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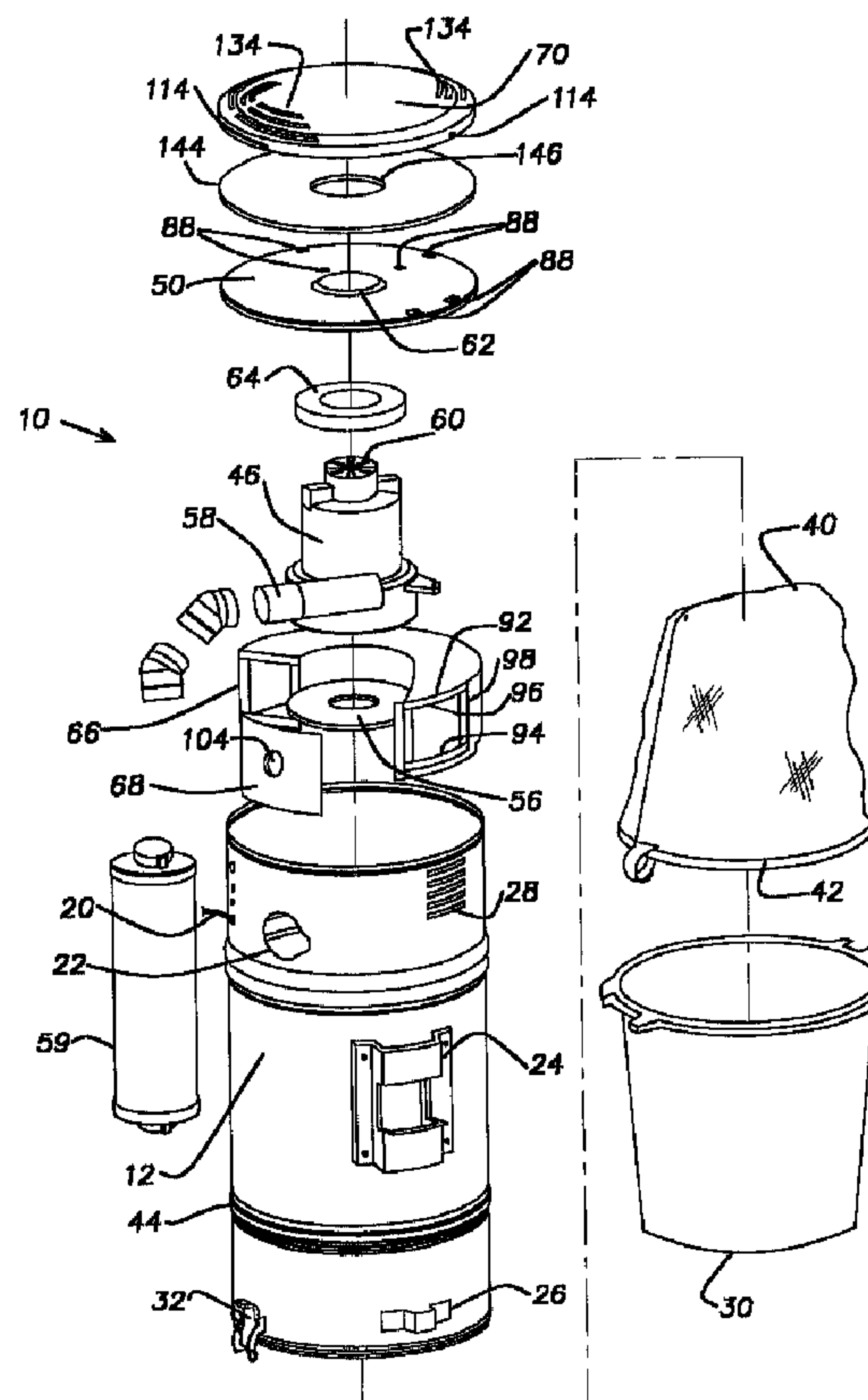
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(54) Titre : SYSTÈME D'ASPIRATEUR CENTRAL AVEC ATTENUATION ACOUSTIQUE

(54) Title: CENTRAL VACUUM WITH ACOUSTICAL DAMPING



(57) Abrégé/Abstract:

A central vacuum unit having an acoustic damping system is provided. The central vacuum unit includes a canister having a sidewall forming a hollow interior and a lid closing an end of the sidewall, a vacuum motor within the canister which emits noise during operation, at least one cooling air inlet for admitting cooling air into the hollow interior, and at least one cooling air outlet in



(57) Abrégé(suite)/Abstract(continued):

the sidewall for exhausting the cooling air from the hollow interior. Additionally, the sidewall has an exhaust port and the motor has an exhaust pipe extending through the exhaust port. The acoustic damping system includes an acoustic damping tunnel, an acoustic damping canopy, and an exhaust port seal. The acoustic damping tunnel is within the hollow interior and forms a pathway between the hollow interior and the cooling air outlet. The pathway is lined with a sound absorbing material so that the tunnel reduces noise emitted from the hollow interior through the cooling outlet. The acoustic damping canopy is attached to the canopy over the cooling air inlet. The canopy has an inlet and forms a serpentine pathway between the canister cooling air inlet and said canopy inlet to reduce noise emitted from the hollow interior through the canister cooling air inlet. The exhaust port seal covers the exhaust port to reduce noise emitted from the hollow interior through the exhaust port. The exhaust port seal preferably includes flexible foam bonded to the canister sidewall.

