US007010829B2

(12) **United States Patent**
Harman et al.

(10) **Patent No.: US 7,010,829 B2**
(45) **Date of Patent: Mar. 14, 2006**

(54) **RETRACTABLE HOSE CENTRAL VACUUM CLEANING SYSTEM APPARATUS AND METHOD**

(76) Inventors: **James Roger Harman**, 8706 137th St. NW., Gig Harbor, WA (US) 98929; **Rod Drivstuen**, 85229 99th Pl. SE., Monroe, WA (US) 98227; **Gary Drivstuen**, 15408 257th Ave. SE., Monroe, WA (US) 98272

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **10/861,994**

(22) Filed: **Jun. 4, 2004**

(65) **Prior Publication Data**

US 2005/0022329 A1 Feb. 3, 2005

Related U.S. Application Data

(60) Provisional application No. 60/476,887, filed on Jun. 5, 2003.

(51) **Int. Cl.**
A47L 5/38 (2006.01)

(52) **U.S. Cl.** **15/315**; 15/314; 285/7; 285/302; 55/DIG. 8

(58) **Field of Classification Search** 15/314, 15/315; 55/DIG. 8; 285/7, 302, 303, 338, 285/196, 216
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,919,017 A	*	12/1959	Weber	285/302
3,023,447 A		3/1962	Senne	
3,213,480 A		10/1965	Miller	
3,568,240 A		3/1971	Hamrick	
3,593,363 A	*	7/1971	Hamrick	15/315
3,682,500 A		8/1972	Hamrick	
3,958,297 A		5/1976	Hukuba et al.	15/315
3,977,038 A		8/1976	Hukuba et al.	15/315
4,336,427 A	*	6/1982	Lindsay	15/314
4,688,292 A		8/1987	Schmiegel	15/315
4,688,596 A		8/1987	Liebmann et al.	137/360
4,895,528 A		1/1990	Choiniere et al.	439/191
5,430,978 A		7/1995	Kohler	52/27
5,526,842 A		6/1996	Christensen	137/360
5,740,581 A		4/1998	Harrelson, II	15/314
5,740,582 A		4/1998	Harrelson, II	15/315
6,158,080 A		12/2000	Schlapkohl	15/301
6,459,056 B1	*	10/2002	Graham	15/314
2001/0022009 A1		9/2001	Spearman	15/314

FOREIGN PATENT DOCUMENTS

CA	880976	9/1971

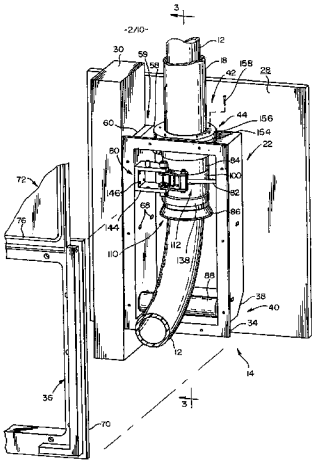
(Continued)

Primary Examiner—Theresa T. Snider
(74) *Attorney, Agent, or Firm*—William Forster

(57) **ABSTRACT**

A retractable hose central vacuum cleaning system comprising a retractable vacuum hose configured to retract through a valve assembly, into a system vacuum pipe responsive to the vacuum communicated from a vacuum source. The valve assembly comprising a static valve seal adapted for coupling a system vacuum pipe to the vacuum hose to create a substantially air-tight sealed communication between the system vacuum pipe and the vacuum hose. The static valve seal being adjustable from a first unsealed configuration where the vacuum hose can move freely through the valve assembly and system vacuum pipe, to a second sealed configuration where the vacuum hose is in sealed communication with a system vacuum pipe, and where the vacuum hose is substantially fixed in relative position to the valve assembly. Wherein movement from first configuration to the second configuration locks the vacuum hose in place relative to the valve assembly.

