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K. A. MERZ ET AL

2,825,540

ROTARY FAN WITH SLINGER ELEMENTS

Filed Aug. 1, 1955

2 Sheets-Sheet 1

FIG. 1

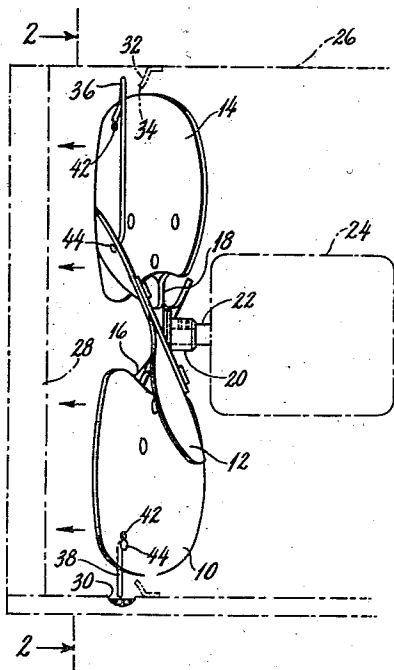


FIG. 2

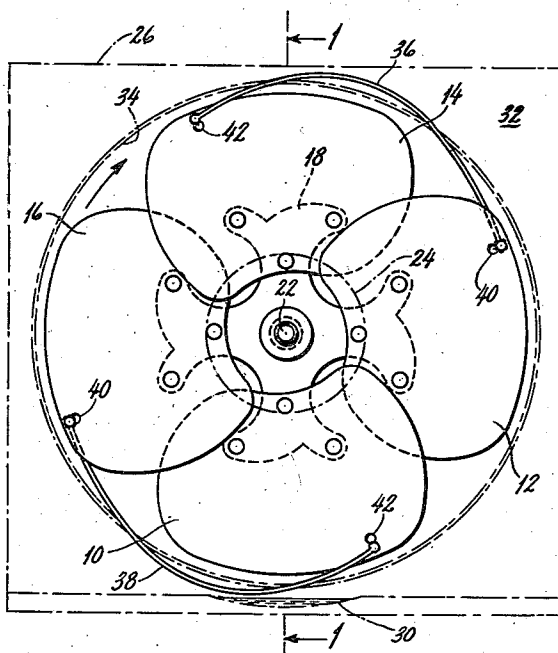


FIG. 3

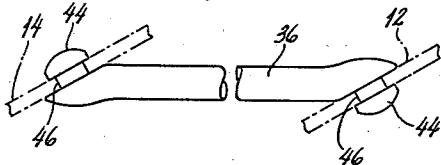


FIG. 4

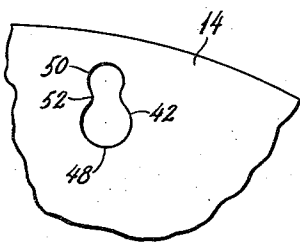
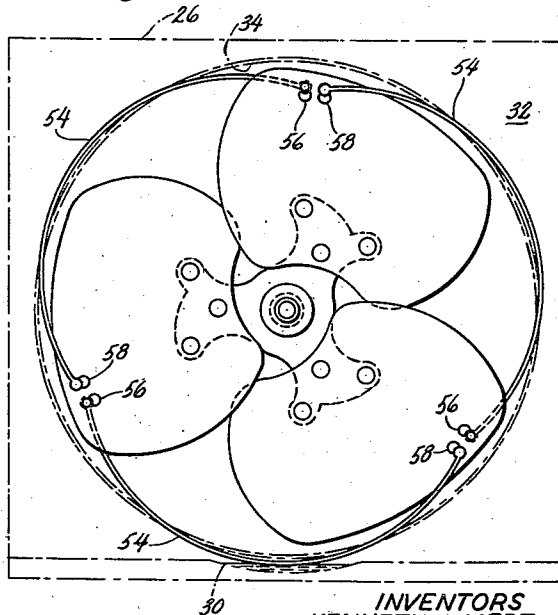