CENTRAL VACUUM WITH ACOUSTICAL DAMPING1 **ABSTRACT OF THE DISCLOSURE**

2 A central vacuum unit having an acoustic damping
3 system is provided. The central vacuum unit includes a
4 canister having a sidewall forming a hollow interior and
5 a lid closing an end of the sidewall, a vacuum motor
6 within the canister which emits noise during operation,
7 at least one cooling air inlet for admitting cooling air
8 into the hollow interior, and at least one cooling air
9 outlet in the sidewall for exhausting the cooling air
10 from the hollow interior. Additionally, the sidewall has
11 an exhaust port and the motor has an exhaust pipe
12 extending through the exhaust port. The acoustic damping
13 system includes an acoustic damping tunnel, an acoustic
14 damping canopy, and an exhaust port seal. The acoustic
15 damping tunnel is within the hollow interior and forms a
16 pathway between the hollow interior and the cooling air
17 outlet. The pathway is lined with a sound absorbing
18 material so that the tunnel reduces noise emitted from
19 the hollow interior through the cooling outlet. The
20 acoustic damping canopy is attached to the canopy over
21 the cooling air inlet. The canopy has an inlet and forms
22 a serpentine pathway between the canister cooling air
23 inlet and said canopy inlet to reduce noise emitted from
24 the hollow interior through the canister cooling air
25 inlet. The exhaust port seal covers the exhaust port to
26 reduce noise emitted from the hollow interior through the
27 exhaust port. The exhaust port seal preferably includes
28 flexible foam bonded to the canister sidewall.

CENTRAL VACUUM WITH ACOUSTICAL DAMPING

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The present invention relates in general to a central vacuum unit and, more particularly, to an acoustical damping system which substantially reduces the level of noise emitted from the central vacuum unit.

DESCRIPTION OF RELATED ART

Built in vacuum systems typically have a central vacuum unit and a system of vacuum ducts which extend into various rooms of the house. Vacuum inlets are located in walls of selected rooms so that a vacuum hose can be connected to the central vacuum unit. When not in use, the vacuum inlets are covered by plates. To use the central vacuum system, one of the vacuum inlets is opened and the vacuum hose is plugged into the inlet. The central vacuum unit is automatically activated and a suction force draws in dirt and dust through a nozzle attached to the end of the vacuum hose. The central vacuum system provides more cleaning power than conventional portable vacuum cleaners and reduces the necessity of carrying portable vacuum cleaners from room to room. Additionally, the central vacuum system vents exhaust air out of the living area to eliminate the recirculation of unhealthy air.

One major disadvantage of built in vacuum systems known in the prior art, however, is the creation of a substantial amount of noise by the central vacuum unit. In most conventional units known in the prior art, the noise level generated from the central vacuum unit lies in the range of about 75 to about 95 decibels. Even though the central vacuum unit is typically located in a remote area such as the basement or garage of the home, many people use such locations as playrooms, workshops, etc. It is almost impossible to comfortably work in such locations when the central power and suction unit is operating, because the high noise level is sometimes

1 deafening and at best extremely irritating.

2 U.S. Patent No. 4,938,309 discloses a built-in vacuum
3 cleaning system with an acoustic damping design. The
4 motors of the unit are enclosed withing an interior
5 chamber which includes at its lower end a baffle covered
6 with acoustic foam and is vented through exhaust ports. .
7 Tips of the motor armatures are separated from the
8 remainder of the armatures and motor by the baffle. The
9 tips of the armatures extend into a separate acoustic
10 damping chamber which is also covered at a lower end with
11 acoustic foam and includes openings for cooling air. While
12 this acoustic damping design may reduce the noise level
13 emitted from the unit while sufficiently cooling the
14 motor, the noise level remains relatively high.
15 Accordingly, there is a need in the art for a built-in
16 vacuum cleaning system with an improved acoustical damping
17 system to significantly lower the noise level emitted from
18 the central vacuum unit.

19 SUMMARY OF THE INVENTION

20 The present invention provides a central vacuum unit
21 with an improved acoustic damping system which overcomes
22 at least some of the above-noted problems. The central
23 vacuum unit includes a canister which forms a hollow
24 interior, a vacuum motor within the canister which emits
25 noise during operation, at least one opening in the
26 canister, and an acoustic damping tunnel within the hollow
27 interior and forming a pathway between the hollow interior
28 and the opening. The pathway is lined with a sound
29 absorbing material so that the tunnel reduces noise
30 emitted from the hollow interior through the opening.

31 According to another aspect of the invention, an
32 acoustic damping canopy is attached to the outside of the
33 canister and covers an opening in the canister. The
34 canopy has at least one inlet and forms a serpentine

1 pathway between the inlet and the opening in the canister to
2 reduce noise emitted from the hollow interior through the
3 opening in the canister.

4 According to yet another aspect of the invention the
5 canister has an exhaust port and the motor has an exhaust
6 pipe extending through the exhaust port. An exhaust port
7 seal is provided which completely covers the exhaust port to
8 reduce noise emitted from the hollow interior through the
9 exhaust port. The exhaust port seal is preferably formed
10 from flexible foam.

11 In another broad aspect, then, the present invention
12 relates to a central vacuum unit comprising: a canister
13 forming a hollow interior; a vacuum motor within said
14 canister which emits noise during operation; at least one
15 opening in said canister; an acoustic damping canopy outside
16 said canister and covering said opening, said canopy having
17 at least one inlet and forming a serpentine pathway between
18 said opening and said inlet to reduce noise emitted from
19 said hollow interior through said opening and said inlet.

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BRIEF DESCRIPTION OF THE DRAWINGS

These and further features of the present invention will be apparent with references to the following description and drawings, wherein:

FIG. 1 is a front elevational view of a central vacuum unit according to the invention;

FIG. 2 is a fragmented and enlarged view, partially in cross-section, of a portion of the central vacuum unit of FIG. 1;

FIG. 3 is an exploded view of the central vacuum unit of FIG. 1;

FIG. 4 is a cross-sectional plan view taken along line 4-4 of FIG. 2;

FIG. 5 is a perspective view of a tunnel of the central vacuum unit of FIG. 1;

FIG. 6 is a perspective view of an exhaust port seal of the central vacuum unit of FIG. 1;

FIG. 7 is a cross-sectional plan view taken along line 7-7 of FIG. 2; and

FIG. 8 is a perspective view of an acoustic damping canopy of the central vacuum unit of FIG. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIGS. 1-3 illustrate a central vacuum unit 10 with an acoustical damping system according to the present invention. The illustrated unit 10 is a model 189

1 manufactured by Beam Industries of Webster City, Iowa.
2 It is noted, however, that while the model 189 central
3 vacuum unit is utilized herein to illustrate the present
4 invention, any conventional central vacuum unit can
5 include the present invention to reduce the amount of
6 noise emitted therefrom.

