HAIR INGESTION DEVICE AND DUST PROTECTOR FOR VACUUM CLEANER

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ABSTRACT

A hair ingestion device and dust protector for a vacuum cleaner, and a combination of an end cap and a dowel assembly having a thread cap, wherein a set of arms extends from the thread cap for rotating with the dowel for deflecting threads to avoid contamination of the bearing assembly included in the dowel assembly. The thread cap also includes tapered vanes for cooperating with an end cap to form a dust shield.
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BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to apparatus for a vacuum cleaner and, in particular, to a cap or to structure integral with the dowel for preventing threads and other thin items such as both hair and dust from reaching the bearings of a vacuum cleaner and damaging the bearings and the vacuum cleaner itself, and for preventing threads, hair and fibers from clogging or seizing the rotation of the dowel which rotates in the head of the vacuum cleaner.

2. Description of the Prior Art

Various items are known for preventing or at least reducing contaminants from reaching the bearings of a vacuum cleaner, these bearings often being carried by the dowel assembly of a vacuum cleaner, where the dowel assembly includes a dowel which rotates about its longitudinal axis. The bearings can be of many types, such as ball bearings or bushings, and other friction reducing means. In a popular version of a vacuum cleaner, the dowel has radially extending tufts of bristles or the like, and the dowel assembly is rotated by means of a belt which is driven by the vacuum cleaner motor. In another version, the dowel assembly is rotated by a motor-driven gear chain. Some of the persistent contaminants of vacuum cleaner bearings are thread, hair, fibers and the like (hereinafter sometimes referred to as “thread”). One attempt to prevent thread from reaching the bearings is the provision of felt on the ends of the dowel, which acts as a barrier to block some thread from passing to the bearings and/or from clogging the dowel. However, the felt has been found to simply accumulate thread, and some thread either breaks from being held by the felt or passes through the felt and is carried to the bearings and/or may contribute to seizing the dowel. Another attempt to keep thread from moving to the bearings or clogging the dowel is a cylindrical wall which extends from a disk overlapping the end of the dowel assembly and extends toward the center of the dowel assembly for acting as a shield or labyrinth for barring the threads from reaching the bearings or clogging the dowel. However, this type of shield is not effective since potentially damaging threads bypass the cylindrical wall.

The thread problem is serious in the vacuum cleaner industry, and various companies have established hair ingestion tests in which particular amounts of hair are spread over a prescribed area. In order to pass the test, a vacuum cleaner is required to prevent the operating vacuum cleaner from picking up the hair and transferring it into the bearing assembly and/or clogging the dowel in the end of the dowel assembly. Passing these tests has been a serious problem in the vacuum cleaner industry.

The problem of dust invading the end of the dowel of a vacuum cleaner and potentially causing damage to the bearings was solved as set forth in Ser. No. 10/375,747 filed Feb. 26, 2003 by the present inventors. In the preferred embodiment of that application, a set of vanes rotating with the dowel cooperate with an appropriately configured end cap to in effect set up an air barrier while expelling dust in the vicinity.

SUMMARY OF THE INVENTION

An object of the present invention is to provide an improved apparatus for protecting a vacuum cleaner from contaminants.

Another object is to protect a vacuum cleaner from threads.

Still another object of the invention is to prevent threads from damaging the bearing assembly of a vacuum cleaner.

It is a further object to prevent threads from clogging or seizing a dowel in vacuum cleaners.

It is an additional object to protect the bearing components held in the dowel assembly of a vacuum cleaner from threads.

Yet another object is to provide apparatus for substantially preventing threads from contaminating the bearings in the dowel assembly of a vacuum cleaner.

It is also an object to provide apparatus for preventing threads from impairing the operation of bearing assemblies in vacuum cleaners, which apparatus is economical to fabricate and install, and effective in use.

Another object is to provide a device for effectively and efficiently preventing hair and dust from contaminating the bearings and/or from clogging the dowel of a vacuum cleaner.

An additional object is to provide an improved device for both preventing threads from impairing the operation of a vacuum cleaner and for preventing dust from also preventing the proper operation of a vacuum cleaner.

These and other objects will become apparent from the description to follow and from the appended claims.

