March 5, 1968 H. F. BRUNS 3,371,855

AIR DIRECTING DEVICE

Filed Feb. 25, 1966

5 Sheets-Sheet 1

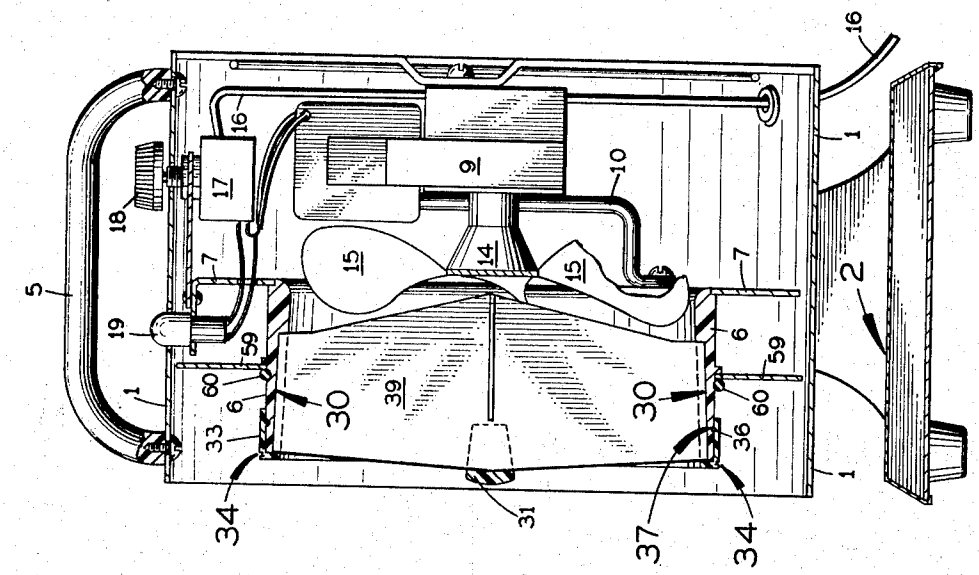


FIG. 2

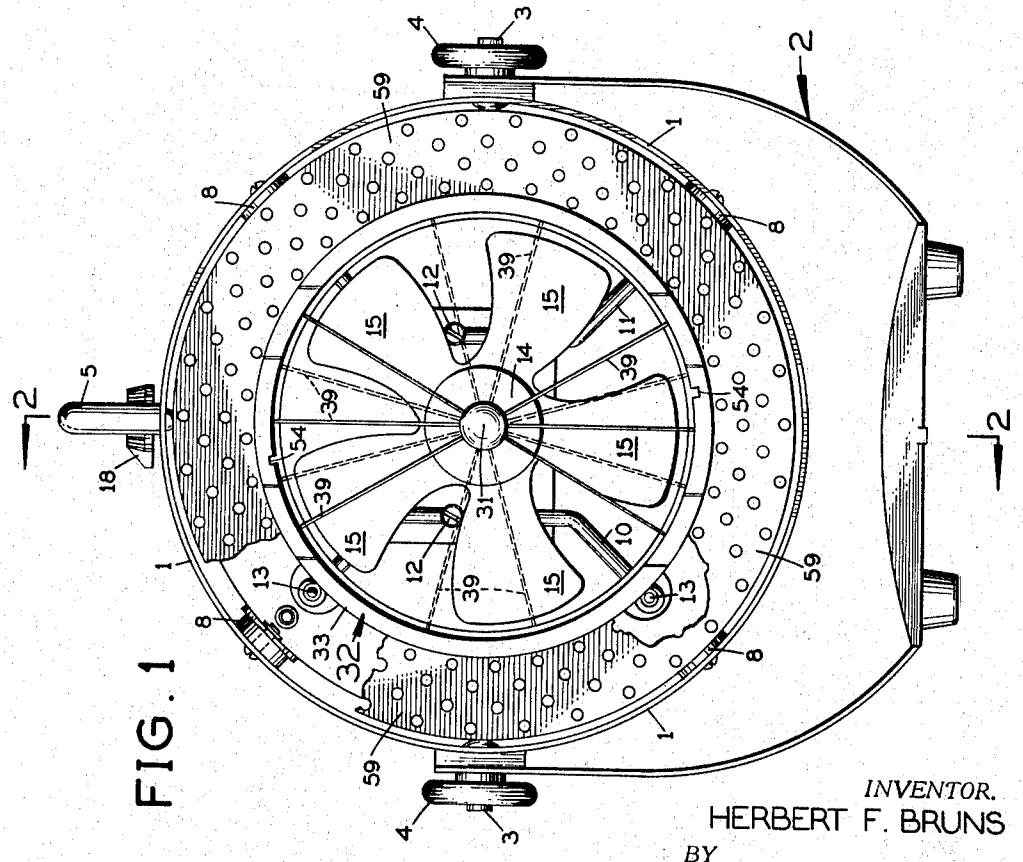


FIG. 1

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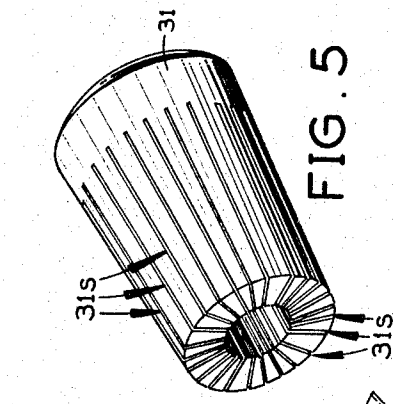


FIG. 5

FIG. 3

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AIR DIRECTING DEVICE

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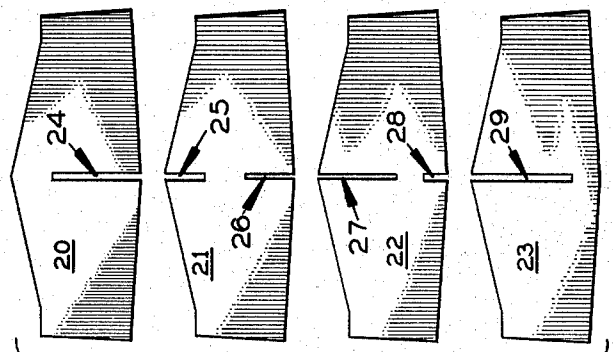