7 The central vacuum unit 10 has a cylindrically-
8 shaped housing or canister 12 of rolled steel which forms
9 a hollow interior space. The canister has a side wall
10 with an air intake port 14 and a vacuum hose port 16
11 located near the bottom of the canister 12. An on-off
12 switch 18 is located near the top of the canister 12. A
13 power cord 20 is provided for connecting the central
14 vacuum unit 10 to a conventional electrical power source
15 (not shown). An exhaust port 22 is also located near the
16 top of the canister 12. Upper and lower mounting
17 brackets 24, 26 are vertically aligned along a rear face
18 of the sidewall and provide means for mounting the
19 canister 12 on a wall. Located in the sidewall near the
20 top of the canister 12 is a cooling air exhaust or outlet
21 28 such as the illustrated plurality of slots.

22 A hollow bucket 30 is removably attached to the
23 bottom of the canister 12 by means such as quick-release
24 clips 32. Within the canister 12 is a partition wall 34
25 which is supported by a ledge 36 formed by an inwardly
26 extending recess 38 formed in the sidewall of the
27 canister 12. Together the sidewall of the canister 12,
28 the bucket 30, and the partition wall 34 form a first or
29 lower interior compartment or chamber 39 within the
30 hollow interior of the canister 12. A removable dirt and
31 dust collection bag 40 which is air permeable and is
32 housed within the lower interior chamber 39. The bag 40
33 has a flexible rim 42 which rests within an outwardly
34 extending recess 44 formed in the side wall of the
35 canister 12.

36 A vacuum motor 46 is housed within a second or upper
37 interior compartment or chamber 48 which is located above

1 the lower interior chamber 39 and is separated from the
2 lower interior chamber 39 by the partition wall 34. The
3 upper interior chamber 48 is formed by the side wall of
4 the canister 12, the partition wall 34, and a steel lid 50
5 which closes the upper end of the canister 12. A vacuum
6 inlet 52 of the vacuum motor 46 is in fluid flow
7 communication with the lower interior chamber 39 through
8 an opening 54 in the partition wall 34. A gasket 56 is
9 provided between the vacuum motor 46 and the partition
10 wall 34 so that a seal is maintained between the lower and
11 upper interior chambers 39, 48.

12 A vacuum exhaust pipe 58 of the vacuum motor 46
13 provides an exit for hot exhaust coming from the vacuum
14 motor 46 and extends through the exhaust port 22 in the
15 sidewall of the canister 12. The vacuum exhaust pipe 58 is
16 connected to a muffler 59 which is located outside the
17 canister 12. The muffler 59 is preferably of the type
18 disclosed in U.S. Patent No. 6,052,863, for a "CENTRAL
19 VACUUM CLEANER MUFFLER", by Steven P. Rittmueller, Douglas
20 E. Johnson, J. Adin Mann III, and David K. Holger.

21 Suction created by the vacuum motor 46 causes a flow
22 of air into the air intakes 14, 16 of the canister 12,
23 through the collection bag 40 within lower interior
24 chamber 39 of the canister 12, and into the vacuum inlet 52
25 of the vacuum motor 46. The air is exhausted from the
26 motor 46 through the exhaust pipe 58 and the muffler 59.
27 Dirt, dust and other debris entrained within the flow of
28 air is blocked by the collection bag 40 and settles in the
29 bucket 30. When the bucket 30 is full of dirt, the snap
30 clips 32 are opened and the bucket 30 is removed so that
31 the bucket 30 can be emptied.

32 A cooling air inlet 60 of the vacuum motor 46
33 extends through an opening 62 in the lid 50 so that the
34 cooling air inlet 60 of the vacuum motor 46 is in fluid

1 flow communication with the exterior of the canister 12.
2 A gasket 64 is provided between the vacuum motor 46 and
3 the lid 50 to seal the opening 62 and also thermally
4 isolate the vacuum motor 46 from the lid 50. Preferably,
5 the gasket 64 comprises an open cell foam. A cooling air
6 fan (not shown) of the vacuum motor 46 draws cooling air
7 through the cooling air inlet 60 of the vacuum motor 46
8 and over the armatures of the vacuum motor 46. The
9 cooling air flows over the armatures of the vacuum motor
10 46, into the upper interior chamber 48, and out the
11 cooling air outlet 28.

12 The acoustic damping system reduces the amount of
13 noise emitted from the upper interior chamber 48 through
14 the cooling air outlet 28, the exhaust port 22, and the
15 cooling air inlet 60. The acoustic damping system
16 includes an acoustic damping tunnel 66, an exhaust port
17 seal 68, and an acoustic damping canopy 70.

18 As best shown in FIGS. 2 and 4, the tunnel 66 is
19 located within the upper interior chamber 48 for the
20 purpose of reducing the amount of noise emitted from the
21 cooling air outlet 28. The tunnel 66 has a first or
22 inlet end 72 in fluid flow communication with upper
23 interior chamber 48 and a second or outlet end 74 in
24 fluid flow communication with the cooling air outlet 28.