FIG. 5



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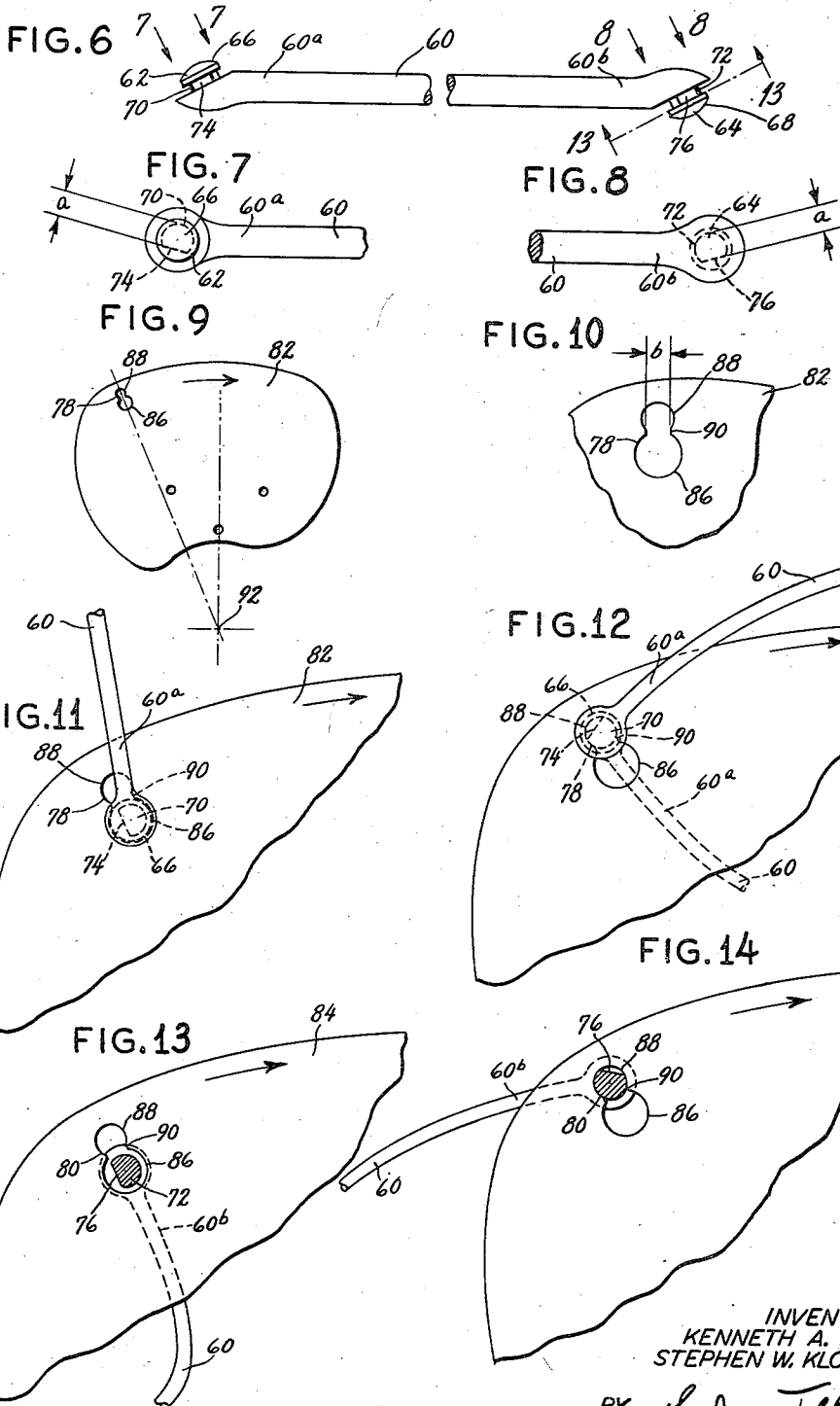
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ROTARY FAN WITH SLINGER ELEMENTS

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2 Sheets-Sheet 2



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1

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ROTARY FAN WITH SLINGER ELEMENTS

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Application August 1, 1955, Serial No. 525,763

20 Claims. (Cl. 261—24)

This application is a continuation-in-part of our prior application, Serial No. 420,360 filed April 1, 1954, for Rotary Fan With Slinger Elements, now abandoned.

Rotary fans intended for use in air conditioning units are commonly provided with concentric circular rigid slinger rings suitably connected with the peripheral portions of some or all of the fan blades. When a fan so equipped with a slinger ring is in use, the slinger ring dips at the bottom thereof into a sump in the lower portion of the housing of the air conditioning unit, the sump serving to collect water resulting from condensation. The rotating slinger ring on the fan withdraws water from the sump and distributes it within the housing so that it can be picked up by the moving air.

A conventional slinger ring such as above referred to is effective for its intended purpose, but its manufacture and its assembly with the fan are costly. Also, the slinger ring when assembled with the fan is easily damaged, and considerable additional cost is involved in avoiding damage during handling, packing, shipment and installation. Furthermore, a fan and slinger ring assembly has a diameter considerably greater than that of a fan alone, and there are many air conditioning units wherein it is desirable during assembly to insert the fan through an opening only very slightly larger than the fan diameter. Such insertion is impossible when a rigid slinger ring is attached, and costly alternative expedients are necessary.