FIG. 4

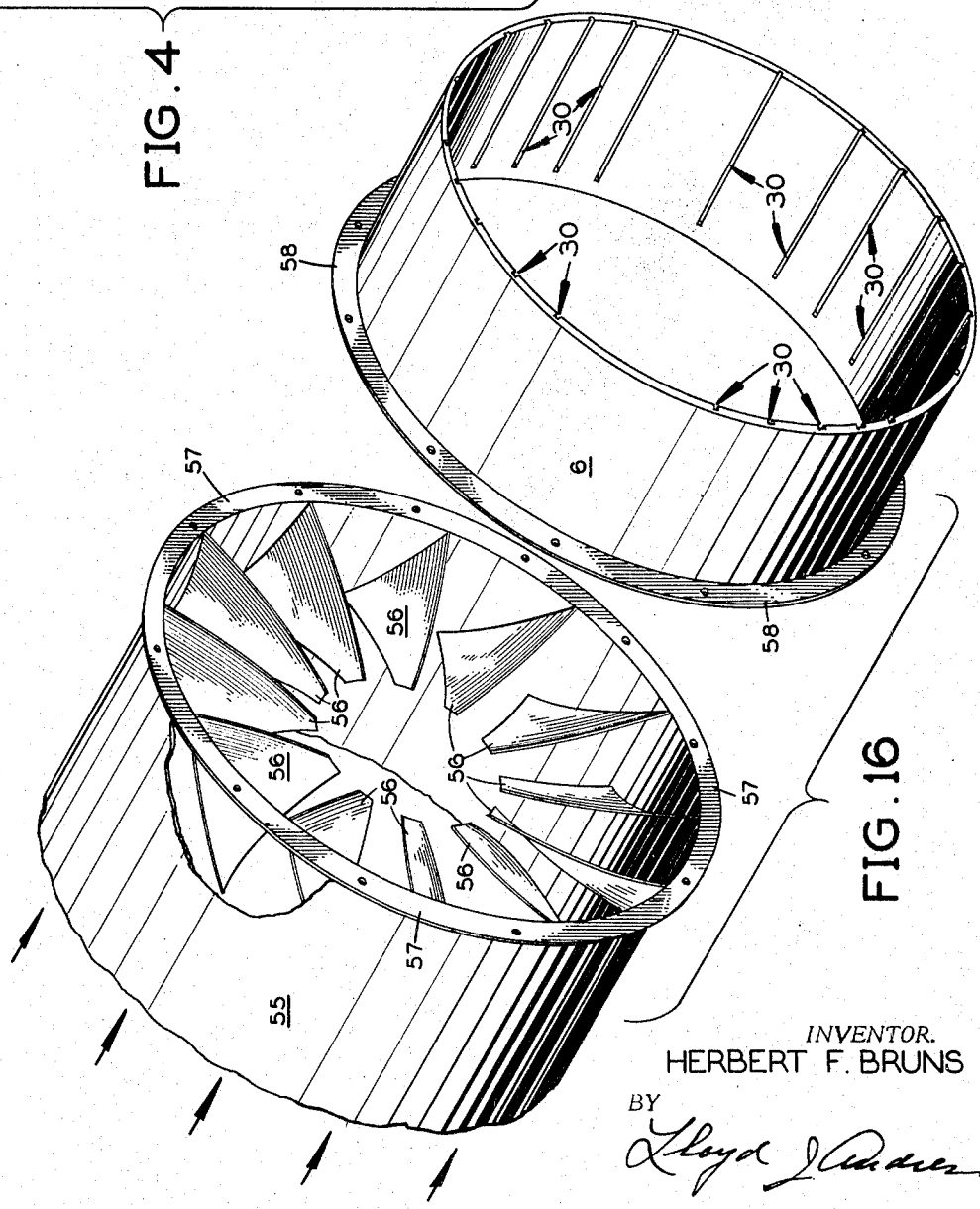


FIG. 16

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3,371,855

AIR DIRECTING DEVICE

Filed Feb. 25, 1966

5 Sheets-Sheet 4