25 As shown in FIG. 5, the tunnel 66 of the illustrated
26 embodiment is generally U-shaped in cross-section having
27 an inner wall 76, an outer wall 78, and a bottom wall 80
28 connecting the inner and outer walls 76, 78. The tunnel
29 66 is preferably molded from a plastic material such as,
30 for example ABS plastic. The outer wall 78 is arcuate
31 having a radius slightly less than the sidewall of the
32 canister 12 and extends for approximately 180 degrees.
33 The inner wall 76 has an arcuate portion 82 and a
34 tangential portion 84. The arcuate portion 82 has a
35 radius slightly greater than the outer surface of the
36 vacuum motor 46 and extends for approximately 180
37 degrees. The tangential portion 84 is generally straight

1 and extends from the arcuate portion 82 to the sidewall
2 of the canister 12. The inner and outer walls 76, 78 are
3 provided with resilient snap clips 86 which extend
4 through openings 88 (FIG. 3) in the lid 50 to secure the
5 tunnel 66 to the lid 50 which both supports the tunnel 66
6 within the upper interior chamber 48 and closes the open
7 top 90 of the tunnel 66.

8 The interior pathway formed by the tunnel 66 and the
9 lid 50 is covered with sound absorbing material such as
10 an open cell foam. As best shown in FIG. 2, a top foam
11 element 92, a bottom element 94, and side elements 96, 98
12 are provided to surround the pathway defined within the
13 tunnel 66. The foam elements 92, 94, 96, 98 are
14 preferably at least 1/2 inch thick and preferably
15 comprise a combustion modified polyether polyurethane
16 material such as, for example, Char Hyfonic 1[™] which is
17 available from Stephenson & Lawyer of Grand Rapids,
18 Michigan. As best shown in FIG. 4, foam elements 100
19 surround the outlet end 74 of the tunnel 66 to seal the
20 outlet end 74 to the sidewall of the canister 12 so that
21 sound is forced to follow the designed pathway through
22 the tunnel 66 to exit through the cooling air outlet 28.
23 As the noise passes through the tunnel 66, the noise is
24 absorbed by the sound absorbing material.

25 The tunnel 66 is most effective at reducing emitted
26 noise if the tunnel 66 has the greatest length and width
27 allowed by the available space within the upper interior
28 chamber 48 and allowed by heat restrictions. A longer
29 tunnel 66 forces the noise to travel a longer path past
30 the sound absorbing material so that more sound can be
31 absorbed and a wider tunnel 66 allows the use of a
32 thicker layer of sound absorbing material which yield
33 more noise reduction. Therefore, various electrical
34 components 102 within the upper interior chamber 48 are
35 preferably located near the exhaust port 22 so that the
36 tunnel 66 can circumferentially extend for substantially
37 the entire distance around the vacuum motor 46 except for

1 the space occupied by the exhaust pipe 58 and the
2 electrical components 102 as best shown in FIG. 4. It
3 can also be seen in FIG. 4 that the width of the tunnel
4 66 extends substantially from the sidewall of the
5 canister 12 to the exterior surface of the vacuum motor
6 46. It is noted that while the pathway formed by the
7 illustrated tunnel 66 is generally arcuate or curved,
8 other tunnels can form effective sound absorbing pathways
9 of other shapes. The pathways should, however, include
10 curves or turns so that the pathways not entirely
11 straight or linear. The pathway of the illustrated
12 tunnel 66 includes a curve which extends for
13 approximately 180 degrees.

14 .The exhaust port seal 68 reduces the amount of noise
15 emitted from the exhaust port 22. As shown in FIG. 6,
16 the exhaust port seal 68 is formed from a rectangular
17 sheet of material which is generally arcuate to conform
18 with the sidewall of the canister 12. The exhaust port
19 seal 68 is preferably formed of a material with either a
20 high transmission loss or a high absorption rate to
21 either block or absorb sound that would otherwise be
22 emitted from the upper interior chamber 48 through the
23 exhaust port 22. The exhaust port seal preferably
24 comprises a flexible foam such as, for example, 8443
25 Neoprene blend which is available from Lundell
26 Manufacturing of Minneapolis, Minnesota. The exhaust
27 port seal 68 forms a circular opening 104 for the exhaust
28 pipe 46. The opening 104 is sized for an interference
29 fit with the exhaust pipe 58 to provide a seal between
30 the exhaust pipe 58 and the exhaust port seal 68. As
31 best shown in FIG. 6, the exhaust port seal 68 is
32 attached to the sidewall of the canister 12 with an
33 adhesive to completely close the exhaust port 22.

34 As best shown in FIGS. 2 and 7, the canopy 70 is
35 attached to the top of the central vacuum unit 10 and
36 encloses the cooling air inlet 60 of the vacuum motor 46
37 to reduce the noise emitted from the cooling air inlet

1 60. The canopy 70 is preferably molded of a plastic
2 material such as, for example, an ABS plastic. As best
3 shown in FIG. 8, the canopy 70 has a dome portion 106 and
4 a cylindrically-shaped side portion 108. A plurality of
5 ribs 110 extend inwardly from the side portion 108 and
6 provide a plurality of abutments 112 for engaging the lid
7 50 to support the canopy 70 on the lid 50. Additionally,
8 a plurality of fastener openings 114 are provided in the
9 side portion for accepting fasteners which attach the
10 canopy 70 to the canister 12.

11 Parallel and spaced-apart dividing walls 116, 118,
12 120, 122 extend from the dome portion 106 and the side
13 portion 108 within the canopy 70. When the canopy 70 is
14 attached to the canister 12, the lid and canopy 12 forms
15 a pair of outer chambers or sections 124, 126, a pair of
16 intermediate chambers or sections or 128, 130, and a
17 central chamber or section 132, as best shown in FIG. 7.
18 Openings or slots 134 are provided in the dome portion
19 106 at each of the outer sections 124, 126 so that the
20 outer sections 124, 126 are in fluid communication with
21 the exterior of the canopy 70 when the canopy 70 is
22 attached to the canister 12. The outer walls 116, 118
23 each form a passage 136, 138 at a first end so that the
24 outer sections 124, 126 are in fluid communication with
25 the intermediate chambers 128, 130 at the first end. The
26 inner walls 120, 122 each form a passage 140, 142 at a
27 second end, opposite the passages 136, 138 of the outer
28 walls 116, 118, so that the intermediate sections 128,
29 130 are in fluid communication with the central chamber
30 132. The central chamber 132 is in fluid communication
31 with the cooling air inlet 60 of the vacuum motor 46 as
32 best shown in FIG. 7.