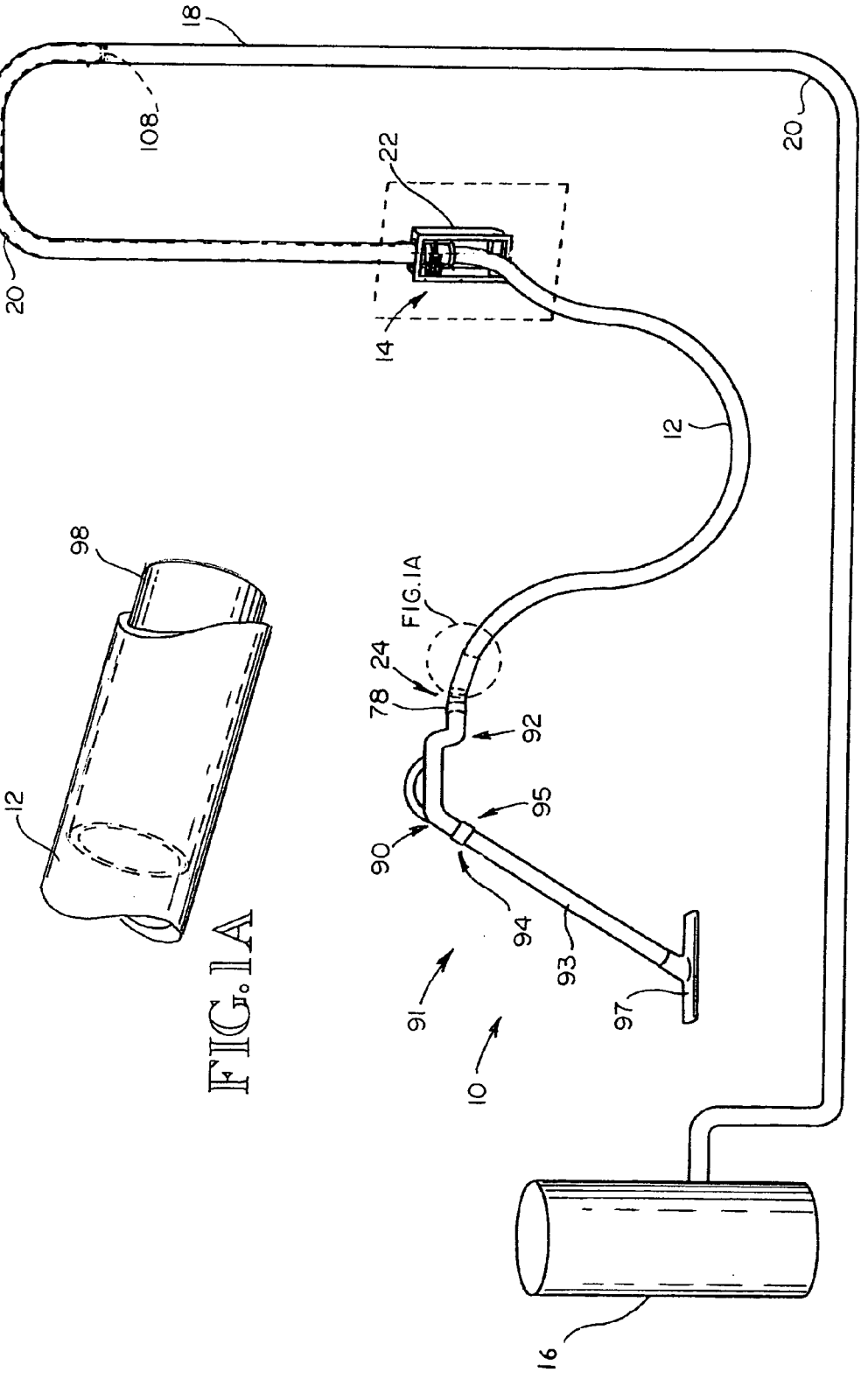
23 Claims, 10 Drawing Sheets



FOREIGN PATENT DOCUMENTS

CA	881627	9/1972
CA	908915	9/1972
EP	0399991 A1	5/1990
WO	WO 0124677 A1	4/2001

* cited by examiner


18
108
20
22
20
14
12
98
FIG.1A
24
78
92
95
90
94
93
91
97
10
16
FIG.1

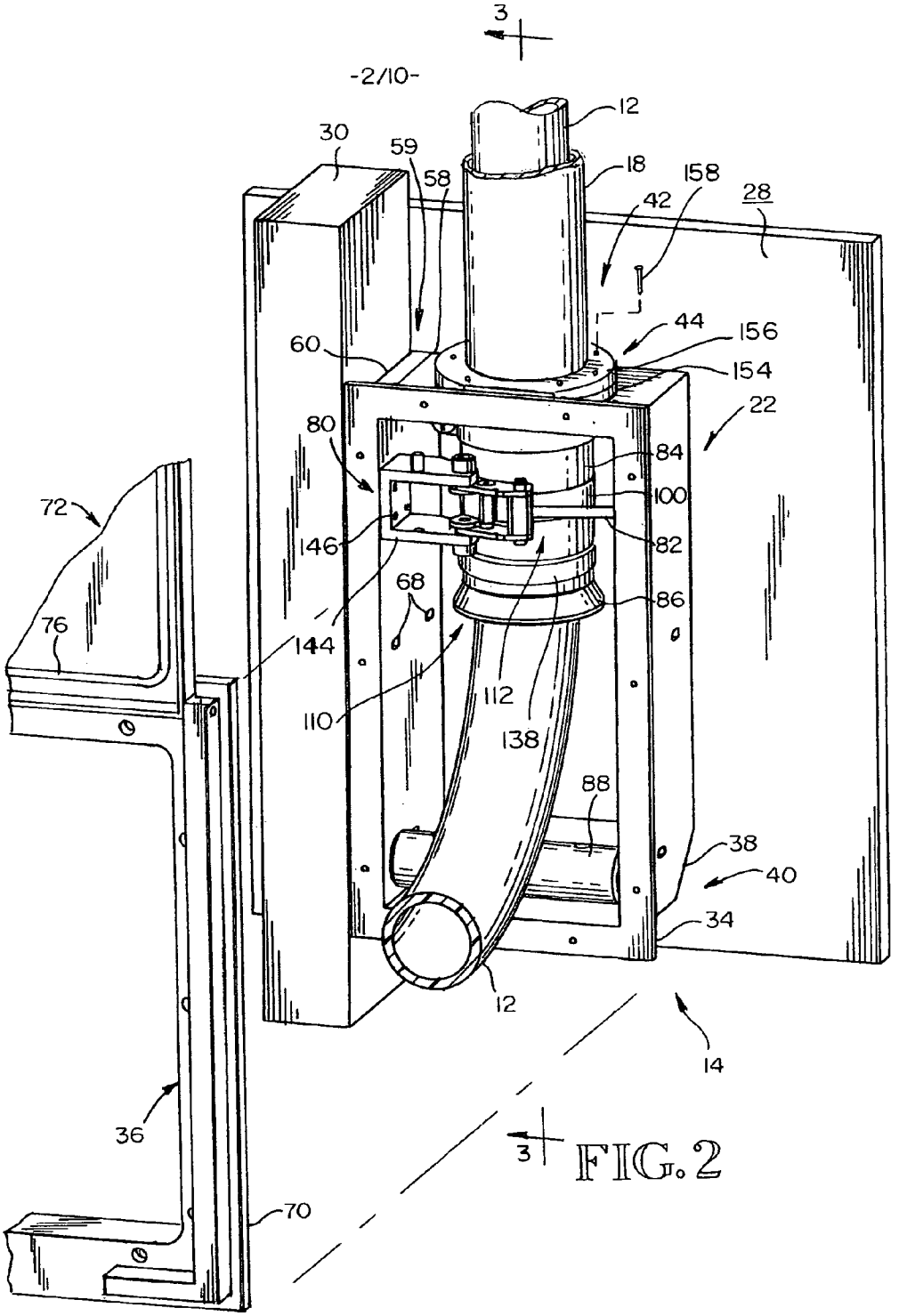
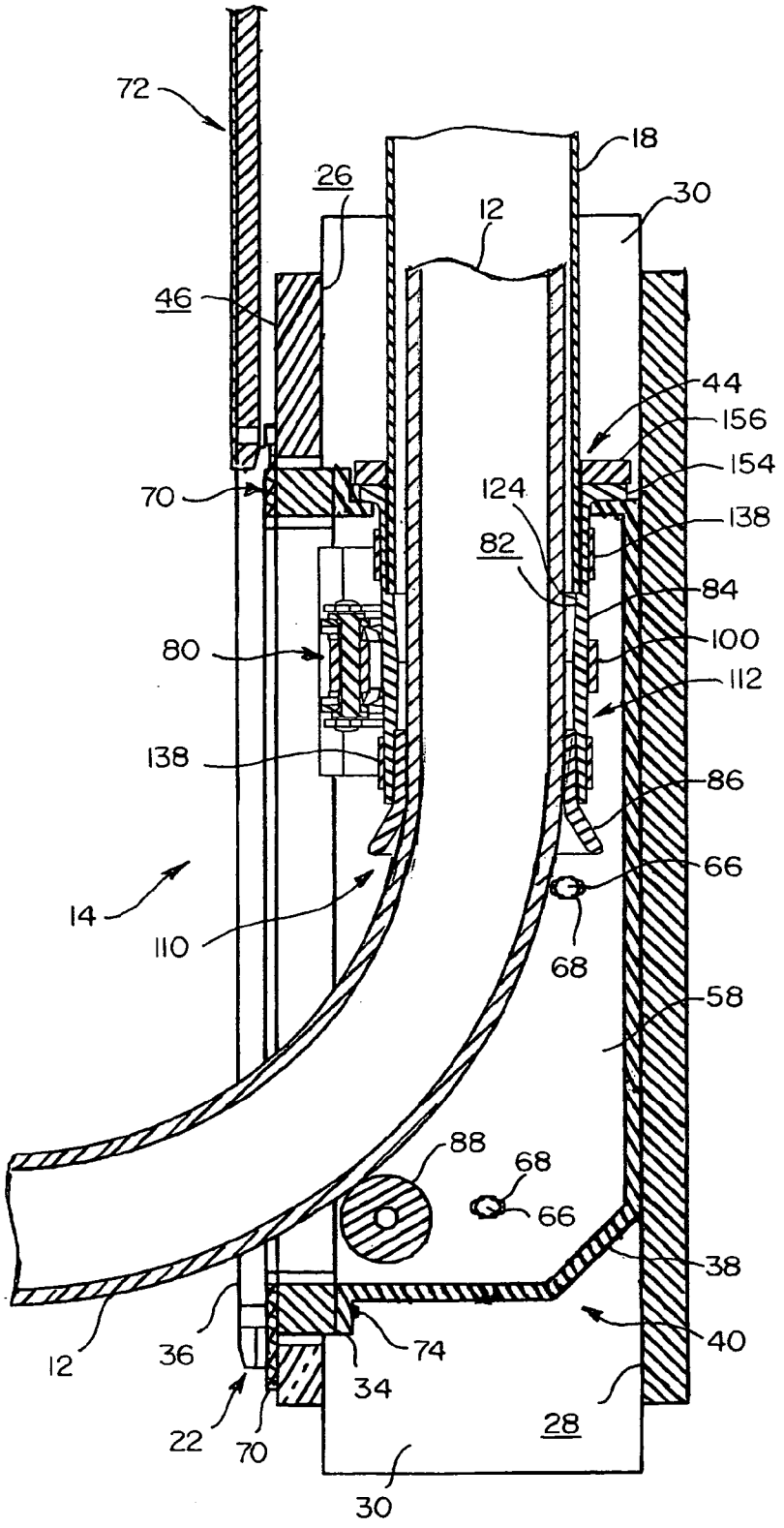

3
-2/10-
12
30
59
58
18
158
42
28
44
156
60
154
22
80
84
100
72
146
82
68
86
76
144
112
110
138
88
38
40
34
12
14
36
3
70

FIG. 2

FIG. 3


72
18
26
12
30
46
44
156
154
70
124
138
82
84
80
100
112
138
86
66
14
110
68
58
88
68
66
38
12
36
74
40
34
22
70
28
30