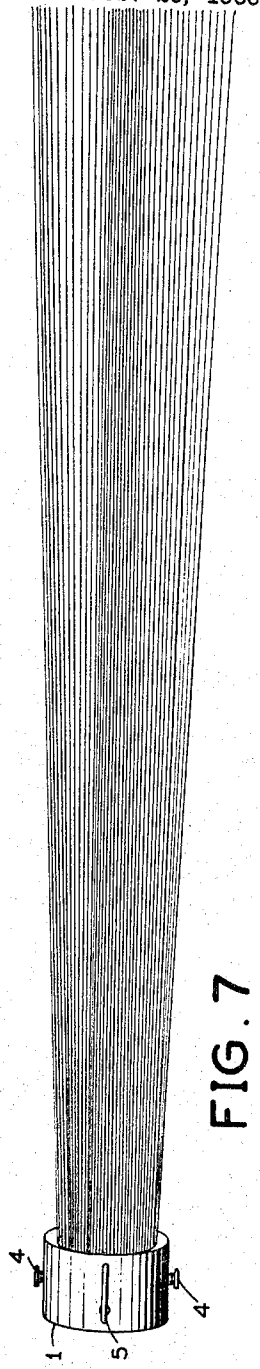


FIG. 7

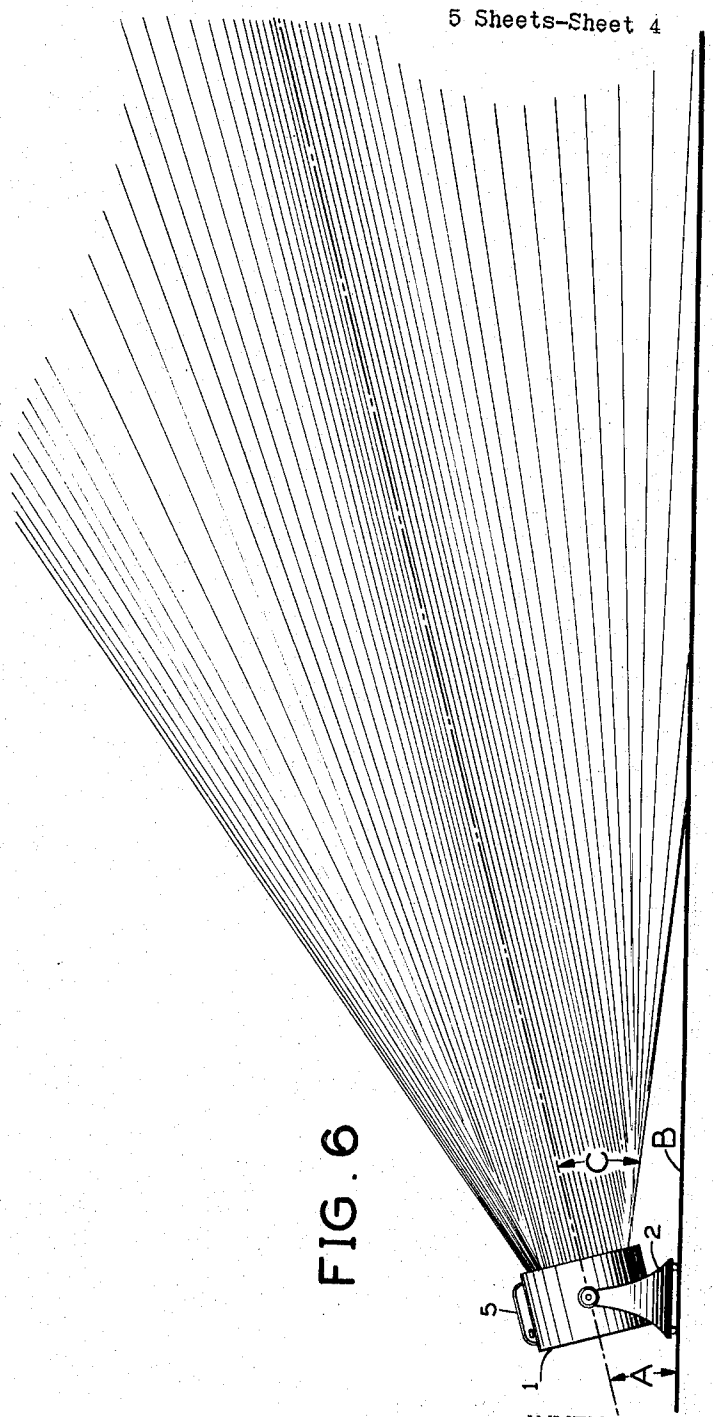


FIG. 6

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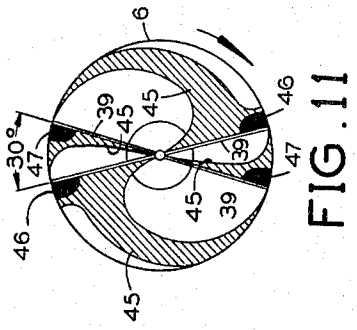