33 As best shown in FIG. 2, a layer of sound absorbing
34 foam 144 is located between the canopy 70 and the lid 50.
35 The layer of foam 144 includes a central opening 146
36 (FIG. 3) for the cooling air inlet 60 of the vacuum motor
37 46. The foam layer 144 is preferably at least 1/2 inch

1 thick and preferably comprises a combustion modified
2 polyether polyurethane material such as, for example,
3 Char Hyfonic 1[™] which is available from Stephenson &
4 Lawyer of Grand Rapids, Michigan. The layer of sound
5 absorbing foam 144 both absorbs sound and seals the
6 pathway between the sections 124, 126, 128, 130 of the
7 canopy 70 so that sound is forced to follow the designed
8 serpentine-shaped pathway of the canopy 70. Each of the
9 serpentine pathways of the illustrated canopy 70 includes
10 two 180 degree turns. The canopy 70 is designed so that
11 noise from the motor cooling fan must travel through the
12 serpentine-shape pathway of the canopy 70 past the layer
13 of foam 144 before exiting through the slots 134. It is
14 noted that additional sound absorbing foam can be added
15 to the top and/or sides of the serpentine passageway.
16 However, the additional foam only increases the noise
17 reduction of the canopy 70 by about 1 db. It is noted
18 that the serpentine pathway formed by the canopy 70 can
19 form effective sound absorbing pathways of other shapes.
20 A serpentine pathway is defined herein as a pathway
21 including at least one curve or at least one turn so that
22 the pathway not entirely straight or linear.

23 The acoustic damping system described hereabove is
24 effective to substantially reduce the noise level of the
25 central vacuum unit 10. For example, in the embodiment
26 described hereabove, the overall noise level of the
27 central vacuum unit 10 was reduced about 10 db with the
28 most significant reductions of about 13 db, about 12 db,
29 and about 12 db occurring in the 1,000 Hz, 2,000 Hz, and
30 the 4,000 Hz octave bands respectively.

31 Although particular embodiments of the invention
32 have been described in detail, it will be understood that
33 the invention is not limited correspondingly in scope,
34 but includes all changes and modifications coming within
35 the spirit and terms of the claims appended hereto.

WHAT IS CLAIMED IS:

- 1 1. A central vacuum unit comprising:
2 a canister forming a hollow interior;
3 a vacuum motor within said canister which emits
4 noise during operation;
5 at least one opening in said canister; and
6 an acoustic damping canopy outside said canister and
7 covering said opening, said canopy having at least one
8 inlet and forming a serpentine pathway between said
9 opening and said inlet to reduce noise emitted from said
10 hollow interior through said opening and said inlet.
- 1 2. The central vacuum unit according to claim 1,
2 wherein said canister has a side wall and a lid closing
3 an end of the canister, and said at least one opening is
4 a cooling air inlet of said motor extending at said lid.
- 1 3. The central vacuum unit according to claim 1,
2 wherein said canopy comprises molded plastic.
- 1 4. The central vacuum unit according to claim 3,
2 wherein sound absorbing material is provided along at
3 least a portion of said pathway.
- 1 5. The central vacuum according to claim 4,
2 wherein said sound absorbing material is an open cell
3 foam.
- 1 6. The central vacuum according to claim 5,
2 wherein said open cell foam comprises combustion modified
3 polyether polyurethane foam.