The principal object of the present invention is to provide a rotary fan having attached slinger elements which are sufficiently flexible to avoid all of the disadvantages inherent in a rigid slinger ring and which are at least equally effective for the distribution of water.

A more specific object of the invention is to provide a fan having elongated and slender, or cord-like, flexible slinger elements each of which is connected with two blades.

Another object of the invention is to provide a fan having cord-like slinger elements each of which is readily connectible manually with two blades. As to this aspect of the invention, it is not always essential that the slinger elements be flexible.

A further object of the invention is to provide a flexible cord-like slinger element so formed at its ends that it is adapted for ready connection with two blades of a fan.

Other objects of the invention will be apparent from the drawings and the following description.

In the drawings we have shown three embodiments of the invention, but it will be understood that various changes may be made from the constructions shown, and that the drawings are not to be construed as defining or limiting the scope of the invention, the claims forming a part of this specification being relied upon for that purpose.

Of the drawings:

Fig. 1 is a side view of a fan with slinger elements embodying the invention, this view also schematically showing in section along the line 1—1 of Fig. 2 certain por-

2

tions of an air conditioning unit in which the fan is used.

Fig. 2 is a front view of the fan, this view showing certain portions of the air conditioning unit in section along the line 2—2 of Fig. 1.

Fig. 3 is an enlarged fragmentary view of one flexible slinger element, the view being taken radially inwardly and portions of two blades being shown schematically.

Fig. 4 is an enlarged fragmentary front view of one of the fan blades.

Fig. 5 is a view similar to Fig. 2 but showing an alternative embodiment of the invention.

Fig. 6 is an enlarged fragmentary view of an alternative flexible slinger element, the view being generally similar to Fig. 3 but omitting the portions of the blades.

Fig. 7 is a fragmentary view taken in the direction of the arrows 7, 7 in Fig. 6.

Fig. 8 is a fragmentary view taken in the direction of the arrows 8, 8 in Fig. 6.

Fig. 9 is a view of a single blade on the same scale as Figs. 1, 2 and 5 and showing the hole for the attachment of one end of a slinger element.

Fig. 10 is an enlarged view more clearly showing said attachment hole.

Fig. 11 is a fragmentary view showing the first step in the attachment of a slinger element as shown in Figs. 6, 7 and 8.

Fig. 12 is a view similar to Fig. 11 but showing the second step.

Fig. 13 is a fragmentary view showing the third step in the attachment of the slinger element, this view being partly in section along the line 13—13 of Fig. 6.

Fig. 14 is a view similar to Fig. 13 but showing the fourth step.

Referring to the drawing and more particularly to Figs. 1 to 4 thereof, the blades of a rotary fan are represented at 10, 12, 14 and 16, these blades being similar and circumaxially spaced and being arranged at similar pitch angles. The blades have axially exposed faces, that is, faces which are exposed in the directions parallel to the axis of rotation. Four blades are shown but the number may be varied. As shown, the several blades 10, 12, 14 and 16 are suitably connected with the arms of a central spider 18 on a centrally apertured hub 20. The hub 20 is connected with the shaft 22 of an electric motor 24. As shown, the shaft 22 is horizontal and the fan is rotatable by the motor 24 about a horizontal axis.

The fan is illustrated as being located within the housing 26 of an air conditioning unit, the said housing being shown only schematically. At the left end of the housing 26, as shown in Fig. 1, there is a condenser 28 which is also shown only schematically. The fan, as shown in Fig. 2, rotates in the clockwise direction, the result being that air is driven toward the left and through the condenser as indicated in Fig. 1. The air delivering side of the fan will be referred to as the "front" and the air intake side of the fan will be referred to as the "rear."

Within the housing 26 and at the bottom thereof is a sump 30 in which water collects. The sump 30 is directly below a portion of the fan and is preferably spaced somewhat forwardly from a transverse plane through the centers of the fan blades. Preferably a partial partition 32 extends transversely of the housing 26, this partition having a large circular opening 34 for the fan. The diameter of the said opening 34 is only slightly greater than the maximum diameter of the fan.

Connected with the blades of the fan are preferably flexible slinger elements 36, 38 which project outwardly beyond the blades and which are positioned to enter the sump 30 as the fan rotates. The slinger elements 36, 38 may be widely varied as to construction and manner of connection, but preferably and as shown they are elon-

gated and slender, and may be described as cord-like. The slinger elements, particularly when flexible, are preferably molded from a suitable plastic material, such as nylon. When so molded the slinger elements are substantially impervious to moisture. For a four-bladed fan there are preferably two slinger elements, each of them being preferably connected at its ends to two blades. The element 36 is shown as connected at its ends with the blades 12 and 14 and the element 38 is shown as connected at its ends with the blades 16 and 10. The positions of connection are preferably spaced inwardly from the peripheries of the blades.