FIG. 11

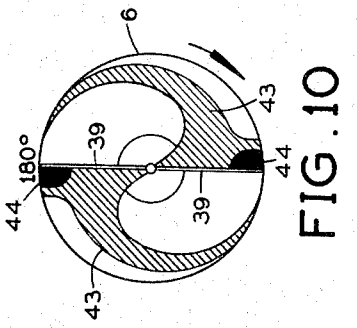


FIG. 10

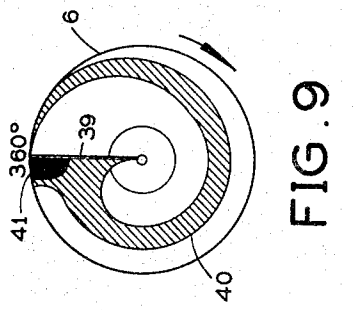


FIG. 9

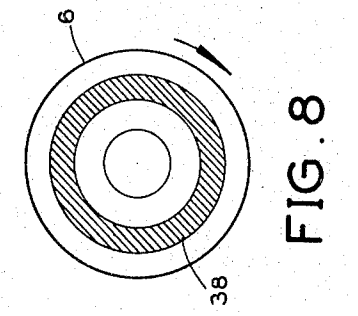


FIG. 8

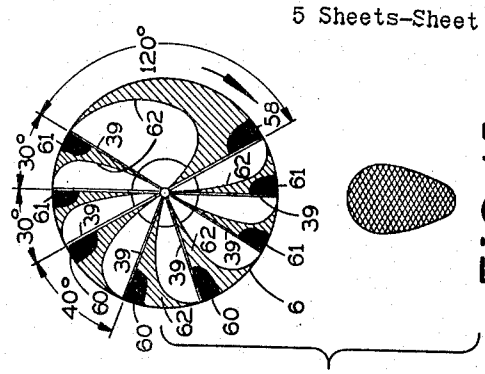


FIG. 15

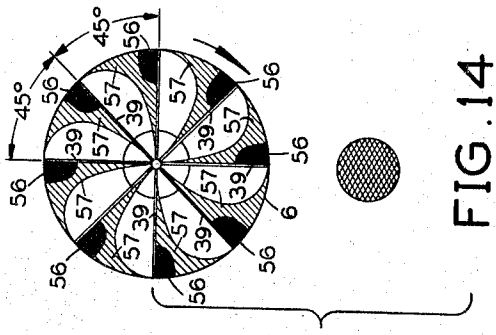


FIG. 14

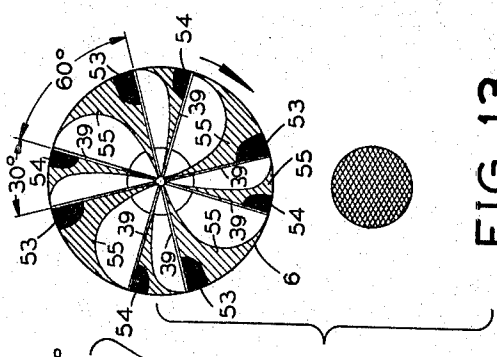


FIG. 13

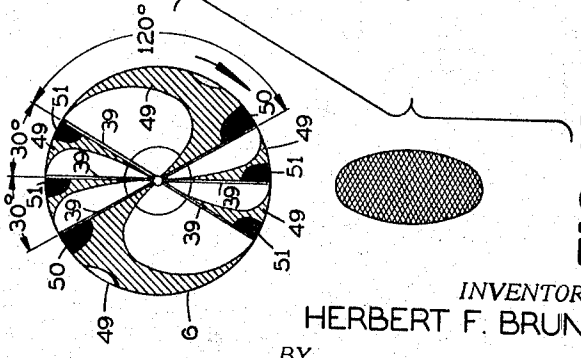


FIG. 12

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United States Patent Office 3,371,855 Patented Mar. 5, 1968

3,371,855

AIR DIRECTING DEVICE

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Filed Feb. 25, 1966, Ser. No. 530,139
9 Claims. (Cl. 230—120)

ABSTRACT OF THE DISCLOSURE

An air directing device consisting of a cylindrical orifice with a power driven fan positioned at one end thereof including a plurality of veins positioned in predetermined relation around the inner periphery of said orifice for creating a plurality of jet streams of air resulting in a relatively long range discrete coherent column of moving air moving from the device when said fan is energized.

This invention relates in general to air motivating apparatus and more particularly to an air directing device for moving and controlling the flow of a predetermined lobe of air in normal space for various uses.

Prior devices of this general character fail to project lobes of moving air accompanied with sharp definition thereof and result in unwanted turbulence and eddies radiating in random fashion from the motivating source. As a result, the use of prior devices in normal enclosures cause unwanted drafts in rooms or like enclosures and are relatively ineffective in providing desired total relatively slow circulation of air within an enclosure.

The well known transverse vanes for directing a column of air in desired directions are effective only for short distances because of the lack of high velocity portions of the flow, which operation results in a high degree of turbulence and eddies limiting the range and direction of the moving air.

The present invention overcomes the above objections and disadvantages by the provision of a power driven device having a plurality of vanes within a directing housing or wind tunnel for efficiently moving a lobe of air of predetermined cross section through a relatively long distance without undesirable turbulence and diffusing eddies, the construction of which is a principal object of the invention.

A further object of the invention is the provision of a power driven air source for moving a column of air in a helical path through an air directing means across which is provided a plurality of radial vanes for creating jet streams of air flowing therefrom.