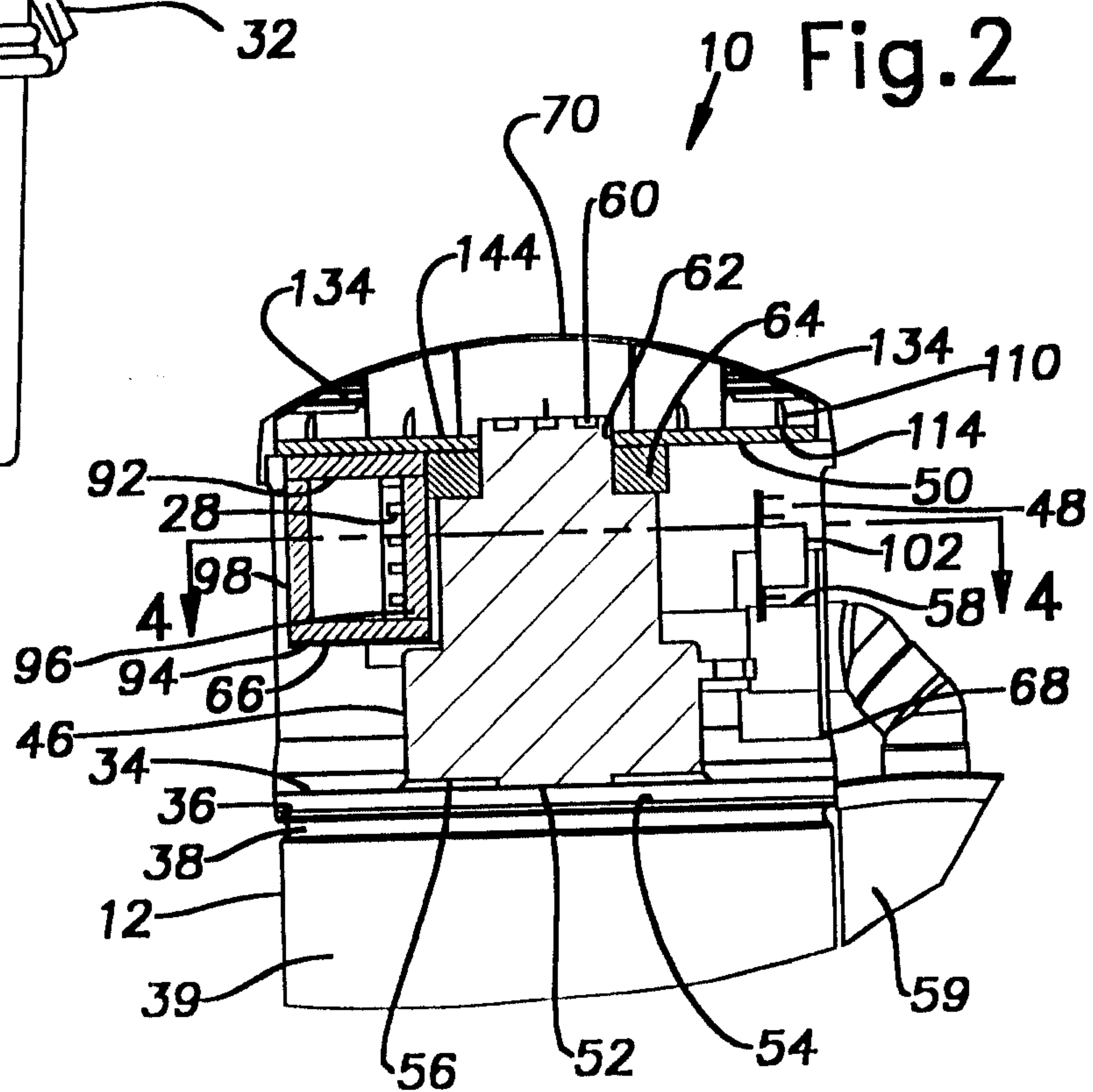
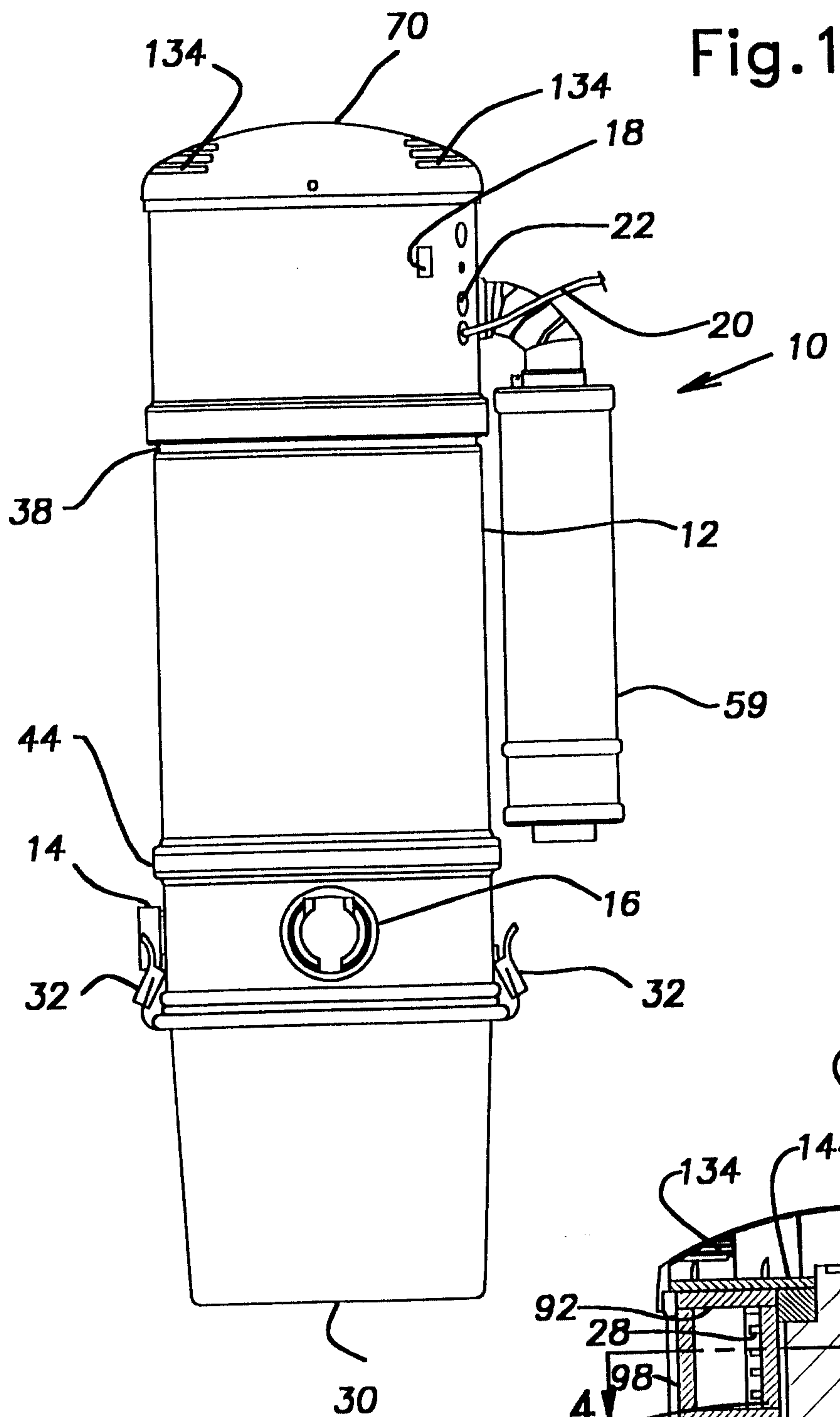