Each slinger element is circumaxially looped so as to be chiefly in a plane perpendicular to the axis of rotation and each element is of such length that its central portion during fan rotation is tangent to a circle concentric with the axis of rotation and having a diameter greater than that of the fan. Preferably each slinger element, such as the element 36, is connected at one end to one fan blade such as 12, at a position on the rear side thereof and is connected at its opposite end to another fan blade, such as 14, at a position on the front side thereof. Each position of connection is preferably near the trailing edge of the corresponding blade, each slinger element being so positioned that its outer portion passes through the sump 30 during each revolution. Figs. 1 and 2 show the slinger elements in the positions with respect to the blades that they occupy during rotation, the elements being maintained in the said positions by centrifugal force. When there is no rotation the slinger elements may sag by gravity or may be otherwise moved to assume quite different positions and shapes.

Preferably, means additional to the fan blades and the slinger elements are provided for the connection of the slinger elements with the fan blades. The ends of the slinger elements are connected with the axially exposed faces of the blades at positions spaced inwardly from the peripheries thereof. The connecting means may be varied, but as shown more particularly in Fig. 3 each slinger element, such as 36, is provided with connection devices 44, 44 at the ends thereof which are adapted to enter and at least partly fit corresponding holes 40 and 42 in two blades, such as 12 and 14. Preferably each connection device 44 comprises a round head and a smaller neck 46 which connects the head with the slinger element. The necks 46, 46 as shown in Fig. 3 are cylindrical. The axes of the two connection devices 44, 44 and of the two necks 46, 46 thereof are parallel with each other and are at oblique angles to the longitudinal axis of the element 36, the said angles corresponding approximately but not necessarily exactly to the pitch angles of the fan blades. Connection devices 44, 44 and the necks 46, 46 thereof are preferably molded as integral parts of the slinger element, the said element being formed as before stated from a plastic material such as nylon. The connection devices 44, 44 although preferably integral are additional to the flexible cord-like slinger element 36. Each blade hole 40 or 42 has a relatively large inner portion 48 and a smaller outer portion 50 with an intermediate portion 52 having a width smaller than the diameter of the said smaller portion 50. The head of each connection device 44 is slightly smaller than the larger portion 48 of the blade hole, and the neck 46 of each connection device is of substantially the same size as the smaller portion 50 of the blade hole.

The connecting means for each end of each slinger element is operable solely by manual manipulation of the slinger element and the parts integral therewith, no wrenches or other tools being required. When one end of the slinger element 36 is to be connected with a blade, the corresponding head is manually entered in the larger inner portion 48 of the blade hole and the corresponding neck 46 is then manually pressed outwardly through the narrower intermediate hole portion 52 and is temporarily distorted so as to enter the outer hole portion 50. The neck fits the hole portion 50 and is retained therein.

With the slinger elements assembled with the fan and with the fan assembled with other parts of an air conditioning unit, the slinger elements assume the positions shown in Figs. 1 and 2 when the fan is rotated. The outer portions of the slinger elements enter the sump 30 to withdraw water therefrom and to distribute the water within the housing 26. As shown in the drawing, the outermost portions of the slinger element move in a path that is approximately tangent to the surface of the water in the sump. The said elements serve to maintain the surface of the water approximately at the level shown.

Fig. 5 shows a three-bladed fan instead of a four-bladed fan, but the fan and the slinger elements are otherwise generally similar. In order to avoid unbalance, three slinger elements 54, 54 are provided, these being similar to the elements 36 and 38 but differing in length. Each blade is provided with two holes 56 and 58, these being similar to the holes 40 and 42. The leading end of each element 54 is connected to each blade at the rear thereof and at the hole 56, and the trailing end of each element 54 is connected to another blade at the front thereof and at the hole 58.