Another object of the invention is the provision of a motor driven fan means positioned in one end of an air directing means for projecting a helical flow of air therethrough for impingement against a plurality of vanes positioned in radial relation within said horn with the surfaces thereof substantially parallel to the axis of rotation of the fan.

Another object of the invention is the provision of a substantially cylindrical air directing means for directing the flow of air including a variable plurality of planar blades detachably secured in radial relation within said means and intersecting and interlocking along the axis thereof.

A further object of the invention is the provision of a substantially cylindrical casing pivoted on a stand for movement transverse the axis thereof and retaining an air directing means therein with a motor driven fan secured for operation in one end thereof including a plurality of planar vanes radially positioned in said air directing means and parallel the axis thereof.

These and other objects and advantages in one embodiment of the invention are shown and described in the following specification and drawings, in which:

FIG. 1 is a front elevation of the device in reduced scale.

FIG. 2 is a cross sectional side view taken through section line 2—2, FIG. 1.

FIG. 3 is a perspective exploded view of a portion of the elements shown in FIG. 1.

FIG. 4 is a plan view of each of the four blades adapted for composite central intersection, as shown in FIGS. 1, 2, and 3.

FIG. 5 is an enlarged perspective view of the sighting element shown in FIG. 1.

FIGS. 6 and 7 illustrate a side and top plan view of a typical air flow lobe, respectively, from the device shown in FIG. 1, tilted at a vertical angle with reference to a planar surface.

FIG. 8 illustrates a cross sectional view of the helical path of flow of air from the device without vanes in the air director.

FIG. 9 illustrates a cross sectional view of the air flow from the device with one vane radially positioned in the air director providing for the intersection of the air stream, shown in FIG. 8, following 360 degrees of rotation thereof.

FIG. 10 illustrates two co-linear radial vanes within the air director dividing the air flow into two 180 degree portions.

FIG. 11 is a cross sectional view of the air flow in the air director with two intersecting blades forming four radial vanes dividing the air flow into two 30 degree and two 150 degree segments.

FIG. 12 shows a cross sectional view of the air flow with three intersecting blades forming six radial vanes dividing the air director into four 30 degree and two 120 degree segments for forming a generally eliptical air flow form, as illustrated.