Fig.3

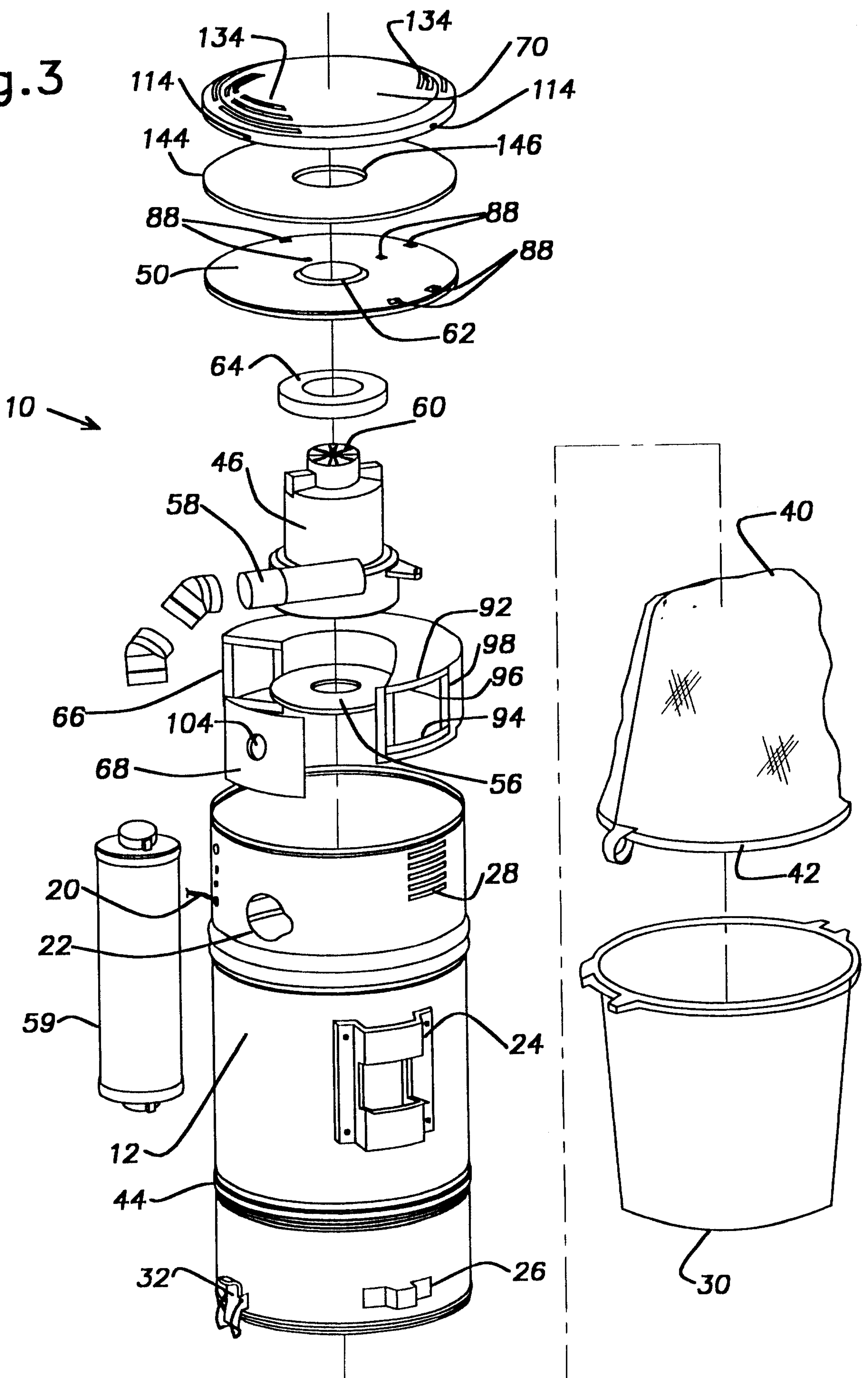


Fig.4

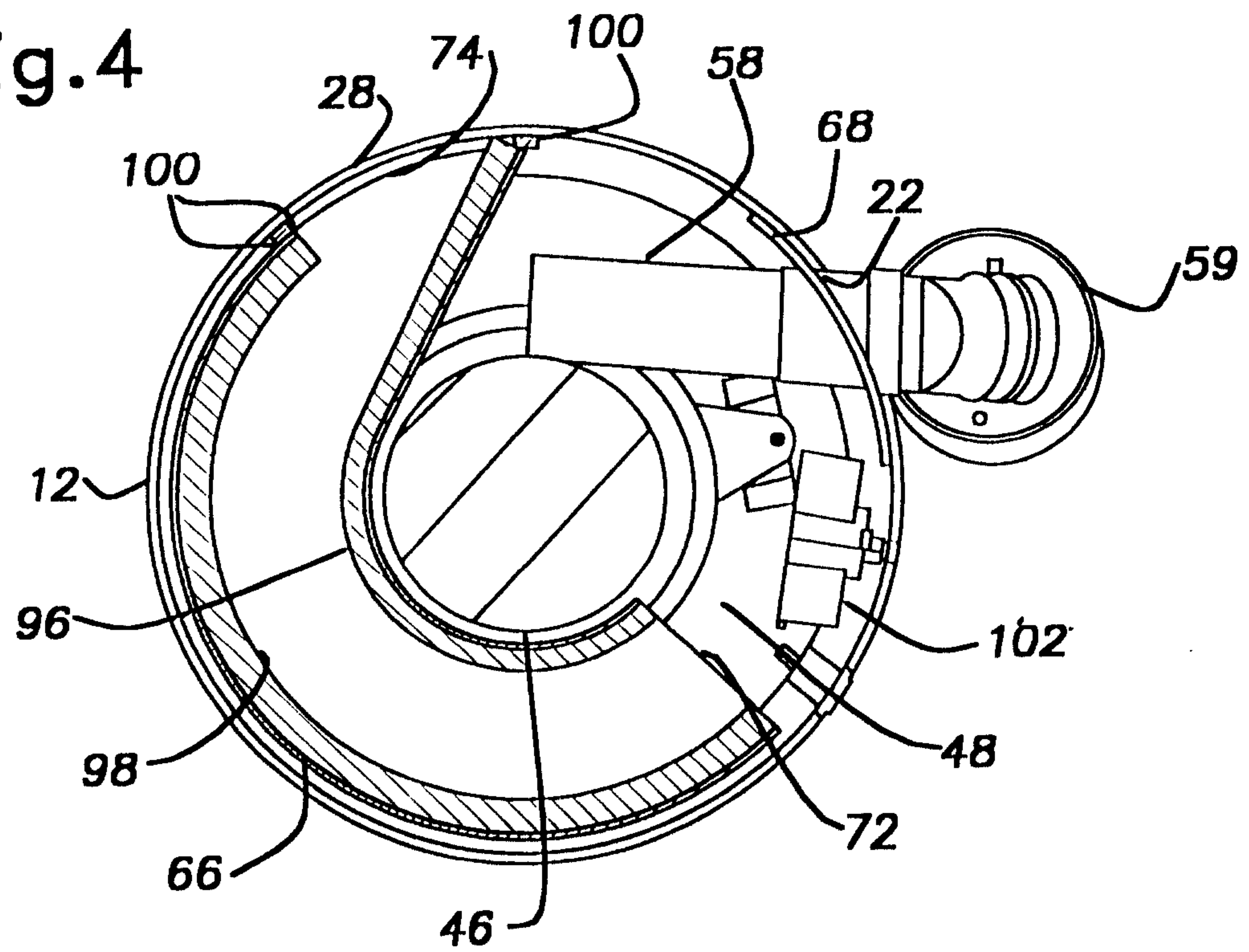