Figs. 6 to 14 show a slinger element 60 and attaching devices therefor alternative to those shown in Figs. 1 to 4 and in Fig. 5. The alternative slinger element 60 is very similar to the slinger element 36 shown in Fig. 4 and a complete description is not necessary. The trailing and leading end portions of said element are respectively designated by 60^a and 60^b. Said element 60 differs chiefly as to its integral attaching devices 62 and 64 at the trailing and leading ends thereof. The attaching devices 62 and 64 have circular heads 66 and 68 similar to the heads of the attaching devices 44, 44 and said attaching devices have necks 70 and 72 somewhat similar to the necks 46, 46 of the attaching devices 44, 44. Each of the necks 70 and 72, although similar, differs in that it has a reduced dimension in one direction that is smaller than its major diameter. As shown, the reduced dimensions are provided by flat faces 74 and 76 as shown in Figs. 7 and 8 which respectively show attaching devices at the trailing and leading ends. It will be obvious that the distance *a* for each neck 70 or 72 is less than the major diameter of said neck. The flat faces 74 and 76 of the said necks are preferably not in the same plane, but are oppositely inclined with respect to the longitudinal axis of the element. Each of said flat faces is inclined outwardly and toward the center of the element.

The fan is provided with trailing and leading attachment holes 78 and 80 for the slinger element 60, these holes preferably being in two separate trailing and leading fan blades 82 and 84. Said holes are generally similar to the holes 40 and 42 shown in Figs. 2 and 4. Each blade hole 78 or 80 has a relatively large partly circular inner portion 86 and a smaller partly circular outer portion 88 with an intermediate portion 90 having a width smaller than the major diameter of said smaller portion 88. Preferably the centers of the hole portions 86 and 88 are on a line extending through the axis of rotation 92 as clearly shown in Fig. 9. The diameter of the larger inner portion 86 is approximately the same as or slightly larger than the diameter of the heads 66 and 68 of the attaching devices. The diameter of the smaller outer portion 88 is preferably approximately the same as the diameter of the neck of each attaching device. The intermediate portion 86 has opposite parallel flat sides, and the distance *b* between said flat sides is approximately equal to the distance *a* shown in Figs. 7 and 8, but is preferably slightly larger.

Various procedures may be followed for assembling a slinger element 60 with two adjacent blades, and one suitable procedure is illustrated in Figs. 11 to 14. Figs. 11 and 12 show the trailing blade 82 and Figs. 13 and 14 show the leading blade 84.

As the first step of assembly, the head 66 of the trailing attaching device is moved from the front and rearwardly into the larger inner portion of the hole 78 in the trailing

5

blade 82. The portion 60^a of the element at said trailing end is at the front of said blade and extends generally outwardly so that in a selected rotative position the flat face 74 on the neck 70 is aligned with one side of the narrow connecting portion 90 of the hole 78.

As the second step of assembly the trailing attaching device is pushed radially outwardly from the Fig. 1 position, the flat face 74 permitting the neck 70 to freely enter the smaller portion 88 of the hole 78. Then the portion 60^a of the slinger element is turned clockwise to another rotative position which may be that shown by full lines in Fig. 12. Said full line position is approximately the operating position and it will be obvious that the slinger element is fully locked in place at its trailing end.

As the third step of assembly, the portion 60^a of the element 60 is moved approximately to the position shown by dotted lines in Fig. 12 and the leading end of said element at 60^b is positioned behind the blade 84 as shown in Fig. 13, said leading end extending generally outwardly. Then the head 68 of the leading attaching device is moved forwardly into the large inner portion of the hole 80 in the leading blade 84. With said leading end 60^b positioned as stated, the flat face 76 on the neck 72 is aligned with one side of the narrow connecting portion 90 of the hole 80.

As the fourth step of assembly, the leading attaching device is pushed radially outwardly from the Fig. 13 position, the flat side 76 permitting the neck 72 to freely enter the smaller portion 88 of the hole 80. Then the portions 60^a and 60^b of the slinger element are turned to the positions shown by full lines in Figs. 12 and 14. These full line positions are approximately the operating positions and it will be obvious that the slinger element is fully locked in place at both ends.

It has been determined that the cost of manufacture and assembly is substantially less for the flexible slinger elements constituting either embodiment of the invention than it is for the conventional slinger ring. Furthermore, when a fan is equipped with a conventional slinger ring, great care must be taken during all handling up to final installation so as to avoid damaging the ring. It is also necessary for the shipping container to make provision for the ring, the container being larger than would otherwise be required. None of these precautions and expedients are necessary with flexible slinger elements embodying the invention, even when the slinger elements are factory assembled with the fan. The flexible elements are not readily susceptible to damage and they do not require any shipping container different from that necessary for the fan itself.

In addition to the foregoing, there is frequently a large saving in final assembly in the air conditioning unit when flexible slinger elements are provided. Fig. 1 shows the fan positioned with its outwardly projecting slinger elements between the condenser 28 and the partition 32. By reason of their flexibility, the slinger elements permit the fan to be moved during final assembly toward the left and through the opening 34 in the partition 32. If the fan were provided with the conventional rigid slinger ring, the above-mentioned convenient assembly procedure could not be followed, and it would be necessary to assemble either the condenser or the partition with the housing after the fan had been put in place.