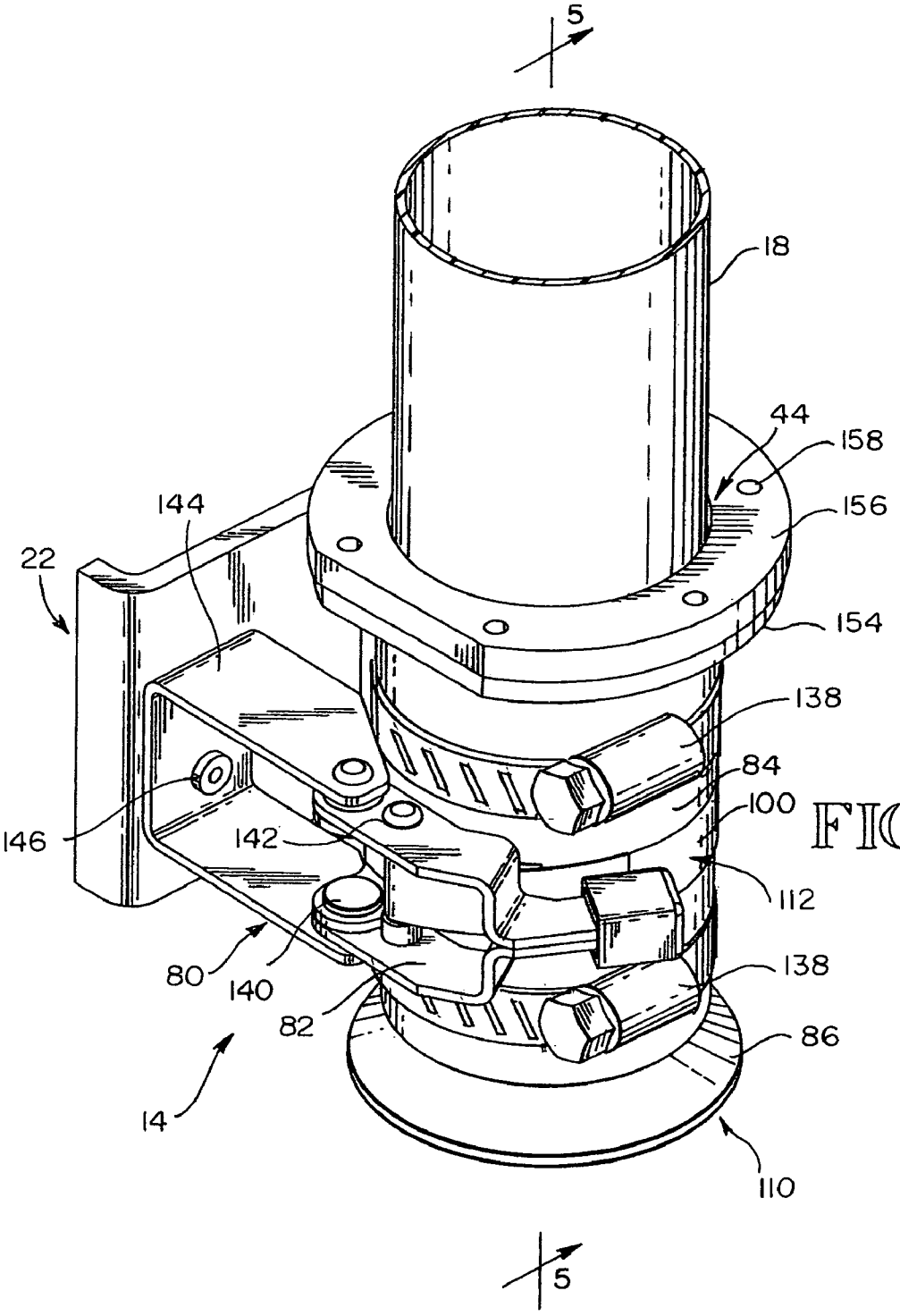

5
18
44
158
156
154
144
22
138
84
100
146
142
112
138
80
140
82
86
14
110
5

FIG. 4

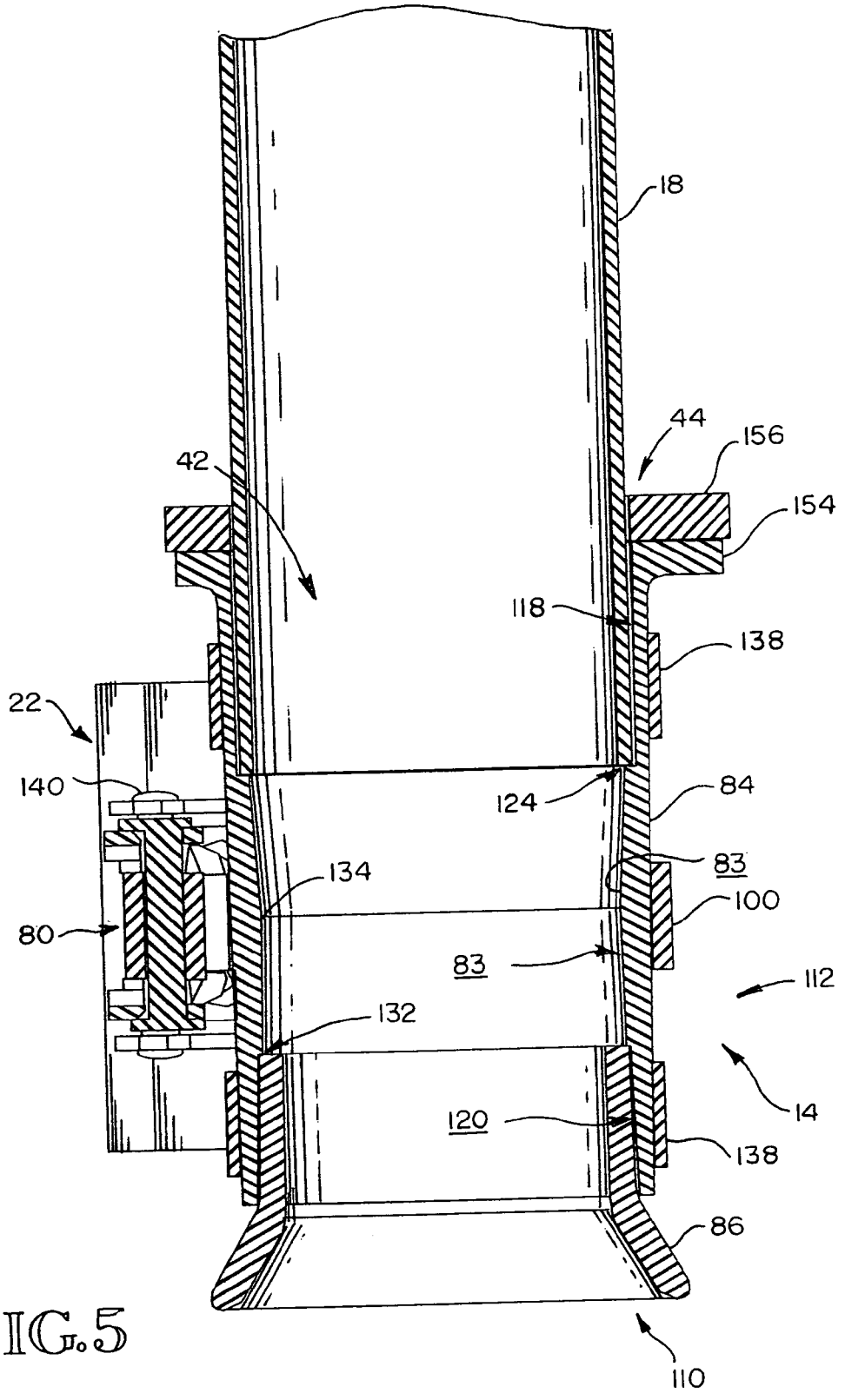

18
44
156
154
42
118
138
22
140
124
84
83
134
100
80
83
112
132
14
120
138
86
110

FIG. 5

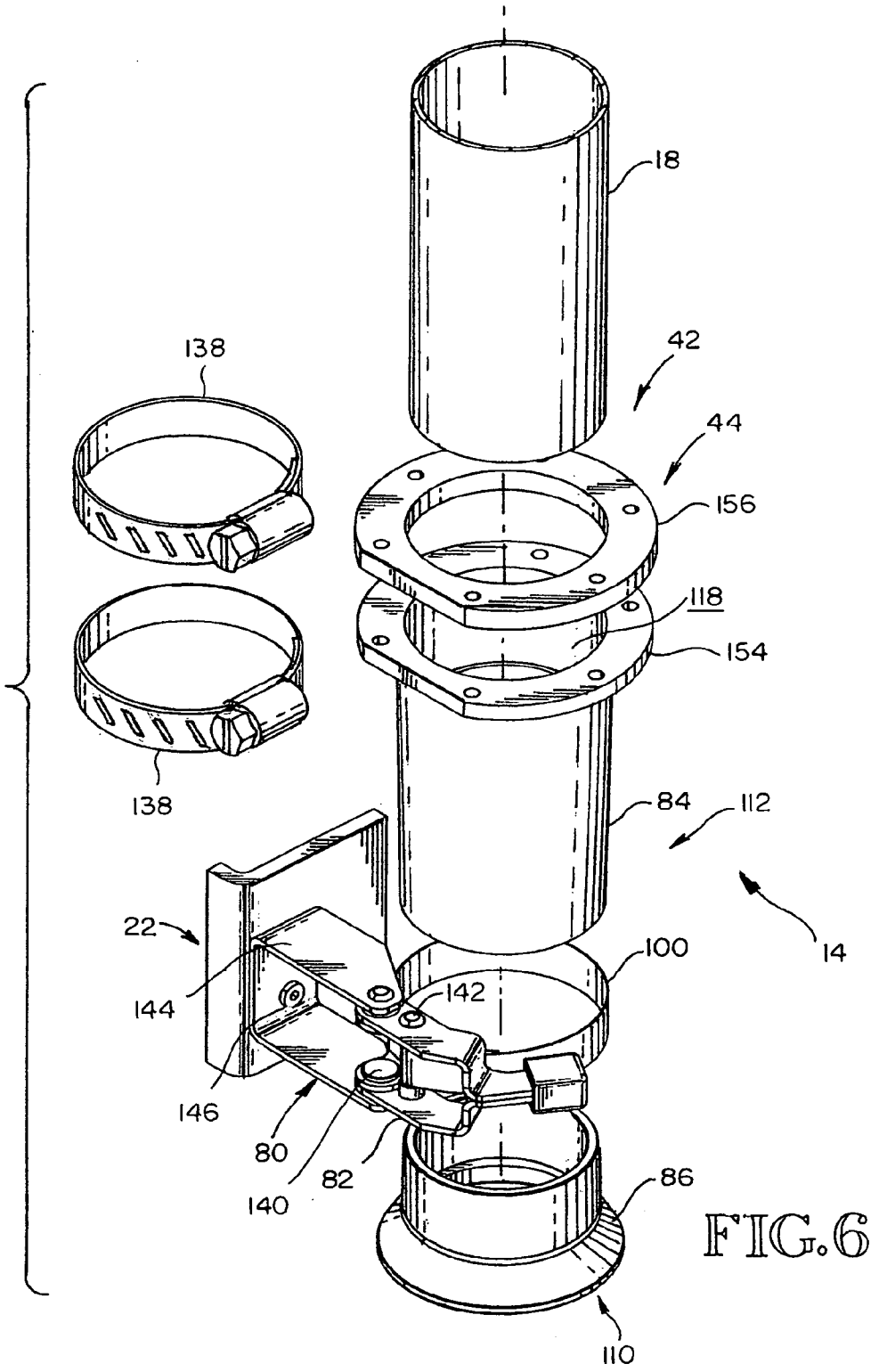
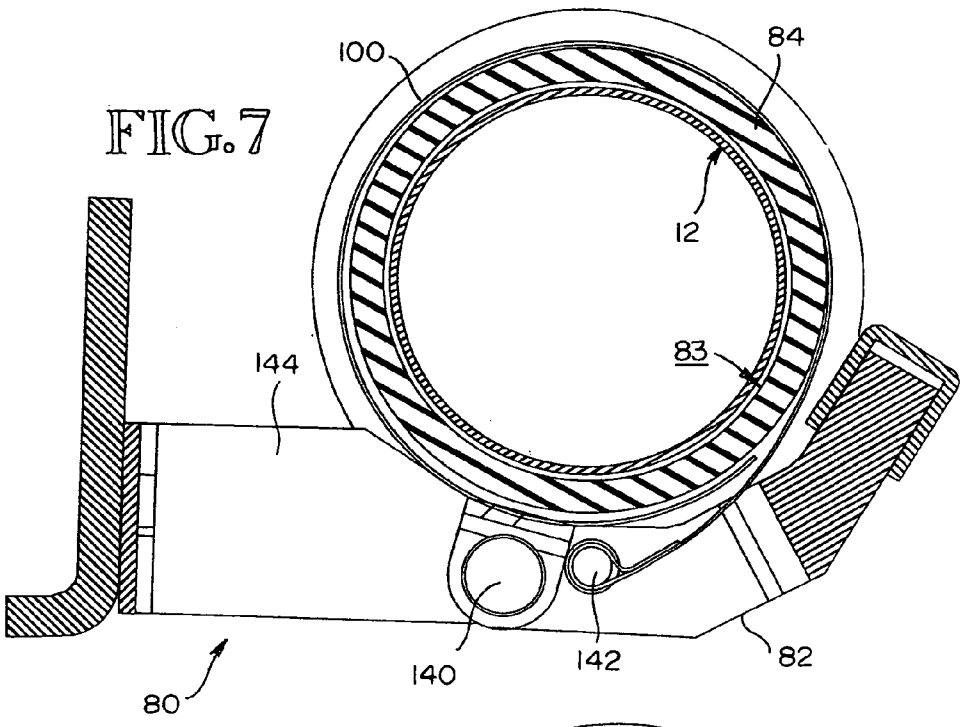