The foregoing objects of the present invention are achieved by the preferred embodiment of the invention. Many vacuum cleaners incorporate a dowel assembly having a dowel with tufts of bristles extending generally radially therefrom for picking up dirt, including dust and thread, as the dowel rotates about its central, longitudinal axis. An axially-extending rod extends from each end of the dowel portion of the dowel assembly, and the dowel rotates with the rod(s). The dowel assembly is rotated by a belt, gear train or the like, which is driven by a motor. The dowel assembly has a dowel which is usually recessed at its opposite ends. A bearing assembly is located in the respective recesses, and the bearing assembly engages both the rod(s) during rotation of the dowel and structure fixed relative to the body of the vacuum cleaner, such as an end cap, for reducing friction between the dowel and the fixed structure. The end cap covers an end of the dowel assembly and has an inner collar configured to fit into the recess and to engage the fixed portion of the bearing assembly. The hair (or thread) ingestion device and dust protector according to the preferred embodiment includes a thread cap. The thread cap is seated inside each recess of the dowel and sits against an end wall of the dowel perpendicular to the longitudinal axis of the dowel. The thread cap has an annular shoulder for locating the bearing assembly which is mounted on the rod. The thread cap has an annular flange from which extend radial arms. The radial arms can lie in a common plane which is perpendicular to the longitudinal central axis of the dowel.
The arms may also be referred to as skirts, tangs or deflector paddles. Each arm is defined on its radial sides by a pair of generally radial edges which are referred to herein as ramps. The respective arms are separated by a space having no arms, the spaces being referred to as “slots.” The arms set up a barrier to prevent thread from moving to the bearing assembly. The number of arms is not crucial, but an inventive end cap with eight arms has been found to be very effective.

[0018] The thread cap has a generally frusto-conical wall defining a recess, and generally radial vanes extend from the latter wall into the recess. The outer walls of the collar of the end cap cooperate with the vanes to form a dust protector.

[0019] Alternatively, the foregoing structure could be incorporated as an integral part of the dowel, or as a separate piece or pieces attached to the dowel. Likewise, some components could be integral with the dowel, and others could be part of an insert in the dowel.

[0020] The dowel assembly rotates about its central axis as it is driven by the driving assembly operated by the vacuum cleaner motor. The rotating deflector arms or paddles, accompanied by the slots, deflect threads and prevent the threads from entering the recesses at the end of the dowel assembly and stop the threads from reaching the bearing assembly or from clogging (i.e. seizing) the dowel. The vanes cooperate with the collar of the end cap to establish an air shield transverse to the longitudinal axis of the dowel and to apply centrifugal force to dust particles to drive them from the recess in the dowel and to the ambient atmosphere.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] FIG. 1 is a part perspective view of a dowel assembly for a vacuum cleaner, showing an end cap with a portion cut away to show a portion of the invention.

[0022] FIG. 2 is a side view of the apparatus shown in FIG. 1.

[0023] FIG. 3 is a perspective view of a thread cap according to a preferred embodiment of the invention.

[0024] FIG. 4 is an alternate thread cap according to the invention.

[0025] FIG. 5 is a cross-sectional view of a dowel assembly with a thread cap as shown in FIG. 3, and an end cap.

[0026] FIG. 6 is a bottom view of a portion of a vacuum cleaner with a dowel assembly and end caps incorporating the present invention. The cover of the vacuum cleaner has been removed to reveal the foregoing parts.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0027] Referring first to FIG. 1, one end portion of a dowel assembly 10 is shown on which is mounted an end cap 30. Dowel assembly 10 incorporates a dowel 12. Dowel 12 is shown as being belt driven and has a pair of annular recesses 14 with radial sidewalls 16, 18 to collectively form a pulley 19 having a rim 21 for receiving a motor driven drive belt. An annular side end portion 20 of dowel 12 has generally radial tufts of bristles 22 extending therefrom for picking up such dirt as dust and threads coming in their path as dowel 12 is rotated by the vacuum cleaner motor. Tufts of bristles 22 are of a type known in the art. The portion of the dowel assembly is shown in FIG. 1, and the opposite end is nearly identical in configuration and components, although usually only one part of the assembly is provided with the structure for rotating the dowel.