FIG. 13 illustrates a cross sectional view of the air flow with four intersecting blades forming eight radial vanes in the air director dividing the air director into four 30 degree and four 60 degree segments for forming an air flow having a generally circular cross section, as illustrated.

FIG. 14 illustrates a cross sectional view of the air flow from the air director with four blades forming eight radial vanes dividing the air director into eight equal 45 degree segments for producing an air flow form of circular cross section of smaller diameter than that shown in FIG. 13.

FIG. 15 illustrates a cross sectional view of the air flow from the air director with three blades and two half blades eight vanes dividing the air flow into one 120 degree, four 30 degree, and three 40 degree segments resulting in an air flow having a generally vertical oval cross section, as illustrated.

FIG. 16 is a fragmentary perspective exploded view of a radial vane means for supplying the helical flow of air from a conduit for passage into an air director normally secured to the outer end thereof.

Referring to FIGS. 1 and 2, a generally cylindrical casing 1 is pivotally secured at opposite sides thereof to a base assembly 2 by well known screws 3 and threaded thumb nuts 4 which will permit the tilting of the casing at a predetermined angle with respect to the base assem-

bly. The casing is also provided with a conventional handle **5** secured thereto for convenient transport.

An air directing member **6**, having a circular inner surface with a slightly conical outward flare, is supported substantially coaxial in casing **1** by a ring **7** which in turn is secured to the casing by four conventional resilient mountings **8** by screw and a bracket means to housing **1**, as shown in FIGS. 1 and 3. The purpose of the resilient mounts **8** is for minimizing the transmission of vibration from the ring **7** to the housing **1**.

An electric motor **9** is secured to ring **7** by a pair of left and right brackets **10** and **11**, which are secured to the motor by screws **12** and to the ring by screws **13**. A conventional fan assembly **14** having five blades **15** is secured coaxial to the motor rotor with the outer ends of the blades positioned in close proximity with the inner end portion of the member **6**, as shown.

The motor is intended to be connected to a source of electric power by a cord **16** with a rheostat **17** in series therewith for controlling the speed of the fan by the manual rotation of the knob **18**. A pilot light **19** is connected in the motor circuit to indicate the on and off position of the rheostat.

Referring to FIG. 4, four flat air directing blades **20**, **21**, **22**, and **23** are preferably made from thin sheet material of uniform thickness and have one edge thereof angularly shaped for close proximity position with the outer path of rotation of the fan blades. Blade **20** has a central slot **24** of predetermined width therein and blade **21** has slots **25** therein of the same width as the slot in blade **20** and, in addition, has a narrow slot **26** therein, as shown. Blade **22** has a narrow slot **27** and a broad slot**28** therein, as shown, and blade **23** has a broad slot **29** therein, as shown, whereby all of the blades may be nested together, as illustrated in FIG. 3, to form the composite arrangement shown in FIG. 1 by the engagement of the outer edges thereof in the parallel longitudinal slots **30** around the inner periphery of the air directing member **6** for retaining the blades, as illustrated in FIG. 3, and also shown in FIGS. 1 and 2. A button **31** has a plurality of radial slots therein for engaging the intersecting portions of several arrangements of the blades to be hereinafter described and forming a means for sighting the device with respect to the axis of rotation of the fan for positioning the device in a desired precise direction.

Referring to FIG. 3, a guard assembly **32** is provided for preventing objects from moving through the front of the device into contact with the fan and comprises a ring **33** having an L shaped cross section and provided with a peripheral groove **34** around the outer periphery thereof with a plurality of short parallel grooves projecting forward and across the flange of the ring, as shown. In order that the guard has a minimum influence on the flow of air from the device, the guard member is a filament **35**, preferably made of nylon, and knotted at its opposite ends, and alternately around the peripheral grooves **34**, and threaded back and forth in the front grooves of the ring, as shown. The guard assembly is retained on air directing member **6** by the detent engagement of internal projections **36** around the inner surface of ring **33** for engagement with peripheral groove **37** around the air directing member **6**, as shown in FIGS. 2 and 3.

The unexpected operating characteristics of the device described are best explained by referring to the air flow patterns shown in FIGS. 8–15, inclusive, since it is possible to form a large number of air flow patterns or lobes by corresponding changes in position and number of radial vanes retained in the air directing member **6**. Several important lobes are best explained by referring to FIG. 8, which illustrates by the shaded area **38**, the cross section of a helical tube of air flow created by a conventional rotating fan in close proximity with the inner end of the substantially cylindrical air directing member **6**. This helical flow of air will quickly turbulate and diffuse and form diversionary eddy currents a short distance from the device and terminate in indiscriminate currents or drafts in the space where operated.