18
42
44
156
118
154
138
138
84
112
14
22
100
144
142
146
80
82
140
86
110

FIG. 6

FIG. 7



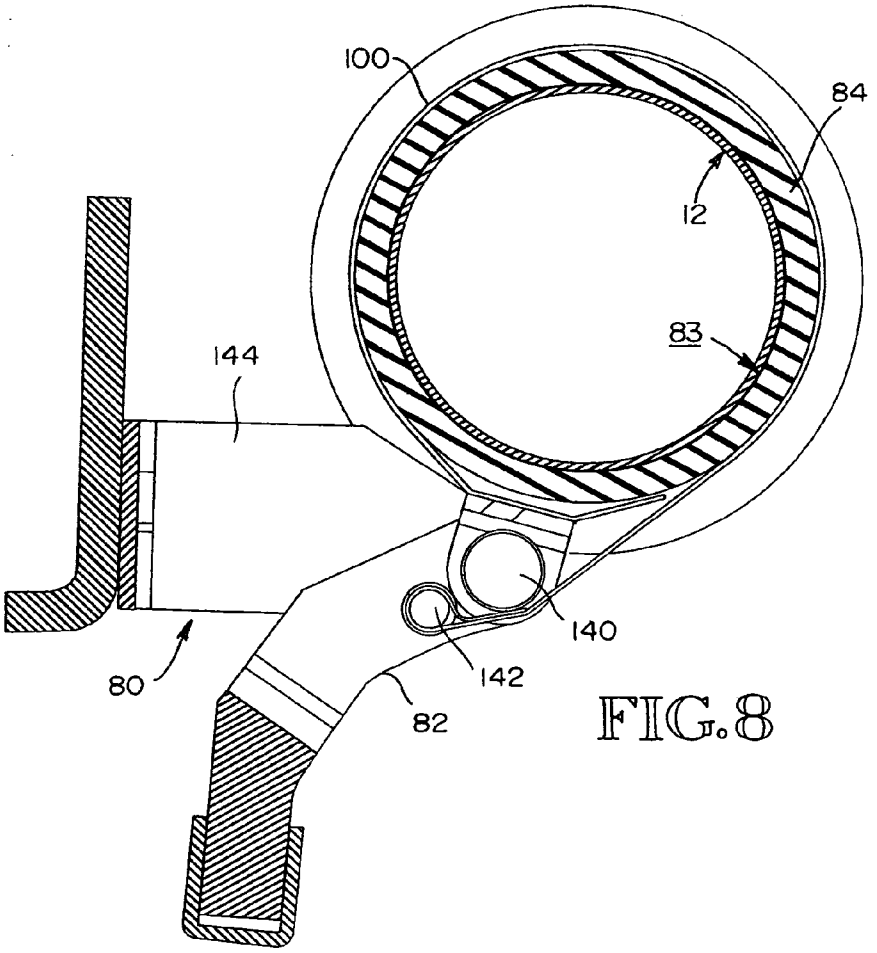
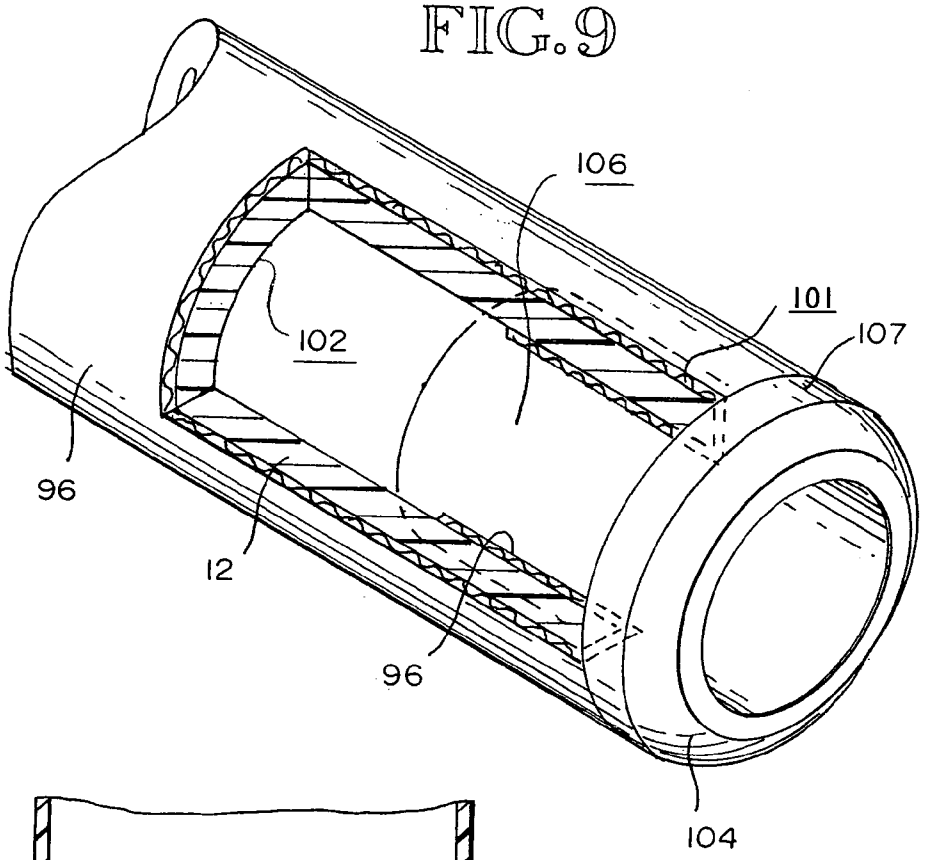