[0028] Dowel 12 rotates about a rod or shaft 24 running along the central longitudinal axis of dowel 12. Rod 24 could extend through the entire length of dowel 12 through a bore 26 extending along the length of dowel 12, or there could be a pair of rods which is disposed at an axial end of dowel 12, in which case bore 26 would be closed to properly locate each rod 24. Dowel 12 and rod(s) 24 are fixed to each other. A thread cap 28 is mounted on the free end of rod 24 extending from a recess in dowel 12 as explained below, and end cap 30 covers the end of dowel assembly 12. As explained later, end cap 30 functions both as a contributing part of a dust shield and as a bearing assembly holder. A bearing assembly 32 is also mounted on the end portion of rod 24 as also discussed below, and end cap 30 has a cylindrical inner collar 34 which engages bearing assembly 32 to hold one part as discussed later. End cap 30 has an outer cylindrical wall 36 which helps to prevent dust from entering the end portion of dowel assembly 10. End cap 30 is fixed relative to the body of the vacuum cleaner in which dowel assembly 10 is mounted.

[0029] The side view of FIG. 1 is shown in FIG. 2. FIG. 2 shows one end portion of dowel assembly 10 with dowel 12, annular recess 14 with sidewalls 16, 18, annular side end portion 20 and tufts of bristles 22. The side of thread cap 28 is shown. End cap 30 covers the end portion of dowel assembly 10.

[0030] Thread cap 28 is shown in detail in FIG. 3. Thread cap 28 comprises a support 29 which is generally frusto-conical in shape, having a frusto-conical wall 39 tapering outwardly from a relatively small in diameter inner hub 40 to the relatively large inside circular portion or inner edge 42 of an annular flange or support 44. Hub 40 has a hole 43 for fitting over rod 24. Thread cap 28 has an inside surface or inner end wall 41 being seated in the recess of dowel 12 and a bearing seating surface 45 upon which a bearing assembly can be seated. Thread cap 28 incorporates a set of vanes 46 extending along the inner surface of frusto-conical wall 39 for cooperating with collar 34 of end cap 30 to prevent dust from contaminating bearing assembly 32 (as described in principle in co-pending U.S. Ser. No. 10/375,747 filed Feb. 26, 2003 cited above), although in the latter application the vane structure is on the dowel and not on a thread cap as is presently being discussed. Vanes 46 extend radially inwardly from wall 38 and are inclined outwardly from the outer edge of hub 40 to the inner edge of flange 44 to set up an air movement which both bars dust from moving towards hole 43 and bearing assembly 32, and for establishing a centrifugal force to eject dust from between thread cap 28 and end cap 30 to the ambient air. Eight vanes 46 have been found to work well, but other numbers may work as well. There may be situations where vanes 46 are not required, and they could be removed; however, arms 46 will function according to the invention. The structure without the vanes is shown in FIG. 4.

[0031] Referring to FIG. 5, collar 34 has an outer (away from the longitudinal axis of end cap 30) wall 47 which is inclined by the same amount as vanes 46, but collar 34
terminates in the radial direction prior to its entering the
space between vanes 46. Wall 47 defines a volume with
the interior of thread cap 28 with vanes 46 for establishing a dust
or air shield to prevent dust from flowing to the bearing
assembly and for defining a path for the dust to be forced
from the dowel assembly and the end cap by centrifugal
force.

[0032] However, whereas the flange corresponding to
flange 44 in FIG. 3 in Ser. No. 10/375,747 is relatively
narrow, flange 44 is wider and it carries radially-extending
angularly (and preferably equiangularly) spaced arms 48.
Each arm 48 is defined on its generally oppositely
disposed sides by ramps 50, 52 and at its free end by an outer
edge or free end 54. Ramps 50, 52 are angled to prevent
threads from clogging or seizing the rotation of dowel 12, or
contaminating the bearing assembly. Viewing FIG. 3, when
thread cap 28 rotates clockwise as shown by arrow A,
threads moving between any of ramps 50 and 52 are engaged by
ramp 52 and deflected in direction C generally parallel with
the axis of rotation of dowel 12 and away from the
bearing assembly. Likewise, when thread cap 28 is rotating
counterclockwise in Direction B, threads are engaged by a
ramp 50 and also deflected in direction C away from the
bearing assembly. The angle θ of ramps 50, 52 should be
between 30°-60°, although other angles and configurations
are within the scope of the invention. For example, θ could
be 0°, the ramps could each have a variety of configurations
within each ramp, and each pair of ramps facing each other
could have different configurations. The depth of arms 48
depend upon the nature of the dowel assembly, the charac-
teristics of thread cap 28, the nature of the threads expected
to be encountered, and other variations depending on
the nature of the vacuum cleaner. Moreover, arms 48 need not
extend radially from outer end 53 of thread cap 28.

