within it a plate of insulating material J, in which are fixed the usual binding-screws m m', to which are fastened suitable spring-arms n n'. The support or casing B carries a cylindrical block of insulating material K, which latter has fixed on it suitable conducting-rings k' k^2, which are so located as to make contact with the spring-arms n n'. Suitable wires o o' pass through the insulating-block K and are connected to the rings k' and k^2, respectively. These wires then pass upwardly through the tubular neck C to the motor. The usual motor connections are not shown. In those cases in which it is desired to introduce a resistance-coil this may be done, as shown at L, Fig. 5, the plate J forming a convenient mounting for the coil.

In Figs. 1 to 3 I show my invention in its preferred form as applied to a suspended fan. The construction in the main is similar to that of Figs. 4 to 6. The support A in this construction is formed as a hollow body comprising two shells a' a^2, preferably hemispherical, adapted to be suspended in any suitable manner—as, for instance, by a base A' and neck A^2, as shown in Fig. 1—and is necessarily arranged above the rotary motor-casing or support B. The neck C of the casing B is formed upon the shell b, which in this construction is the upper shell, and this neck extends upwardly within the support A, within which it is held by the collar or sleeve E, as in Fig. 5. In the present instance, however, the weight of the casing B is supported by the collar, the balls of the bearing C′ being confined between the flat under side of this collar and a grooved ball-race a^3, formed on the interior of the shell a'. By using a bearing member (the collar in the present case) whose bearing-face is flat I reduce the friction to a minimum, a very important feature and one which makes it possible to rotate the rotary casing with a very slight movement of the fans. The use of a grooved bearing-face on the opposite member prevents lateral displacement of the balls. A suitable set-screw e', passing through the collar E, holds the latter firmly in place upon the neck C, as before. The binding-studs m m' are shown as screwed directly into the upper shell a^2 of the support A, and the spring-arms n n' are also fixed to these studs and are bent upwardly to engage the sleeves k' k^2, which are carried, as before, by the block K.

When my invention is applied to a suspended fan, I prefer to mount the fans so that they shall deliver a downward blast, while at the same time causing the motor-casing to rotate. This is done, as shown, by mounting the fan-shafts so that they extend obliquely to the horizontal, while still reacting against the motor-casing at a point out of line with its axis. This feature of my invention is clearly shown in Figs. 1 and 3, wherein the axes of rotation of the fans extend at an oblique angle of about thirty degrees to the horizontal. The fans are geared to the motor-shaft in the same manner as before described, as best seen in Figs. 2 and 3.

The principles which cause and govern the rotation of the motor about its vertical axis are most easily understood by considering the action of the blades on the air as resolved into two components—one a wedging action or effect in the direction of the fan-shafts and the other a paddle-wheel action or effect in a plane perpendicular to the fan-shafts—each of these components being of course accompanied by a reaction of equal magnitude but opposite direction. The first reaction—namely, that developed by the wedging action of the blades—is in the line of the fan-shafts and opposite in direction to the movement of the propelled columns of air. Since the movement of the air column is always in the same direction, the rotative effect upon the motor which is produced by the wedging reaction is always in the same direction, regardless of the direction of rotation of the blades. The second force is a paddle-wheel effect, due to the rotation of the blades, and is perpendicular to the fan-shaft. As shown in Fig. 6, the upper blade of the fan D′ produces a reaction x and the lower blade a similar reaction x' of equal force and in the same line of action. Their rotative effects about the vertical axis are therefore equal and being in opposite directions neutralize each other. This, however, is true only when the fan-shafts are horizontal. Where the fan-shafts are inclined, the effect is quite different. In Fig. 3, for example, y and y' are the reactions of the uppermost and lowermost blades equal and opposite in direction, but the line of action of the former being at a perpendicular distance z from the vertical axis and that of the latter at a much shorter distance z'. The resultant of the two will therefore be a strong rotative effect about the vertical axis in the direction of the force y. This principle is utilized by me to secure a desired slowness of rotation about the vertical axis. If the two—the wedging reaction and the paddle-wheel reaction—were in the same direction, the casing would revolve too rapidly on its vertical axis. The individual fans would move axially backward with a greater force than that with which they propel the air forward. If there were no paddle-wheel reaction, the fans would still not have time to start a column of air in motion before being themselves forced rearwardly to a succeeding position. By opposing these two reactions to each other, however, the casing resists the rearward forces, so as to revolve slowly, and the individual fans have a purchase by which they can push the air forward without being themselves pushed backward with equal force. Fig. 3 shows such an arrangement, the arrow Y showing the direction and force of rotation due to the algebraic sum of the reactions y and y' and the arrow X showing the direction and force of rotation due to the wedging reactions. The force X is designed to be a little greater than the force Y, giving a resultant slow rotation in the direction of X.

I believe myself to be the first to make a practical utilization of the paddle-wheel reaction referred to for affecting (either by producing or regulating) the bodily movement of a wedging or "propeller" fan.

I mount the field-magnet frame in the motor casing or support B in the same manner as that described with reference to Figs. 5 to 7, except that the shell b, in which the lugs l l' are formed, is inverted. The field-magnet is thus fixed at its upper side instead of at its lower side, as before described. The set-screw b^2 will hence pass through the shell b' at its under side, as shown in Fig. 2. A set-screw e^2 may be also provided in the construction of fan shown in Figs. 1 to 3 in case it may ever be desired to fix the casing B against rotation relatively to the support A, so that each fan shall deliver a constant blast in one direction. In some cases it may be desirable to remove one of the fans, so that a single blast is delivered.