In the foregoing description, it has been assumed that the slinger elements are assembled at the factory and are shipped in assembled positions on the fan. However, when there are manually manipulable means for connecting the slinger elements, they may, if preferred, be shipped unassembled and they may be assembled with the fan when the fan is installed in the air conditioning unit. When the slinger elements are to be assembled as last above stated, it is less important that they be flexible.

The invention claimed is:

1. The combination of a fan rotatable about a central axis and comprising a plurality of similar circumaxially

6

spaced generally radial blades arranged at similar pitch angles, and a plurality of similar circumaxially spaced cord-like slinger elements which are readily flexible and substantially impervious and which are looped and are fixedly connected at their ends to the fan blades at circumaxially spaced positions on said blades, each of said slinger elements having its central portion during fan rotation tangent to a circle concentric with the fan axis and having a diameter greater than that of the fan.

2. The combination of a housing having a sump in the bottom thereof adapted to receive and contain liquid which sump has an area substantially smaller than the area of said housing bottom, a fan within the housing and above said sump and rotatable about a horizontal axis which fan comprises a plurality of similar circumaxially spaced generally radial blades arranged at similar pitch angles, and a plurality of similar circumaxially spaced card-like slinger elements which are readily flexible and substantially impervious and which are circumaxially looped and are fixedly connected at their ends to the fan blades at circumaxially spaced positions on said blades, each said slinger element having its central portion during fan rotation tangent to a circle that is concentric with the fan axis and that has a diameter sufficiently greater than the diameter of the fan to enable said slinger elements to enter said sump for engagement with liquid therein.

3. The combination of a fan rotatable about a central axis and comprising a plurality of similar circumaxially spaced generally radial blades arranged at similar pitch angles, and a plurality of similar elongated and slender substantially impervious slinger elements which are circumaxially looped with each of them fixedly connected at one end to one fan blade and fixedly connected at the opposite end to another fan blade, each of the said elements being of such length that its central portion during fan rotation is tangent to a circle concentric with the fan axis and having a diameter greater than that of the fan.

4. The combination of a housing having a sump in the bottom thereof adapted to receive and contain liquid which sump has an area substantially smaller than the area of said housing bottom, a fan within the housing and above said sump and rotatable about a horizontal axis which fan comprises a plurality of similar circumaxially spaced generally radial blades arranged at similar pitch angles, and a plurality of similar elongated and slender substantially impervious slinger elements which are circumaxially looped and each of which is fixedly connected at one end to one fan blade and is fixedly connected at the opposite end to another fan blade, the said slinger elements having their central portions during fan rotation tangent to a circle that is concentric with the fan axis and that has a diameter sufficiently greater than the diameter of the fan to enable said slinger elements to enter said sump for engagement with liquid therein.

5. The combination of a fan rotatable about a central axis and comprising a plurality of similar circumaxially spaced generally radial blades arranged at similar pitch angles, and a plurality of similar readily flexible circumaxially looped cord-like slinger elements each connected at one end to one fan blade at a position on the rear side thereof and is connected at its opposite end to another fan blade at a position on the front side thereof, each of the said elements being of such length that its central portion during fan rotation is tangent to a circle concentric with the fan axis and having a diameter greater than that of the fan.

6. The combination of a fan rotatable in a predetermined direction about a central axis and comprising a plurality of similar circumaxially spaced generally radial blades arranged at similar pitch angles, and a plurality of similar readily flexible circumaxially looped cord-like slinger elements each connected at its leading end to one fan blade at a position on the rear side of the said blade and near the trailing edge thereof and connected at its

7

trailing end to another fan blade at a position on the front side of the said other blade and near the trailing edge thereof, each of the said elements being of such length that its central portion during fan rotation is tangent to a circle concentric with the fan axis having a diameter greater than that of the fan.

7. The combination of a fan rotatable about a central axis and comprising a plurality of similar circumaxially spaced generally radial blades arranged at similar pitch angles, and a plurality of similar readily flexible circumaxially looped cord-like slinger elements each fixedly connected at one end to one fan blade at a position spaced inwardly from the periphery thereof and fixedly connected at the opposite end to another fan blade at a position spaced inwardly from the periphery thereof, each of the said elements being formed of a molded plastic material and each of the said elements being of such length that its central portion during fan rotation is tangent to a circle concentric with the fan axis and having a diameter greater than that of the fan.