[0033] Still considering arms 48, each arm 48 extends
from an outer end 53 of thread cap 28, outer end 53 being
nearest the end of dowel 12 when inner hub 40 at an inner
end 55 is inserted into the end portion of dowel 12. Flange
44 is at outer end 53. Free ends 54 lie in an imaginary
cylindrical surface concentric with the axis of dowel 12,
with each end 54 being partially concentric with that axis.
Ramps 50, 52 are therefore concentric with the axis of dowel
12 and are inclined inwardly from outer end 53 towards
inner end 55. In other words, the projection of ramps 50, 52,
on the respective arms 48 would meet in the direction of
the inner end 55 of end cap 28. Edges 54 are preferably curved
and concentric with the longitudinal, central axis of bore 26.
Flange 44 and arms 48 are advantageously planar, and the
plane is perpendicular to the axis of bore 26.

[0034] Inner hub 40 of thread cap 28 includes bearing
sealing surface 45 for sealing bearing assembly 32 in the
recess of dowel 12. Surface 45 is on a relatively thick inner
cylindrical part for providing strength to thread cap 28 as
well as to provide an increased area of thread cap 28 for the
rod in the dowel to engage.

[0035] FIG. 5 shows the invention in a slightly different,
but similar, dowel assembly 100 for a vacuum cleaner. The
same numerical designators will be used as in FIGS. 1 and
2, but a different pulley 60 is used and cutting channels are
incorporated as explained below. Pulley 60 is fixed in dowel
12, which is engaged by a belt driven by the motor for the
vacuum cleaner to rotate dowel 12 about rod 24. The end of
dowel 12 as shown includes tapering sidewall 62 and an end
wall 64, for defining a recess in the end of dowel 12 (there
are like structures at both ends of dowel 12). Bore 26 extends
through dowel 12 to accommodate rod 24 which rotates with
dowel 12. Dowel 12 further includes cutting channels 66, 68
in which scissors or other cutting device can be inserted to
cut thread wound about dowel 12 to facilitate removal of the
thread.

[0036] Bearing assembly 32 is a ball bearing assembly
(although other bearing assemblies such as bushings could
be used) and is composed of an inner ring or race 70
having an axial hole with an inner diameter generally equal to
the diameter of rod 24 so that ring 70 will rotate with rod 24,
an outer ring or race 72 with an outer diameter, and a set of
bearing balls 74. Inner hub 40 of thread cap 28 has bearing
surface 45, and inner ring 70 sits on surface 45. As discussed
below, outer ring 72 is fixed with respect to end cap 30.

[0037] Thread cap 28 is shown as being seated in the
recess in the end of dowel 12. Wall 39 of thread cap 28 and
tapering sidewall 62 of dowel 12 are configured to nest
together. Thread cap 28 has its inner end wall 41 which is
seated against end wall 64 of dowel 12. Thread cap 28 is
shown having inwardly extending vanes 46 and outwardly
extending flanges 44 with arms 48.

[0038] End cap 30 is mounted across the end of dowel
assembly 100 and has protrusion 76 having an inner recess
defined by inner cylindrical wall 78 and inner protrusion end
wall 80. Protrusion 76 receives the end of rod 24. End cap
30 further has an inner shoulder 82 engaging the end of outer
ring 72 of bearing assembly 32. Collar 34 has an interior
bore 84 for engaging outside surface 86 of bearing assembly
32 by means of a press fit. By this arrangement, the rotation
of dowel 12, rod 24, thread cap 28 and inner ring 70 is
affected, and end cap 30 and outer ring 72 of bearing
assembly 32 are stationary with respect to the foregoing
rotation.