FIG. 9 illustrates the phenomenon obtained by the presence of a single vane **39** placed in radial relation within member **6** in close proximity to the fan and the light shaded area **40** represents the primary outward helical flow of air from the fan through a rotation of 360 degrees with angular impingement against the vane **39** which creates a substantially forward moving jet of relatively high velocity air **41** having a cross section indicated by the dense area shown. This single jet of air tends to stabilize the normal dispersion of the helical flow from the fan but is relatively ineffective as a useful lobe.

FIG. 10 illustrates the member **6** having a pair of oppositely positioned radial vanes **39**. The opposite forms of light shading **43** represent the helical moving primary air from the fan moving through 180 doerees and impinging against each vane and forming a pair of forward moving jet streams **44—44** which further reinforces the directivity of the air flow from the device, as compared with the arrangement shown in FIG. 9.

FIG. 11 illustrates the use of two pair of oppositely positioned radial vanes at 30 degree placement. Under this arrangement the primary flow of air **45—45** with each thereof rotating through 150 degrees will impinge against opposite vanes and form a pair of primary forward moving jet streams **46—46**. The relatively small primary air flow in the opposite 30 degree sectors will impinge against opposite blades **39** and form two additional forward moving jet streams **47—47**. This arrangement represents a small reinforcement to the arrangement shown in FIG. 10.

A preferred form of vane arrangement for household use is shown in FIG. 12 wherein three oppositely positioned sets of vanes **39** are arranged 30 degrees apart forming two opposite sectors of 120 degrees each in which the primary helical air flow **49** from the fan will impinge substantially normal to the sides of the vanes **39** and form a pair of opposite forward moving jet streams **50—50**, and other smaller portions of the helical primary air flow from the fan will impinge against opposite sides of the remaining secondary vane and form two pair of opposite secondary forward moving jet streams **51—51**.

The generally eliptical cross section of the lobe thus formed by the vane arrangement in FIG. 12 is considered substantially optimum for coherent formation and a relatively long range discrete lobe, for blending, as illustrated in FIGS. 6 and 7.

As an example of the effectiveness of the fan device having the aforesaid optimum structure, as shown in FIGS. 6, 7, and 12, and considering the subject space to be two rooms separated by a hallway, which rooms are desired to be draft-free and cooled or heated from a source in one room, then the placement of the device in the hall will result in draft-free circulation of the air in both rooms the air in the lower part of the rooms gradually moving in one direction and returning over the projected air lobe in the hall to compelte the draft-free uniform air circulation via the upper portion of the rooms, and, in addition, substantially defeat an undesired large temperature gradient between floor and ceiling in either room.

It is to be noted that in order to conveniently change the blade placement to form different types of output lobes the ring **33** has a pair of notches **54** through the front flange thereof through which any blade may be passed into its desired pair of grooves **30** in member **6** by rotating the ring **33** about member **6** into register with each pair of opposite slots **30**.

To illustrate the large number of variations of discrete and substantially coherent lobes of air moved by the aforesaid device, reference is made to FIG. 13 in which eight vanes are radially positioned in the director **6** forming four 60 degree and four 30 degree sectors, as shown. Thus four portions of the primary moving air **55** will impinge

against four vanes to form four substantially uniform jet air streams **53**. Concurrently, four minor portions of the primary air will impinge against vanes **39** to form four jet air streams **54** of lesser magnitude. This arrangement will result in a substantially coherent cylindrical lobe of air projecting a substantial distance from the device before dispersion.

FIG. 14 illustrates eight radial vanes in the director **6** forming eight equal 45 degree sectors, as shown. With this arrangement, the primary moving air **57** is equally impinged against vanes **39** to form eight equal jet air streams **56** resulting in the projection of a substantially coherent cylindrical lobe of smaller diameter and increased velocity and range as compared to the lobe illustrated in FIG. 13.

FIG. 15 illustrates a non-symmetrical formation of vanes **39** in which they form a single sector of 120 degrees, four sectors of 30 degrees, and three sectors of 40 degrees in which the primary flow of air is divided accordingly and will produce an unexpected substantially discrete lobe of moving air having an oval shape substantially as shown.

It is now apparent that in order to form lobes of various predetermined shape utilizing the aforesaid construction, the primary flow of air must be helical in form. Therefore, in adapting the linear flow of air to the directing device and referring to FIG. 16, a cylindrical casing **55** represents a conduit conducting linear moving air with the casing provided with a plurality of blades **56** positioned around the inner periphery of said casing at the outlet end thereof, as shown. A flange **57** integral with casing **55** is provided to engage with flange **58** on director **6** by well known means for completing the assembly. Thus the fixed blades **56** will produce a helical flow of air into director **6** in substantially the same manner as produced by a fan.