8. The combination of a fan rotatable about a central axis and comprising a plurality of similar circumaxially spaced generally radial blades arranged at similar pitch angles, a plurality of similar slinger elements each of which is elongated and slender, and means operable solely by manual manipulation of the several slinger elements and of the parts integral therewith and comprising interengageable parts on said elements at the ends thereof and at circumaxially spaced positions on said fan blades for fixedly connecting the slinger elements at said ends thereof to the fan blades at said positions thereon, each of the said slinger elements when so connected having its major portion circumaxially spaced from the major portion of each other element and each said element extending circumaxially in an outwardly projecting loop having its central portion tangent to a circle concentric with the fan axis and having a diameter greater than that of the fan.

9. The combination of a fan rotatable about a central axis and comprising a plurality of similar circumaxially spaced generally radial blades arranged at similar pitch angles, a plurality of similar readily flexible slinger elements each of which is elongated and slender, and means operable solely by manual manipulation of the several slinger elements and of the parts integral therewith and comprising interengageable parts on said elements at the ends thereof and at circumaxially spaced positions on said fan blades for fixedly connecting said elements to said blades, each element being connected at one end to one fan blade at a position on the rear side thereof and to another fan blade at a position on the front side thereof, each of the said slinger elements when so connected having its major portion circumaxially spaced from the major portion of each other element and each said element extending circumaxially in an outwardly projecting loop having its central portion during fan rotation tangent to a circle concentric with the fan axis and having a diameter greater than that of the fan.

10. The combination of a fan rotatable about a central axis and comprising a plurality of similar circumaxially spaced generally radial blades arranged at similar pitch angles, at least some of the said blades having similar holes therein near their peripheries, and a plurality of similar readily flexible looped cord-like slinger elements each having at the respective ends thereof connection devices which enter and at least partly fit corresponding holes in two adjacent blades for the detachable connection of the element to the last said blades, each of the said elements being of such length that when so connected its central portion during fan rotation is tangent to a circle concentric with the axis and having a diameter greater than that of the fan.

11. The combination of a fan rotatable about a central axis and comprising a plurality of similar circumaxially spaced generally radial blades arranged at similar pitch angles, at least some of the said blades having

8

similar holes therein near their peripheries each of which holes has a relatively large inner portion and a relatively small outer portion, and a plurality of similar readily flexible looped cord-like slinger elements each having at the respective ends thereof connection devices comprising heads adapted to enter the larger inner portions of the said holes in two blades but larger than the outer smaller portions of the said holes and also comprising necks connecting the said heads with the body of the element and adapted to enter and approximately fit the smaller outer portions of the said holes for the detachable connection of the element to the last said blades, each of the said elements being of such length that when so connected its central portion during fan rotation is tangent to a circle concentric with the axis and having a diameter greater than that of the fan.

12. The combination of a fan rotatable about a central axis and comprising a plurality of similar circumaxially spaced generally radial blades arranged at similar pitch angles, at least some of the said blades having similar holes therein near their peripheries, and a plurality of similar readily flexible looped cord-like slinger elements each provided at the respective ends thereof with integral connection devices having axes parallel with each other and at oblique angles to the longitudinal axis of the element which angles correspond approximately to the pitch angles of the fan blades, the inclined connection devices of each slinger element projecting through and at least partly fitting the holes in two adjacent blades for the connection of the element to the blades.

13. The combination of a fan rotatable about a central axis and comprising a plurality of similar circumaxially spaced generally radial blades arranged at similar pitch angles, at least some of the said blades having similar holes therein near their peripheries each of which holes has a relatively large inner portion and a relatively smaller outer portion, and a plurality of similar readily flexible looped cord-like slinger elements each having at the respective ends thereof connection devices with their axes at oblique angles to the longitudinal axis of the element which angles correspond approximately to the pitch angles of the fan blades, said connection devices comprising heads adapted to enter the larger inner portions of the said holes in two blades but larger than the outer smaller portions of the said holes and also comprising necks connecting the said heads with the body of the element and adapted to enter and approximately fit the smaller outer portions of the said holes for the detachable connection of the element to the last said blades, each of the said elements being of such length that when so connected its central portion during fan rotation is tangent to a circle concentric with the axis and having a diameter greater than that of the fan.