[0039] Dowel 12 is preferably made by injection molding
of an appropriate plastic, although wood or metal could also
be used. Injection molding is advantageous in that it pro-
vides fast, consistent results and yields a product of even
density that may not require rotational balancing. Thread cap
28, end cap 30 and pulley 106 shown in FIG. 5, are also
preferably made from an appropriate plastic by injection
molding, and various pulley designs are possible depending
on the driving device. Appropriate plastics include nylon,
glass-filled nylon, ABS and the like. Metal pulleys are also
possible.

[0040] FIG. 6 shows a dowel assembly 100 with end caps
30 mounted in a vacuum cleaner 102. Dowel assembly 100
is rotated by a belt 104. Belt 104 is rotated by a shaft 106
which is rotated by the vacuum cleaner motor. Tufts of
bristles 22 perform the cleaning operation. End caps 30 are
fixed relative to the body of vacuum cleaner 102 by means
of sole plates 108 which fixedly engage protrusions 76 of
end caps 30. While dowel 12 is shown as being rotated by
belt 104, other means for rotating a dowel are known. In
addition to a gear train mentioned earlier, the dowel could be
rotated by airflow, a motor within the dowel, a worm gear,
an electrical device or by a shaft.

[0041] In operation, dowel 12 is rotated about its longi-
tudinal axis by the drive belt 104, gear drive or the like.
Considering first the threads which could damage bearing assembly 32, thread cap 28 rotates with dowel 12. Radially-extending arms 48 deflect threads, which might otherwise work their way between end cap 30 and bearing assembly 32, and prevent them from damaging the bearing assembly. The deflected threads may be wound about dowel 12 or may be deflected entirely away from the vacuum cleaner.

[0042] Turning to the dust, the rotation of thread cap 28 establishes air turbulence in a cavity 86, around the inner portion of collar 34 to its termination at outer cylindrical wall 36. This turbulence provides a barrier to dust which otherwise could flow through the cavity and contaminate the bearing assembly. Any dust that happened to be in or around the bearing assembly would be expelled by centrifugal force.

[0043] The invention thus provides a very effective yet inexpensive way to prevent both threads and dust from contaminating the bearing assembly. The invention can be made through injection molding of appropriate plastics using known manufacturing techniques. Plastic has been found to be a preferable material, but other materials such as metal, wood, glass fibers and the like could also be used. Although the preferred embodiment of the invention showed the arms and vanes as being part of the thread cap, the invention also encompasses the arms and/or vanes being integral with the dowel.

[0044] The invention has been described in detail, with particular emphasis on the preferred embodiments thereof, but variations and modifications may occur to those skilled in the art to which the invention pertains from the foregoing specification and drawings, and the appended claims.

We claim:

1. Apparatus for keeping threads from moving to the bearing assembly of a vacuum cleaner, the vacuum cleaner having a dowel for rotating about the longitudinal axis of the dowel, said apparatus comprising:

   a set of angularly spaced arms extending generally radially from structure near the bearing assembly for rotating with the dowel, said arms deflecting threads moving towards said arms away from the bearing assembly.

2. A thread cap for rotating with a dowel in a vacuum cleaner for deflecting threads away from said thread cap to avoid the contamination of the vacuum cleaner by said threads, said thread cap comprising:

   a support for rotating with the dowel,

   a set of arms extending from said support in a direction generally away from the longitudinal axis of the dowel, said arms being spaced from each other for deflecting threads in the vicinity of said arms.

3. A thread cap according to claim 2 wherein said arms have free ends spaced from said support, said free ends being configured for deflecting threads away from said support in a direction generally parallel to the axis of rotation of the dowel.

4. A thread cap according to claim 3 having an outer end for being placed near the end of the dowel and an inner end, and said free ends extend radially outwardly with respect to the dowel, said free ends being partially concentric with the dowel and terminating in concentric edges in the form of ramps inclined inwardly from the outer end of said thread cap towards the inner end of said thread cap for deflecting threads striking the respective ramps.