FIG. 8

FIG. 9



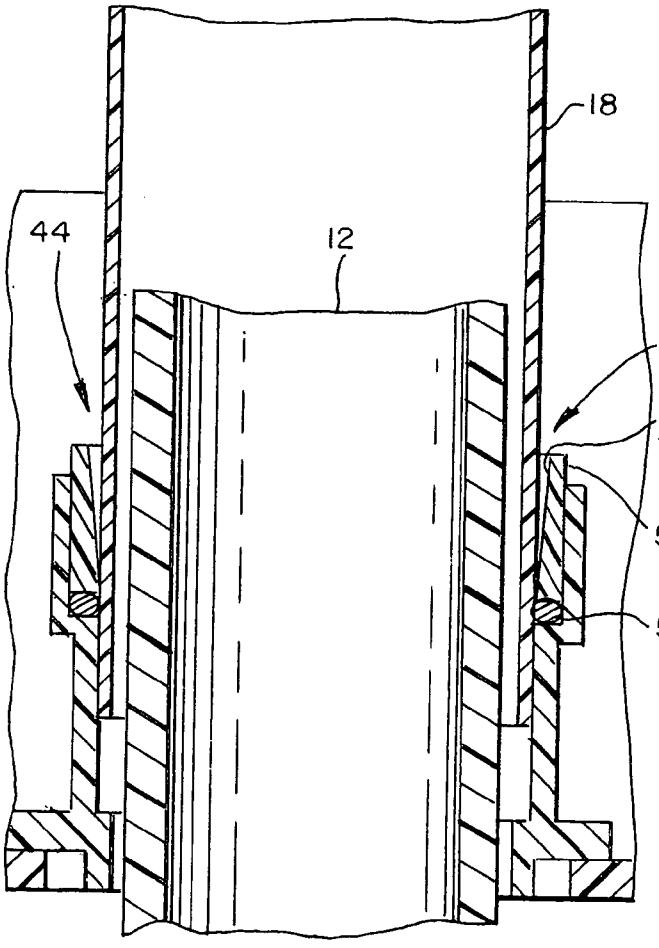


FIG. 10

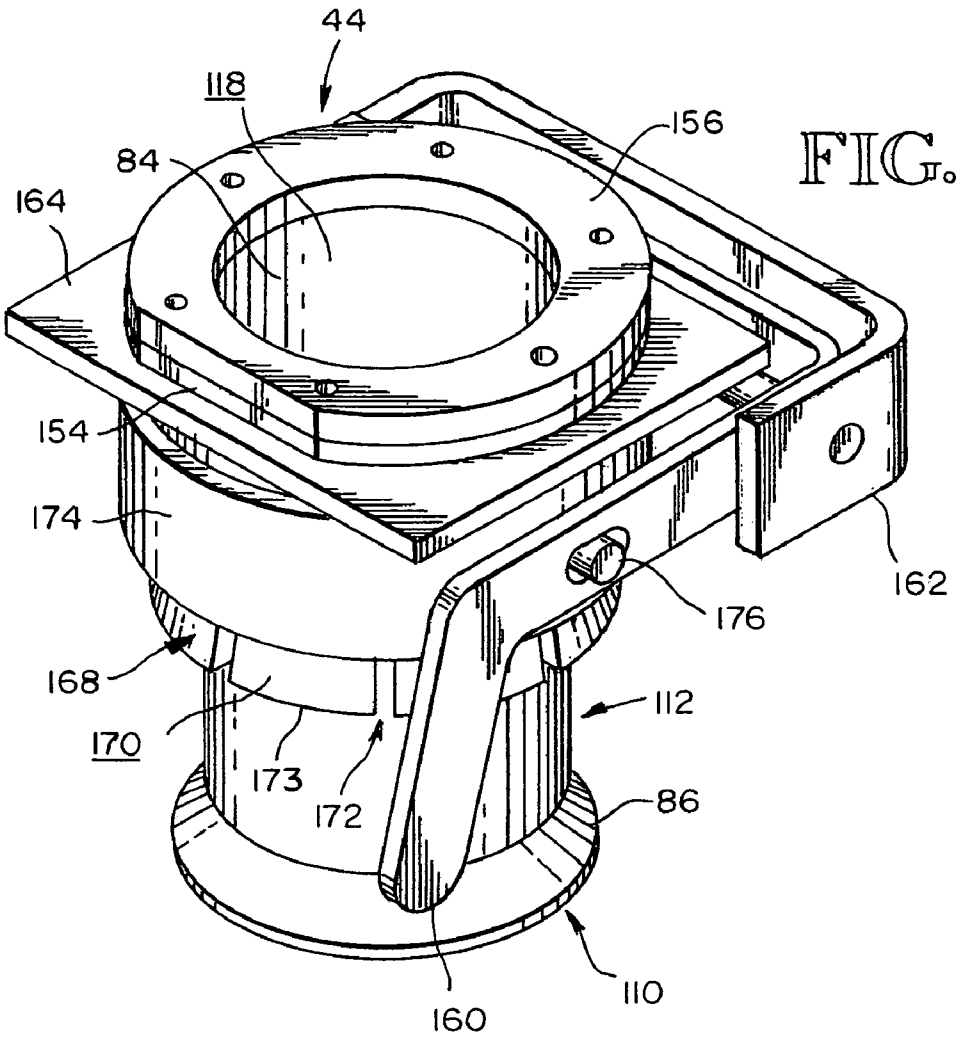


FIG. 11

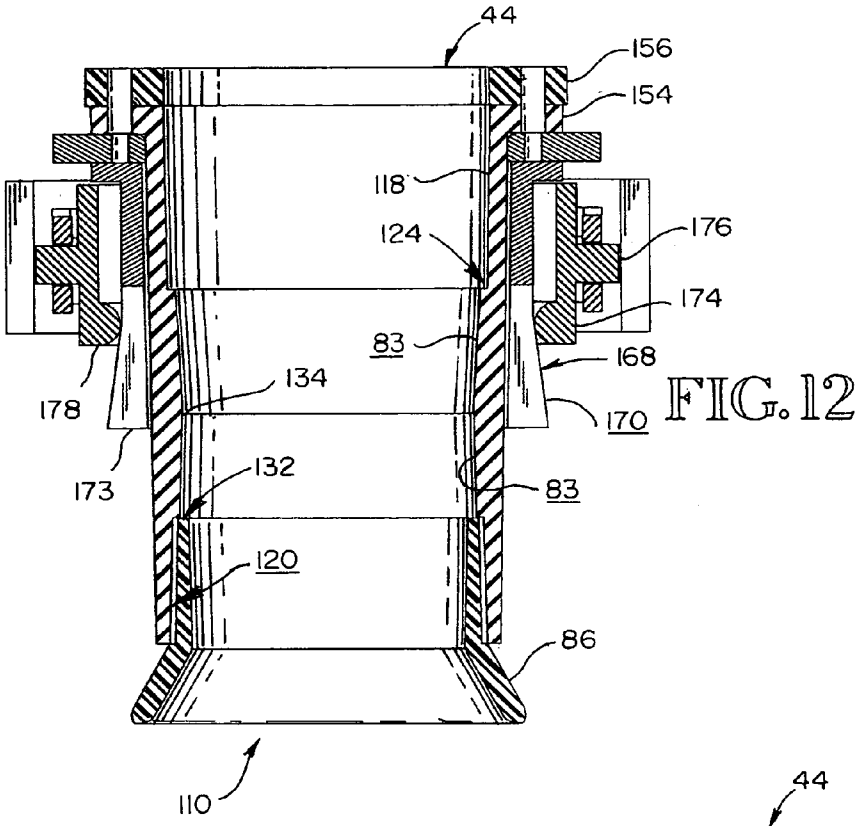

44
156
154
118
124
176
174
83
168
134
178
170
173
132
83
120
86
110

FIG. 12

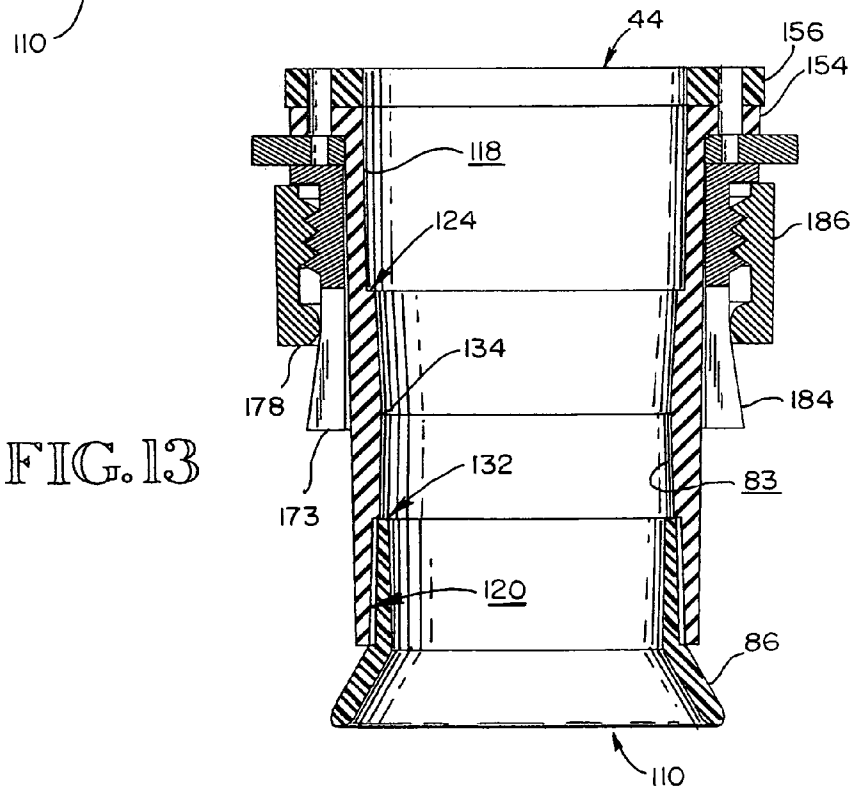

44
156
154
118
124
186
134
178
184
132
83
173
120
86
110

FIG. 13

RETRACTABLE HOSE CENTRAL VACUUM CLEANING SYSTEM APPARATUS AND METHOD

This application claims the benefit of U.S. Provisional Application No. 60/476,887 filed Jun. 5, 2003.

BACKGROUND

This invention relates generally to central vacuum cleaning systems, and more particularly to central vacuum cleaning systems comprising retractable suction hoses that retract into a system vacuum pipe.

Central vacuum cleaning systems are well known and have been available for many years. One early design is U.S. Pat. No. 3,593,363 issued in 1972 disclosing a central vacuum cleaning system using a retractable hose. The inserted end of the hose has a compressible annular seal. The hose is pulled out of the suction conduit located in a wall or floor until the foot end or inserted end reaches the receptacle mounted on the floor or wall, at which time the annular seal on the hose engages a corresponding annular abutment at the receptacle to hold the hose in position and seal between the hose and the receptacle. Accordingly, this design requires that the full length of the hose be pulled out prior to the user using the vacuum.

In 1987, U.S. Pat. No. 4,688,596 issued disclosing a wall outlet box for a control vacuum system that connects to a vacuum hose. The '596 design does not provide any hose storage, or retractable hose features.

In 1990, U.S. Pat. No. 4,895,528 issued disclosing a hose-to-wall fitting for a central vacuum system. Like the earlier '596 reference, the features of the '528 patent were directed to a hose connection fitting only.

Later, in 1996, U.S. Pat. No. 5,526,842 issued to Christensen disclosing a motorized hose wind-up mechanism that requires a somewhat complicated and expensive mechanism for the operation thereof.

While most of the above noted central vacuum system designs include features that are useful in the task to perform the debris vacuum removal process, they typically do not provide a simple, quick way of deploying a long vacuum hose to a selected length. In addition, these designs do not address the problems associated with convenient storage of such long hoses.

Accordingly, a need remains for a central vacuum cleaning system that is easy to install, and facilitates ease of deployment of the vacuum hose therein, and ease of storage of the same following the use of a long vacuum hose to quickly clean large areas.

SUMMARY OF THE INVENTION

One object of the present invention is to reduce the effort required to deploy and operate a central vacuum system.

A second object is to reduce the costs associated with installing a central vacuum system.

Another object is to manage and easily store a long vacuum hose in a central vacuum system.

Yet another object is to employ common readily available vacuum accessories constructed for use with central vacuum systems.

A further object is to stabilize and maintain a deployed vacuum hose that moves responsive to the vacuum created by a central vacuum system.

Still another object is to maintain the air seal around a vacuum hose designed to retract in a vacuum system pipe.

An additional object is to allow the user to select the desired length of vacuum hose needed to perform the vacuum process.

The invention is a retractable hose central vacuum cleaning system provided for use in locations where ease of deployment of the vacuum hose is desired. The retractable hose central vacuum cleaning system comprises a retractable vacuum hose that includes a tool end adapted to removably receive a vacuum cleaning tool for vacuuming debris, and an opposing retracting end.

In addition, the retractable hose central vacuum cleaning system includes a valve assembly having a receiving port for receiving the retracting end of the vacuum hose. In this way, the vacuum hose can extend through the receiving port and through the valve assembly. Further, the valve assembly comprises a vacuum pipe connection port that is adapted to receive a system vacuum pipe that is in communication with a centrally located vacuum source for creating a vacuum within the system vacuum pipe.

Moreover, the valve assembly incorporates a static valve seal that is located between the receiving port and the vacuum pipe connection port. The static valve seal is adapted for coupling together a system vacuum pipe to the vacuum hose to create a substantially air-tight sealed communication between the system vacuum pipe and the vacuum hose. Accordingly, the vacuum generated by a central vacuum source is communicated through a system vacuum pipe, and through the vacuum hose to a vacuum cleaning tool.