Fig.5

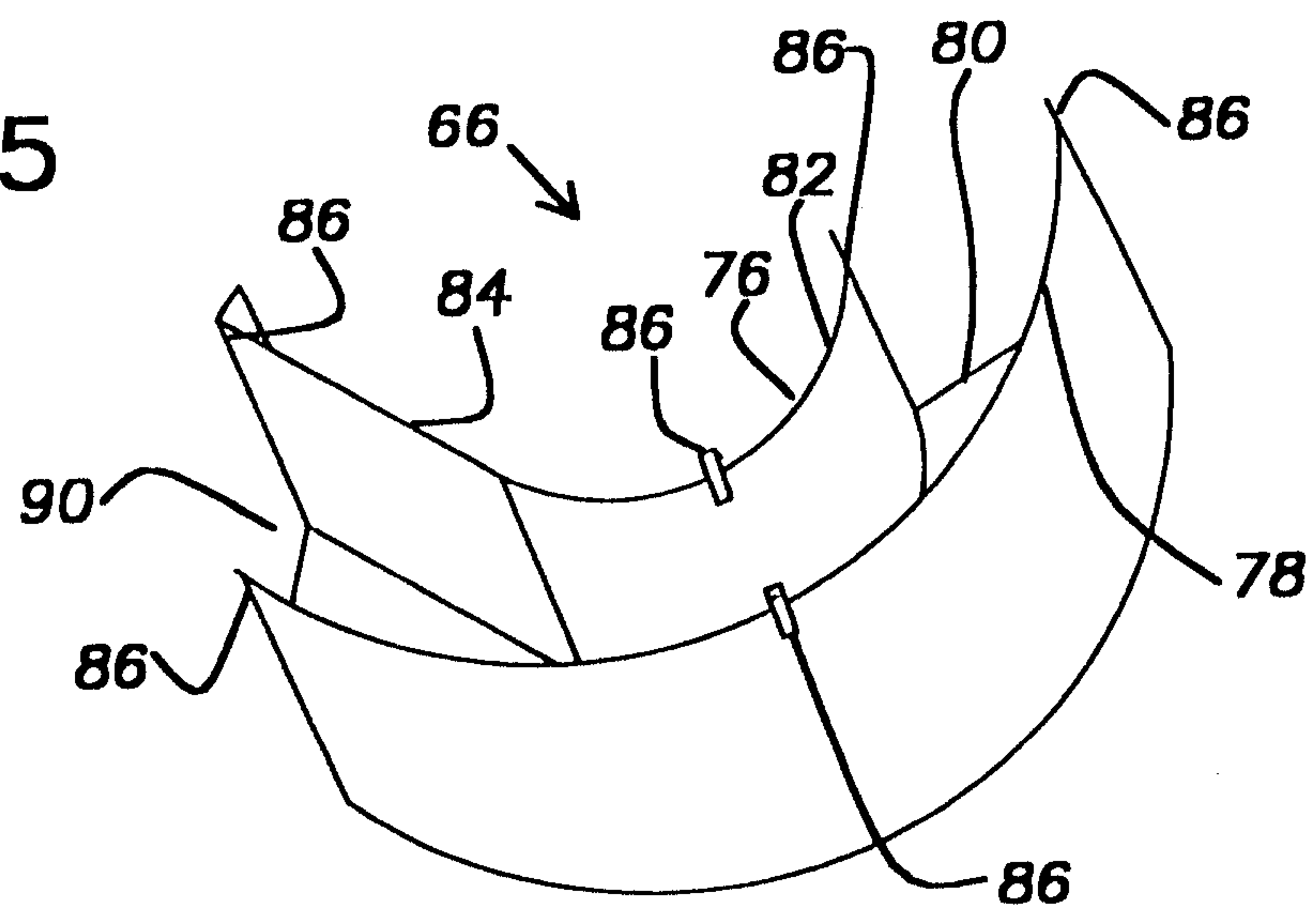


Fig.6