5. A thread cap according to claim 2 wherein the dowel has an axially extending shaft and the vacuum cleaner has a bearing assembly, and said thread cap is mountable on the shaft near the bearing assembly for deflecting threads away from the bearing assembly.

6. A thread cap according to claim 2 wherein the dowel has at least one recess at an end of the dowel, and said thread cap is configured to be mountable on the shaft within the recess.

7. A thread cap according to claim 6 wherein said thread cap further comprises:

   a surface for being engaged by the bearing assembly to position the bearing assembly relative to the dowel.

8. A thread cap according to claim 6 wherein said thread cap further comprises:

   a wall extending longitudinally with respect to the longitudinal axis of the dowel in which said thread cap is mountable, and tapered vanes extending from said wall and directed towards the longitudinal axis for cooperating with other structure to keep dust from contaminating a vacuum cleaner incorporating said thread cap.

9. A thread cap according to claim 8 wherein the at least one recess in the dowel is generally of a frusto-conical configuration with the larger dimension being at the end of the dowel, and wherein said thread cap further comprises:

   a relatively narrow hub portion for being placed inwardly in the dowel away from the end of the dowel, said hub portion having an inner edge fixing said hub portion to said shaft and an outer edge; and

   a relatively wide annular flange longitudinally spaced from said hub portion, and having an inner edge and an outer edge;

   wherein said set of arms extends radially from said outer edge of said annular flange, and said wall extends between said hub portion and said inner edge of said annular flange.

10. Apparatus for a vacuum cleaner, said apparatus comprising:

   a dowel assembly including:

   a rotatable dowel having a longitudinal axis and opposite ends;

   a shaft extending from at least one end of said dowel;

   a bearing assembly attached to said shaft, and

   a set of angularly spaced arms extending generally radially with respect to said dowel adjacent to said bearing assembly for rotating with said dowel, for deflecting threads moving towards said arms away from said bearing assembly.

11. Apparatus for a vacuum cleaner according to claim 10, wherein said dowel assembly further includes:

   a support for rotating with said dowel, said set of arms forming part of said support.

12. Apparatus for a vacuum cleaner according to claim 10 wherein said dowel further includes:

   surfaces defining a recess at least one end of said dowel; and

   wherein said dowel assembly further includes:
a thread cap mounted on said shaft and being disposed in said recess, said set of angularly spaced arms extending from said thread cap.

13. Apparatus for a vacuum cleaner according to claim 12, wherein said thread cap further comprises:

a hub having a hole for fixing said thread cap to said shaft; and wherein said support comprises:

a flange spaced from said hub and extending transversely to the longitudinal axis of said dowel, said angularly spaced arms extending from said flange.

14. Apparatus for a vacuum cleaner according to claim 13 wherein:

said surfaces defining a recess in said dowel define a recess having a frusto-conical configuration; and

said thread cap further comprises a wall extending longitudinally with respect to the longitudinal axis of said dowel between the outer edge of said hub portion and the inner edge of said flange, said wall being configured to rest in the recess of said dowel.

15. Apparatus for a vacuum cleaner according to claim 14 wherein said hub includes a surface for locating said bearing assembly with respect to said dowel.

16. Apparatus for a vacuum cleaner according to claim 14 wherein the vacuum cleaner has a body, and wherein said apparatus further comprises:

an end cap located on an end of said dowel and fixed with respect to the body of the vacuum cleaner, said end cap having a collar for engaging a first portion of said bearing assembly to fix said first portion to one body of the vacuum cleaner.

17. Apparatus for a vacuum cleaner according to claim 16 wherein said bearing assembly is a ball bearing assembly having an inner ring fixed to said shaft and an outer ring fixed to said collar of said end cap.

18. Apparatus for a vacuum cleaner according to claim 16 and further comprising a set of tapered vanes extending from said wall and directed towards the longitudinal axis for cooperating with said end cap to keep dust from contaminating the vacuum cleaner.

19. Apparatus for a vacuum cleaner according to claim 18 wherein said collar of said end cap has tapered configuration corresponding to said tapered vanes, said thread cap rotating with said dowel relative to said end cap to establish an air shield to keep dust from contaminating said bearing assembly and for directing dust from between said dowel assembly and said end cap to the ambient air.

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