While I prefer that the supports A and B should each be formed as a casing, it will be understood that this is not essential to my invention, it being only necessary that the fans should be mounted upon any suitable support or frame in such manner that they may bodily revolve around a fixed support while rotating upon their own axes.

It will be understood that I have used the termed "vertically" in a relative sense, it being, of course, within the invention to turn the structure into any desired position, so that the axis of rotation of the rotary support may extend in any convenient direction.

I claim as my invention the following-defined novel features substantially as hereinbefore specified, namely:

1. In an electric fan, the combination with a single electromotor, of a support mounted to rotate upon a vertical axis, and two fans both driven from said motor mounted to rotate upon axes on opposite sides of said vertical axis and tangential thereto so as to rotate said support.

2. In an electric fan, the combination with a single electromotor, of a support mounted to rotate upon a vertical axis, and two fans both driven from said motor mounted to rotate upon axes on opposite sides of said vertical axis and tangential thereto so as to rotate said support, said fans being rotated in the same direction as you face them.

3. In an electric fan the combination of a motor, a support adapted to rotate about an axis, a shaft rotated by said motor and having a gear at each end, and two fans mounted on shafts on opposite sides of said axis and each having a gear at its inner end, one meshing with the gear at one end of said motor-shaft, and the other meshing with the gear at the other end of said shaft, said motor and shafts being situated upon said support.

4. In an electric fan, the combination of a stationary support, a rotary support mounted thereon, a motor, a shaft rotated by said motor, having a gear at each end, and two fans mounted on shafts on opposite sides of said axis and each having a gear at its inner end, one meshing with the gear at one end of said motor-shaft, and the other meshing with the gear at the other end of said shaft, said motor and shafts being situated upon said rotary support.

5. In an electric fan the combination of a motor, a support adapted to rotate about an axis, a shaft rotated by said motor and having a helical gear at each end, and two fans mounted on shafts on opposite sides of said axis, and each having a helical gear at its inner end, the one meshing with the gear at one end of said motor-shaft, and the other meshing with the gear at the other end of said shaft, said motor and shafts being situated upon said support.

6. In an electric fan the combination of a motor, a support adapted to rotate about an axis, a shaft rotated by said motor and having a helical gear at each end, and two fans mounted on shafts on opposite sides of said axis, and each having a helical gear at its inner end, the one meshing with the gear at one end of said motor-shaft, and the other meshing with the gear at the other end of said shaft, the teeth of the gears on said motor-shaft being inclined in opposite directions, said motor and shafts being situated upon said support.

7. The combination with a support mounted to rotate about a vertical axis, of a fan mounted in bearings in said support so that it rotates on an axis oblique to the horizontal and on one side of said vertical axis and tangential thereto so as to rotate said support, and means for rotating said fan.

8. The combination with a support mounted to rotate about a vertical axis, of a fan mounted in bearings in said support so that it rotates on an axis oblique to the horizontal and on one side of said vertical axis and tangential thereto so as to rotate said support, and means for rotating said fan, the reaction due to the paddle-wheel effect of the blades being opposite to that due to the wedging action thereof.

9. The combination with a support mounted to rotate about a vertical axis, and an electromotor carried thereby, of a fan receiving motion from said motor and mounted on said support to rotate upon an axis extended obliquely to the horizontal and on one side of said vertical axis and tangential thereto so as to rotate said support.

10. In an electric fan, the combination with a motor of a support mounted to rotate upon a vertical axis, and two fans mounted to rotate upon axes arranged on opposite sides of the axis of said support and tangential thereto so as to rotate said support, the axes of rotation of said fans being extended obliquely to the horizontal.

11. In an electric fan, the combination with a motor of a support mounted to rotate upon a vertical axis, and two fans mounted to rotate on axes arranged on opposite sides of the axis of said support and tangential thereto so as to rotate said support, the axes of rotation of said fans being extended obliquely to the horizontal, and said fans being arranged to rotate in the same direction as you face them.

12. An electric fan comprising a support adapted to rotate about a vertical axis, a motor mounted upon said support, a shaft rotated by said motor and having a helical gear at each end, and two fans mounted on shafts extended angularly to said motor-shaft, and each having a helical gear at its inner end, the one meshing with the gear at one end of said motor-shaft, and the other meshing with the gear at the other end of said shaft, said fan-shafts extended downwardly in an oblique direction, whereby a downward blast is delivered by each of said fans, and the support is caused to rotate by the reactive thrusts of said fans.

13. In an electric fan, the combination with a stationary casing, of a rotary motor-casing, said stationary casing comprising a pair of shells one of which supports said rotary casing and the other of which carries contact-arms for conveying the current to said rotary casing.

14. In an electric fan, the combination with a stationary casing comprising a pair of shells

a' and a^2, of a rotary motor-casing having a neck extending within the stationary casing, a collar on said neck supported by a ball-bearing in said shell a', and conductors in said neck adapted to contact with contact-arms carried by said shell a^2.

15. The combination with a support mounted to rotate upon a vertical axis, of a fan mounted to rotate upon an axis on one side of said vertical axis and tangential thereto so as to rotate said support by a wedging reaction, the axis of rotation of said fan being oblique to the horizontal, and means for rotating said fan in a direction to produce a paddle-wheel reaction opposed to said wedging reaction.

16. The combination with a support mounted to rotate upon a vertical axis, of two fans mounted to rotate upon axes on opposite sides of said vertical axis and tangential thereto so as to rotate said support by a wedging reaction, the axes of rotation of said fans being oblique to the horizontal, and means for rotating said fans in a direction to produce a paddle-wheel reaction opposed to said wedging reaction.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

JAMES J. WOOD.

Witnesses:
F. S. HUNTING,
L. M. PROVINES.