In order to manage the vacuum hose, the static valve seal is adjustable from a first unsealed configuration where the vacuum hose can move freely, in either direction, through the valve assembly and through a system vacuum pipe. As will be more fully explained in the following, the retracting movement of the vacuum hose is responsive to the vacuum created by a vacuum source.

Further, the static valve seal is adjustable to a second sealed configuration where the vacuum hose is in sealed communication with a system vacuum pipe, and where the vacuum hose is substantially fixed in relative position to the valve assembly. In this way, the movement from first configuration to the second configuration enables a user to select and fix the vacuum hose length that extends outward from the receiving port of the valve assembly.

The foregoing and other objects, features, and advantages of this invention will become more readily apparent from the following detailed description of a preferred embodiment which proceeds with reference to the accompanying drawings, wherein the preferred embodiment of the invention is shown and described, simply by way of illustration of the best mode contemplated of carrying out the invention. As will be realized, the invention is capable of other and different embodiments, and its several details are capable of modifications in various obvious respects, all without departing from the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a simplified schematic view illustrating a retractable hose central vacuum system connected to a vacuum system pipe that includes a central vacuum source.

FIG. **1A** is a fragmentary side perspective view illustrating an end cuff stiffener inserted into a vacuum hose near the hose end cuff thereof.

FIG. **2** is a front side perspective view of a valve assembly having a vacuum hose extending through the same, wherein

the valve housing thereof is installed within a wall structure with the system vacuum pipe routed from above.

FIG. **3** is a cross-sectional view taken along **3**—**3** in FIG. **2**. illustrating the valve assembly and the valve housing thereof installed within a wall structure.

FIG. **4** is a perspective view of a static valve seal wherein the clamp lever is in a first position where the flexible sleeve is in the first undeformed, unsealed configuration, ready to receive a vacuum hose to enable the vacuum hose to move substantially freely through the valve assembly.

FIG. **5** is cross-sectional view taken along **5**—**5** in FIG. **4**.

FIG. **6** is an exploded perspective view of a static valve seal and the components thereof.

FIG. **7** is a cross-sectional view through the clamp of a static valve seal with the clamp in the first unclamped position.

FIG. **8** is a cross-sectional view through the clamp of a static valve seal with the clamp in the second clamping position.

FIG. **9** is a fragmentary perspective view of a hose collar installed on an end of a vacuum hose with a hose sock tucked around the end of the vacuum hose, and the hose collar engaging the vacuum hose and hose sock to maintain the hose sock in position.

FIG. **10** is a fragmentary sectional view illustrating an o-ring retainer employing an o-ring to maintain an air-tight connection between a system vacuum pipe and the valve assembly.

FIG. **11** is a perspective view of an alternate embodiment where a static valve seal comprises a collet shiftingly disposed around a tapered compression sleeve.

FIG. **12** is a sectional view of the embodiment illustrated in FIG. **11**, wherein the radially inner surface of the collet is disengaged from the compression elements of the compression sleeve.

FIG. **13** is a sectional view of an embodiment similar to that of FIG. **12** wherein the collet comprises a radially inner threaded surface for rotational engagement with a threaded compression sleeve, wherein the radially inner surface of the collet is disengaged from the compression elements of the compression sleeve.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

FIGS. **1** through **9** show an embodiment of a retractable-hose central vacuum cleaning system **10**. The vacuum cleaning system **10** is provided to assist and simplify the management of a retractable vacuum hose **12** in locations where ease of deployment of a vacuum hose is desired.

The vacuum cleaning system **10** comprises the retractable vacuum hose **12** of the type commonly employed in central vacuum cleaning systems, and a valve assembly **14** designed to operate with a standard, readily available central vacuum source **16**. A plurality of valve assemblies such as valve assembly **14** may be installed in the vacuum cleaning system **10**, and may be positioned at various locations in a building. The vacuum cleaning system **10** also utilizes industry standard vacuum plumbing, including a system vacuum pipe **18**, with minor exceptions. Large radius elbows **20**, having a radius in the range of 9 to 12 inches, are required to allow the vacuum hose **12** to pass through the bends in the system vacuum pipe **18**. Likewise, as will be discussed more fully below, a valve housing **22** is typically provided to contain the hose-clamping and sealing components of the valve assembly **14**, as well as for accessing the tool end **24** of the vacuum hose **12**.

Valve assembly **14** is connected for communication with a suitable system vacuum pipe **18** fitted with large radius elbows to facilitate hose storage within the system vacuum pipe **18**. Additionally, the valve assembly **14** is preferably formed with the suitable valve housing **22** that can be installed within a standard wall construction between wall surfaces **26** and **28**, and secured to wall stud **30** as is shown in FIGS. **1** through **3**. As illustrated, the valve assembly **14** is configured for ease of removal from its mounted position to facilitate servicing and replacement without altering the wall covering or the vacuum system plumbing. The valve assembly **14** is designed to fit completely into the space inside a standard 2×4 stud wall, between wall surfaces **26** and **28**, through an opening in the wall that is larger, by a clearance gap, than the foot print of the valve housing face flange **34**. In this way, a faceplate **36** that mounts flush with the wall outside surface **46** is used to cover the clearance gap.

The back edge **38** of the valve housing **22** is chamfered for installation clearance as shown in FIG. **3**. The chamfered end **40** of the valve housing **22** is inserted into the wall so that the same is disposed away from the vacuum pipe end **42** and rotated through the opening until it is totally inserted between the wall surfaces **26** and **28**. The valve assembly **14** is then slid towards the vacuum pipe end **42** until the vacuum pipe connection port **44** engages the vacuum pipe end **42** of the system vacuum pipe **18**. For installation, valve housing **22** is gently rocked back and forth to aid in the alignment and insertion of the vacuum pipe end **42** into the vacuum pipe connection port **44**.

In one embodiment illustrated in FIG **10**, an o-ring retainer **50** has a lead-in taper, i.e., a radially tapered inner surface **52** to accommodate an angular misalignment with the centerline of the system vacuum pipe **18**. With this arrangement, as the vacuum pipe end **42** enters the o-ring retainer **50**, it slides through and against a captive o-ring **56** which seals the outside surface of the system vacuum pipe **18** with the lead-in radially tapered inner surface **52**. No other attachments to the system vacuum pipe **18** are required. The o-ring retainer **50** has clearance ahead of the o-ring **56** to accommodate variation in vacuum pipe engagement lengths. Since sealing occurs on the radially outer surface of the system vacuum pipe **18**, the condition and exact position of the vacuum pipe end **42** is not critical.

Turning now to FIGS. **2** and **3**, valve housing face flange **34** is disposed adjacent to, and flush with the wall stud **30** which results in a gap **59** between the sidewall **58** of valve housing **22** and wall stud **30**. Accordingly, a wall stud standoff **60** is attached to wall stud **30** to build or shim out-to the sidewall **58** of valve housing **22**. In addition, the valve housing **22** is attached to the wall stud **30** and wall stud standoff **60** with mounting screws **66** through horizontal slots or holes **68** in the valve housing sidewall **58**. The valve assembly **14** is then slid towards the wall opening to the limit of the mounting slots, i.e., holes **68** and the mounting screws **66** lightly tightened. A standoff **70** the same general size and shape as the valve housing face flange **34** is used to build out slightly beyond the wall **18** outer surface. The faceplate **36** and valve housing door **72** are then attached to the valve housing **22** by passing mounting screws **74** through the standoff **70** into the valve housing face flange **34**. As indicated in the drawings, the standoff **70** can be constructed integrally with the faceplate **36**.

To facilitate mounting the valve housing **22**, the hex head mounting screws **66**, inside the valve housing **22** are loosened and the whole valve assembly **14** slid back into the wall

until the faceplate **36** rests flush against the outer wall surface. The mounting screws **66** are then tightened.

In some installations the system vacuum pipe is routed down through the wall from the ceiling and in others it is routed up from the floor. The valve assembly **14** can be mounted with the vacuum pipe connection port **44** pointing up or down and on either side of the wall stud **30**.

The common mounting hole pattern in the faceplate **36**, standoff **70** and valve housing face flange **34** is typically symmetrical. The faceplate **36** and valve housing door **72** are mounted with the valve housing door swinging up. The valve housing **22** can be mounted with the vacuum pipe connection port **44** pointing up or it can be rotated 180 degrees and mounted with the same pointing down. In either case the valve housing door **72** swings up. The valve housing door is equipped with a seal **76** and when closed, the valve housing **22** is air tight preventing leakage and reduced vacuum suction at the other valves in the system.

For system operation, the vacuum hose **12** is extracted from storage by opening valve housing door **72** on the valve assembly **14**, reaching inside, grasping the hose end cuff **78** and pulling outward. Any length of vacuum hose **12**, up to full length, can be extracted. The operator then closes clamp **80** by moving the clamp lever **82** to the second closed-clamping position. This seals the outer surface of the vacuum hose **12** to the radially inner surface **83** of a flexible sleeve **84** which is connected through the vacuum pipe connection port **44** to the system vacuum pipe **18** preventing air leaks. It also locks the vacuum hose **12** in position preventing further deployment or retraction.

Moreover, there is a hose receptacle **86** and a guide roller **88** to guide the vacuum hose **12** and prevent chafing as it enters and leaves the valve assembly **14**. The operator now attaches the tool handle **90** onto the vacuum hose end cuff **78**. It should be noted the tool handle **90** is one of various vacuum accessories **91** which could also include a vacuum wand **93**, and a vacuum cleaning tool **97** as illustrated in FIG. **1**. The vacuum cleaning system **10** is now ready to use in the conventional manner. This system may feature a wireless (RF) controller (not illustrated) integrated into the tool handle **90** to turn the vacuum source **12** on and off. An off-on switch (not illustrated) could be mounted on or near the valve assembly **14** if the wireless controller is not preferred.