In order to illustrate the effectiveness of the aforesaid device, a typical working model having a five blade fan of four inches in diameter and an approximate pitch angle of 35 degrees was positioned in a director, as shown in FIGS. 1, 2, and 3, and operated at approximately 2800 r.p.m. With the blade arrangement shown in FIGS. 3 and 12, a discrete substantially coherent lobe of projected air, substantially as illustrated in FIGS. 6 and 7, was effective for approximately 15 feet.

The same device with the blades positioned as shown in FIG. 14 will project a cylindrical column of substantially coherent air through an effective distance of approximately 25 feet.

It is believed that the plurality of jet air streams combine to form an outer form of the projected lobe, which lobe is retained for a substantial distance by the lower air pressure within the center thereof, which originates in the central portion of the director and this lower pressure no doubt extends a considerable distance within the lobe of higher velocity air.

It is to be noted that only the outer portions of the vanes are effective in creating the forward moving jet streams and for the purposes of certain integral construction of director and vanes, the center intersecting portions of the vanes may be omitted.

It is understood that certain modifications in the above construction, utilizing the features described, are intended to come within the scope of the appended claims.

Having described my invention, I claim:

1. A device for projecting air in a predetermined discrete formation comprising an air director having a substantially cylindrical inside peripheral surface about a central axis with a relatively large ratio of diameter to axial length, means defining a source of forward moving air positioned in close proximity to the inlet end of said director for providing a substantially helical flow of air into the latter, a plurality of planar vanes retained about said inside periphery of said director in parallel radial relation to said axis and in predetermined angular relation with each other, said vanes extending radially from said central axis to said inside peripheral surface terminating at the outlet end of said director whereby the said flow of air from said means will impinge against said vanes and concentrate at the angular trough formed by the junction of said vanes and said inner periphery to form a like plurality of outward moving jets of air from said opposite end and forming a substantially discrete lobe of outward moving air having a shape and range dependent upon the number and angular position of said vanes and their corresponding troughs in said director.

2. The construction recited in claim **1** wherein the said means defining a source of air is a motor driven electric fan with the blades of the latter positioned for coaxial relation about said axis in close proximity to the said one end of said director.

3. The construction recited in claim **1** including the width of each of said blades at its junction with the inner periphery of said director having a width less than the radius thereof.

4. The construction recited in claim **1** wherein the said inner periphery has a predetermined outward divergent conical shape with respect to said means defining a source of air.

5. An electric fan assembly for projecting predetermined forms of air therefrom comprising a means forming a housing,

an air director in said housing having a cylindrical inner peripheral surface about a principal axis,

an electric fan having a plurality of like radial blades secured in said housing with the said blades adapted to rotate about said axis and in close proximity to one end of said director for forming a helical flow of air into said director when said fan is energized,

said peripheral surface having a plurality of spaced longitudinal slots therein for retaining a plurality of blades,

a plurality of flat blades having mating central slots therein whereby said blades will engage said slots within said director in predetermined radial spacing about said axis with the outer edges of said blades substantially co-planar with the opposite end of said director whereby the helical flow of air from said fan will impinge against said blades and form concentrated forward moving jets of air at the junction of the outer ends of said blades and said peripheral surface for forming an outward extending substantially discrete form of air from said fan of predetermined shape and range dependent upon the number and position of said blades in said director when said fan is energized.

6. The construction recited in claim **5** including a guard rim secured to the said other end of said director including a plurality of filaments retained in spaced relation secured across the outer end thereof for guarding the entry to said director.

7. The construction recited in claim **5** including a sighting member positioned at the said intersection of said blades within the plane of the outer edges thereof.

8. The construction recited in claim **5** including a resilient support means connecting said director to said housing to isolate the latter from vibration in said director when said fan assembly is operated.

9. A device for projecting a predetermined substantially discrete form of moving air,

an air director means having a substantially cylindrical inner peripheral surface about a principal axis,

a plurality of predtermined flat vanes projecting from said peripheral surface in predetermined spaced parallel radial relation to the axis with said vanes parallel thereto,

a conduit for conducting a flow of air in a forward linear direction,

a plurality of equi-spaced blades in radial angular position with respect to said axis for rotating said flow of air into said director in helical form whereby said

helical flow of air will impinge against said vanes and concentrate at the junction of each of said vanes and said peripheral surface for producing forward moving jets of air from said director in the form of a substantially discrete flow of air of predetermined shape and range dependent upon the number and position of said vanes in said director when air is moved through said conduit.

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