14. The combination of a fan rotatable about a central axis and comprising a plurality of similar circumaxially spaced generally radial blades arranged at similar pitch angles, at least some of the said blades having similar holes therein near their peripheries each of which holes has an inner portion of relatively large diameter and an outer portion of relatively small diameter and an intermediate portion narrower than the diameter of said relatively small portion, and a plurality of similar readily flexible looped cord-like slinger elements each having at the respective ends thereof connection devices comprising heads adapted to enter the large inner portions of the said holes in two blades but larger than the small outer portions of the said holes and also comprising cylindrical necks connecting the said heads with the body of the element and adapted to enter and approximately fit the small outer portions of said holes for the detachable connection of the element to the last said blades, the diameter of each of said necks being larger than the width of the intermediate portion of the corresponding blade hole so that the neck must be somewhat distorted to enter said small outer portion of said hole and the length of each of the said slinger elements

being such that said element when connected to said blades as described has its central portion so located during fan rotation that it is tangent to a circle concentric with the axis and having a diameter greater than that of the fan.

15. The combination of a fan rotatable about a central axis and comprising a plurality of similar circumaxially spaced generally radial blades arranged at similar pitch angles, at least some of the said blades having similar holes therein near their peripheries each of which holes has an inner portion of relatively large diameter and an outer portion of relatively small diameter and an intermediate portion narrower than the diameter of said relatively small portion, and a plurality of similar readily flexible looped cord-like slinger elements each having at the respective ends thereof connection devices comprising heads adapted to enter the large inner portions of the said holes in two blades but larger than the small outer portion of the said holes and also comprising necks connecting the said heads with the body of the element and each having a major diameter adapting it to enter and approximately fit the small outer portions of the said holes for the detachable connection of the element to the last said blades, each of said necks having a dimension in one direction smaller than said major diameter thereof and about equal to the width of the narrower portion of the corresponding blade hole so that said neck in a selected rotative position may freely pass outwardly through said narrower portion of said hole and so that said neck in another rotative position is locked in said small portion of said hole and the length of each of the said slinger elements being such that said element when connected to said blades as described has its central portion so located during fan rotation that it is tangent to a circle concentric with the axis and having a diameter greater than that of the fan.

16. The combination as set forth in claim 15, wherein the flat faces on the necks of the attaching devices are inclined with respect to an arc concentric with the center of rotation and extending through the centers of said devices, said flat face on the trailing device being inclined forwardly and outwardly and said flat face on the leading device being inclined forwardly and inwardly.

17. For use with a fan rotatable about a central axis and comprising a plurality of similar circumaxially spaced generally radial blades arranged at similar pitch angles and having similar holes therein, a readily flexible slinger element having a main longitudinal body and provided at the respective ends thereof with integral connection devices extending oppositely from said main body and having axes parallel with each other and at angles to the longitudinal axis of said element, said connection devices being adapted to project through and at least partly fit the holes in two adjacent fan blades for the connection of the element to the blades.

18. For use with a fan rotatable about a central axis and comprising a plurality of similar circumaxially spaced generally radial blades arranged at similar pitch angles

and having similar holes therein, a readily flexible slinger element having a main body and provided at the respective ends thereof with integral connection devices extending oppositely from said main body and having axes parallel with each other and at oblique angles to the longitudinal axis of said element which angles correspond approximately to the pitch angles of the fan blades, the said inclined connection devices of said slinger element being adapted to project through and at least partly fit the holes in two adjacent fan blades for the connection of the element to the blades.

19. For use with a fan rotatable about a central axis and comprising a plurality of similar circumaxially spaced generally radial blades arranged at similar pitch angles and having similar holes therein each of which holes has a portion of relatively large diameter and a portion of relatively small diameter, a readily flexible slinger element having a main longitudinal body and provided at the respective ends thereof with integral connection devices extending oppositely from said main body and having axes parallel with each other and at angles to the longitudinal axis of said element, each said connection comprising a head and a neck smaller than the head which head is adapted to be moved through the relatively large portion of a corresponding blade hole and which neck is adapted to be moved into and to at least partly fit the relatively small portion of said corresponding blade hole.

20. For use with a fan rotatable about a central axis and comprising a plurality of similar circumaxially spaced generally radial blades arranged at similar pitch angles and having similar holes therein each of which holes has a portion of relatively large diameter and a portion of relatively small diameter and an intermediate portion narrower than the diameter of said relatively small portion, a readily flexible slinger element having a main longitudinal body and provided at the respective ends thereof with integral connection devices extending oppositely from said main body and having axes parallel with each other and at angles to the longitudinal axis of said element, each said connection comprising a head and a neck smaller than the head which head is adapted to be moved through the relatively large portion of a corresponding blade hole and which neck has a dimension in one direction such that it is adapted to be moved through said intermediate portion of said corresponding hole and said neck having another dimension in another direction such that it is adapted to at least partly fit the relatively small portion of said corresponding blade hole.

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