Use of a wireless controller eliminates the need for any electrical wiring routed to the valve assembly **14** and any electrical conductors in the vacuum hose **12**. This results in a cost savings both in installation labor and in the use of lower cost components.

Conventionally, vacuum cleaning systems are provided with a debris trap for preventing large debris, such as pens and pencils, from entering the system. Typically this trap is in the form of a sharp 90 degree turn in the system vacuum pipe immediately behind the valve assembly. As previously noted, this hose storage system cannot tolerate sharp turns in the portion of the pipe used for hose storage, so a debris trap can not be use at this location. A much preferred location for the debris trap **92** is shown in FIG. **1**, wherein debris trap **92** is integrated into the tool handle **90** in the form of an offset or jog in the air passage.

Alternately, the debris trap can be located anywhere between the tool end **24** of vacuum hose **12** and the tool end **95** of the tool handle **90**. It can be integrated into the tool handle **90** or it can be a separate component. In addition, it should also be noted that an end cuff stiffener **98** can also be employed as a stiffening insert within the vacuum hose **12** near the hose end cuff **78**, or at the opposing retracting end **108**. The cuff stiffener is primarily used to prevent the vacuum hose **12** from bending enough to travel or move through the valve assembly **14**.

When the operator is finished with the cleaning task, the vacuum hose **12** is retracted by releasing the clamp **80**, and allowing the system vacuum to pull the vacuum hose **12** back to the valve housing **22** and into the system vacuum pipe **18**. The rate of retraction can be controlled by restricting the air flow into the tool handle nozzle **94** or hose end cuff **78** with the operator's hand or other air restriction device.

The tool handle **90** is then detached from the hose end cuff **78** and the vacuum hose **12** is retracted inside and through the valve assembly **14**. If so equipped, the RF sender (not illustrated) on the tool handle **90** is used to turn off the vacuum source **16** and the valve housing door **72** is closed. The tool handle **90** and other vacuum accessories used are stored in a conventional closet or cabinet.

Directing attention to FIG. **9**, the performance of this hose storage and retraction arrangement can be enhanced by covering vacuum hose **12** with a thin, tight fitting fabric hose sock **96**. Most vacuum hoses are of the elastomeric spiral ribbed construction and generate significant friction between the hose outer surface thereof and the vacuum plumbing including the system vacuum pipe **18**. Further, a fabric tube, referred to in the industry as a "hose sock" is placed over the entire length of the vacuum hose **12**. This reduces the friction and provides increased "sealing action" between the outside surface of the hose sock **96** and the radially inner surface of the system vacuum pipe **18** thereby increasing the suction force available to pull the hose back into the system vacuum pipe **18** using the system vacuum suction.

The hose sock **96** does not provide an air tight seal with the system vacuum pipe **18**. This leakage reduces the suction and air flow available for cleaning at the "tool end" of the vacuum hose **12** and must be eliminated during the vacuuming operation.

Accordingly, it is the valve assembly **14** that comprises a primary object of this invention. Included therein is a flexible sleeve **84** disposed in the valve housing **22** connected to the system vacuum pipe through the vacuum pipe connection port **44**. The vacuum hose **12** passes through the flexible sleeve **84** before exiting the valve assembly **14**. The flexible sleeve **84** is encircled by a clamp band **100** which can be tightened or loosened by the operator moving the clamp lever **82** which opens and closes clamp **80**. The clamp band **100** correspondingly compresses, i.e., radially deforms, or relaxes the flexible sleeve **84** radially. When the flexible sleeve **84** is deformed, i.e., compressed radially around the radially outer surface **101** (FIG. **9**) of the vacuum hose **12**, and accordingly the hose sock **96**, it forms a seal forcing the air to flow into the tool end **24** of the vacuum hose **12**.

It should be understood that when the flexible sleeve **84** is compressed as noted above, it also provides another important function. For example, any time the system vacuum source **16** is turned on, the suction pulls the vacuum hose **12** back into the system vacuum pipe **18**. The pulling force varies depending on the degree of air restriction at the tool end **24** of the vacuum hose **12**. This means that unless the vacuum hose **12** is axially restrained by some other means, the operator would constantly have to pull on the vacuum hose to keep it from being retracted into the system vacuum pipe **18**. The radially compressed and deformed sleeve **84** acts as a brake or lock to axially restrain the vacuum hose **12**.

Turning again to FIG. **9**, there is a recognized need in the central vacuum cleaner industry for a convenient, low profile device to secure and terminate the ends of hose socks to the vacuum hose ends. One present industry method of attachment utilizes draw strings (not illustrated), captured in the ends of the sock, which are pulled tight around the vacuum hose and tied. This results in an enlarged sock outside diameter, and a draw string knot at each end of the sock. For this reason, the present invention includes a hose collar **104** which provides an improved method of attaching the hose sock **96** to the vacuum hose **12** at the ends thereof. Hose collar **104** has an outer surface **106** which engage the internal threads or spiral ribs on a vacuum hose inner surface **102**. Accordingly, the hose sock **96** covers the entire outer surface of vacuum hose **12**.

In installation, the hose collar **104** is forced into the vacuum hose **12**, pressing the hose sock **96** against the inner wall of the vacuum hose **12**, trapping hose sock **96** between the hose collar **104** and the vacuum hose **12**. While this design and arrangement utilizes a hose collar **104**, any device with features that engage the inner surface **102** of a vacuum hose **12**, and that engage and trap the hose sock **96** between these features and the inner surface **102** of a vacuum hose **12** could be employed.

Additionally, the hose collar **104** includes an outer surface **106** that is the same or slightly larger than the inside diameter of the vacuum hose **12**. Similarly, the outside diameter **107** of the hose collar **104** is also slightly larger than the inside diameter of the radially inner surface **83** of the flexible sleeve **84** when the same is in the unclamped position. Accordingly, the hose collar **104** acts as a stop or detent when the vacuum hose **12** is fully extended. This prevents the hose end from inadvertently being pulled out of the hose receptacle **86** during a deployment.

For removal, the hose end at hose collar **104** can be removed from the hose receptacle **86** and valve housing **22** by grasping the vacuum hose **12**, as it enters the hose receptacle **86**, and gently pulling straight down. The flexible sleeve **84** will expand, functioning as a detent, and allow the hose collar **104** to pass through.

This procedure can also be used to remove the vacuum hose **12** from the wall for service, cleaning or replacement. The vacuum hose **12** can also be easily moved from one valve assembly to another, and stored at the last valve assembly used.

While the present vacuum hose storage arrangement focuses on convenient management of multiple hoses, this feature allows the system to be operated with only one hose and yet provides for convenient hose storage at the last location used. This feature also allows a vacuum hose **12** to be shared by another valve assembly which has a damaged vacuum hose until a replacement is obtained.

Another feature of the present invention, is that clamp lever **82** is located such that when the clamp **80** is closed, the position of the clamp lever **82** prevents the valve housing door **72** from being closed. In other words the clamp **80** must be in the first unlocked position in order to close the valve housing door **72**. This prevents the flexible sleeve **84** from being left in the "compressed" deformed condition for long periods of time. When clamp **80** is open, clamp lever **82** is inside the valve housing **22** thereby allowing the valve housing door **72** to close and seal.

A plurality of valve assemblies such as valve assembly **14** can be positioned in vertical walls or in horizontal floor configurations, wherein each would employ its own hose **12**, and each would be installed and connected to a common central vacuum cleaning system **10**.

In another aspect of the invention, the vacuum hose **12** includes a retracting end **108** that leads the vacuum hose **12** into and through the valve assembly **14**. For this purpose, valve assembly **14** includes a receiving port **110** which is defined by hose receptacle **86** for receiving the retracting end **108** of the vacuum hose **12**. In this way, the vacuum hose **12** can extend through the receiving port **110**, and through the valve assembly **14**. Further, as noted above, the valve assembly **14** comprises the vacuum pipe connection port **44** adapted to receive the system vacuum pipe **18** that is in communication with a centrally located central vacuum source **16** for creating a vacuum within the system vacuum pipe.

Importantly, the valve assembly **14** incorporates a static valve seal **112** that is located between the receiving port **110** and the vacuum pipe connection port **44**. In general The static valve seal **112** comprises the components that facilitate the substantially air-tight seal between the vacuum hose **12** and the system vacuum pipe **18**.

Regarding the above disclosure, the static valve seal **112** would include the flexible sleeve **84** and clamping components including clamp **80** along with its clamp lever **82** and clamp band **100**. In the present invention, the flexible sleeve **84** includes an integrally formed sleeve flange **154** that is disposed adjacent the valve housing **22** as illustrated in FIG. **2**. Additionally, a flange retainer **156** is included to securely connect and lead-in the system vacuum pipe **18** into the flexible sleeve **84**. Fasteners such as **158** could be employed to secure the flange retainer **156**.

Moreover, the static valve seal **112** is adapted for coupling together a system vacuum pipe **18** to the vacuum hose **12** to create a substantially air-tight sealed communication between the system vacuum pipe **18** and the vacuum hose **12**. With this construction, the vacuum generated by the central vacuum source **16** is communicated through the system vacuum pipe **18**, and through the vacuum hose **12** to the vacuum accessories **91** including a vacuum cleaning tool **97** which could be connected to a vacuum wand **93**.

In order to manage the vacuum hose **12**, the static valve seal **112** is adjustable from a first unsealed configuration where the vacuum hose **12** can move freely, in either direction, through the valve assembly **14** and through a system vacuum pipe **18**. As disclosed above, the retracting movement of the vacuum hose is responsive to the vacuum or suction created by a vacuum source **16**.

Further, the static valve seal **112** is adjustable to a second sealed configuration where the vacuum hose is in sealed communication with a system vacuum pipe **18**, and where the vacuum hose **12** is substantially fixed in relative position to the valve assembly **14**. In this way, the movement from first configuration to the second configuration enables a user to select and fix the length of vacuum hose **12** that extends outward from the receiving port **110** of the valve assembly **14**.

In one embodiment, the static valve seal **112** comprises radially deformable flexible sleeve **84** adapted for sealed communication with the system vacuum pipe **18**. The flexible sleeve **84** is disposed for receiving the vacuum hose **12** so that the vacuum hose **12** can extend substantially coaxially through the flexible sleeve **84**, into the system vacuum pipe **18**. Importantly, the flexible sleeve **84** is adjustable to radially deform from a first non-deformed configuration, where the vacuum hose **12** can move substantially freely through the valve assembly **14** and into the system vacuum pipe **18**, to a second radially deformed configuration where the flexible sleeve **84** is radially deformed to constrict tightly

around the vacuum hose **12** to create substantially air-tight sealed communication between the vacuum hose **12** and a system vacuum pipe **18**.

It should be understood, that there are many ways to cause the flexible seal **84** to deform as noted above. For example, a user could simply grasp the flexible seal with a hand and squeeze tightly. Because the flexible seal **84** is constructed from a somewhat soft PVC type of material, the squeezing pressure would not have to be that great.

Further, the flexible sleeve **84** includes a radially inner sleeve outlet surface **118** that is of a size and diameter to snugly receive the vacuum pipe end **42** of a system vacuum pipe **18**. This produces a somewhat loose interference fit that could be adequate to form an air-tight seal between the system vacuum pipe **18** and the flexible sleeve **84**. However, a clamp mechanism is typically provided to increase and secure the seal. For this purpose, a worm type drive clamp **138** is employed for this purpose.

Regarding the air-tight seal required between the vacuum hose **12** and the flexible seal **84**, one embodiment, noted above, employs the clamp **80** that comprises the clamp band **100** disposed around the flexible seal **84** to deform the same when the clamp lever **82** is moved from an open to the closed clamping position. As can be seen, this type of clamping mechanism simply uses the clamp lever **82** connected to the clamp band **100**, wherein the clamp lever pivots about a clamp pivot point **140**, with the band connection point **142** shifting to an over-center position in relation to the clamp pivot point **140**. In this way, the clamp lever **82** will remain in the closed position when it is so moved. Also, in this type of construction, the clamp **80** could be mounted by a clamp bracket **144** to the valve housing **22** by any means of attachment, including bracket fasteners **146** (FIG. **4**)

Directing attention to FIGS. **11** through **13**, another embodiment is illustrated where the static valve seal **112** is formed by a radially tapered member engaging a radially disposed surface. For example, a compression sleeve **168** is coaxially disposed around the flexible sleeve **84**. The compression sleeve **168** having a plurality of spaced, cantilevered compression elements **173** encircling the flexible sleeve **84**. Each compression element **173** extends along the flexible sleeve **84** to define a radially outer tapered surface **170** that tapers in an axial direction as best illustrated in FIG **12**. Also, an axially shiftable collet **174** includes a radial inner surface **178** disposed around the compression sleeve **168**. The collet **174** being axially shiftable or slidable from a first position, where the radially inner surface **178** thereof is disengaged from the compression elements **173**, to a second engaging position where the radially inner surface **178** of the collet **174** engages the radially outer tapered surface **170** of the compression elements **173** causing the same to bend toward the flexible sleeve **84**, deforming the flexible sleeve **84** to constrict tightly around the vacuum hose **12** to create substantially airtight sealed communication between the vacuum hose **12** and a system vacuum pipe **18**.

In another aspect of the invention, the collet **186** is threaded as illustrated in FIG. **13**. Likewise, the compression sleeve **184** is formed to threadedly engage the threaded collet **186** by rotation of the collet **186**. As can be seen, the same sealing action in imposed on the flexible seal **84**.

Regarding the fit of the system vacuum pipe into the flexible sleeve **84**, a system pipe receiving seat **124** is formed by creating a step in the transition from the radially inner sleeve outlet surface **118** to the sealing portion of the flexible seal **84**. Similarly, a receptacle receiving seat **132** is formed by creating a step as best shown in FIGS. **5**, **12**, and **13**. The receiving seat **132** is provided as a stop for the hose receptacle **86**. Additionally, because of the manufacturing process, a crown **134**, i.e., a slightly raised area, is formed in the radially inner surface **83**, of the flexible seal **84**.

In the drawings and specifications there have been set forth preferred embodiments of the invention and although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation. The design of the hose seal and restraint depicted in this invention combine several functions, that of sealing, restraining and wear reduction, into one device or mechanism. Separate devices or mechanisms could be used for each function. Other devices or mechanisms could be used to achieve the functions and results.

In addition, whereas the drawings and specifications relate to central vacuum cleaning systems for a home or building, the application is not limited to this industry alone but to any industry or operation where a vacuum system is used.

Finally, as stated above, this application is based on, and claims benefit of U.S. Provisional Application No. 60/476,887 filed Jun. 5, 2003. It should be noted that the reference numerals for some of the components have been changed from the provisional application. The changes were only made to present a generally more sequential order thereof in the specification, and to aid the reader in locating and cross reference components disclosed in the illustrations and the specification.

Having illustrated and described the principles of my invention in a preferred embodiment thereof, it should be readily apparent to those skilled in the art that the invention can be modified in arrangement and detail without departing from such principles. I claim all modifications coming within the spirit and scope of the accompanying claims.

What is claimed is:

1. A retractable hose central vacuum cleaning system comprising:

a retractable vacuum hose having a tool end adapted to removably receive a vacuum cleaning tool for vacuuming debris, and an opposing retracting end;

a valve assembly having a receiving port for receiving the retracting end of the vacuum hose, wherein the vacuum hose is extendable through the receiving port and through the valve assembly;

the valve assembly further comprising:

a vacuum pipe connection port adapted to receive a system vacuum pipe that is in communication with a central vacuum source for creating a vacuum within the system vacuum pipe;

a static valve seal disposed between the receiving port and the vacuum pipe connection port, the static valve seal being adapted for coupling the system vacuum pipe to the vacuum hose to create substantially air-tight sealed communication between the system vacuum pipe and the vacuum hose so that the vacuum generated by the central vacuum source can be communicated through the vacuum hose to the vacuum cleaning tool; and

wherein the static valve seal is adjustable from a first unsealed configuration where the vacuum hose can move freely through the valve assembly and through the system vacuum pipe, responsive to the vacuum created by the central vacuum source, to a second sealed configuration where the vacuum hose is in sealed communication with the system vacuum pipe, and where the vacuum hose is substantially fixed in relative position to the valve assembly, wherein the movement from first unsealed configuration to the second sealed configuration enables a user to select and fix the vacuum hose length that extends outward from the receiving port of the valve assembly.

2. The retractable hose central vacuum cleaning system as recited in claim 1 wherein the static valve seal further comprises a radially deformable flexible sleeve adapted for sealed communication with the system vacuum pipe, the flexible sleeve being disposed for receiving the vacuum hose so that the vacuum hose can extend substantially coaxially through the flexible sleeve, into the system vacuum pipe; and

wherein the flexible sleeve is adjustable to radially deform from a first non-deformed configuration, where the vacuum hose can move substantially freely through the valve assembly and into the system vacuum pipe, to a second radially deformed configuration where the flexible sleeve is radially deformed to constrict tightly around the vacuum hose to create substantially air-tight sealed communication between the vacuum hose and the system vacuum pipe, and where a selected length of vacuum hose is fixed and maintained outward from the receiving port.

3. The retractable hose central vacuum cleaning system as recited in claim 2 wherein the flexible sleeve further comprises a radially inner sleeve outlet surface adapted to sealingly receive the system vacuum pipe.

4. The retractable hose central vacuum cleaning system as recited in claim 2 wherein the flexible sleeve further comprises a radially inner sleeve outlet surface adapted to sealingly receive the system vacuum pipe, wherein a substantially air-tight seal is formed by an interference fit between the radially inner sleeve outlet surface and the system vacuum pipe.

5. The retractable hose central vacuum cleaning system as recited in claim 3 further comprising an adjustable clamp having a band disposed around the flexible sleeve, the clamp being adjustable to deform the radially inner sleeve outlet surface inward to create a seal between the flexible sleeve and the system vacuum pipe.

6. The retractable hose central vacuum cleaning system as recited in claim 2 wherein the static valve seal further comprises means for radially deforming the flexible sleeve, said deforming means being movable from a first non-deforming configuration where the vacuum hose can move substantially freely through the valve assembly, to a second deformed configuration to deform the flexible sleeve to constrict tightly around the vacuum hose.

7. The retractable hose central vacuum cleaning system as recited in claim 6 wherein the deforming means comprises a clamp having an adjustable clamp band disposed around the flexible sleeve, the clamp band being movable from the first non-deforming configuration, where the vacuum hose can freely move through the valve assembly, to the second radially deformed configuration to radially deform the flexible sleeve to constrict tightly around the vacuum hose to form a substantially air-tight seal between the vacuum hose and the system vacuum pipe.

8. The retractable hose central vacuum cleaning system as recited in claim 7 wherein the clamp further comprises a clamp lever, wherein the clamp band is responsive to the clamp lever being shifted from a first position where the clamp band in untensioned, to a second position where the clamp band is tensioned to radially deform the flexible sleeve to constrict tightly around the vacuum hose.

9. The retractable hose central vacuum cleaning system as recited in claim 2 wherein the static valve seal further comprises:

a compression sleeve coaxially disposed around the flexible sleeve, the compression sleeve having a plurality of spaced, cantilevered compression elements encircling the flexible sleeve, each compression element extending along the flexible sleeve to define a radially outer surface that tapers in an axial direction; and

an axially shiftable collet having a radial inner surface disposed around the compression sleeve, the collet being axially shiftable from a first position, where the radially inner surface thereof is disengaged from the compression elements, to a second engaging position where the radially inner surface of the collet engages the tapered surface of the compression elements causing the compression elements to bend toward the flexible sleeve, deforming the flexible sleeve to constrict tightly around the vacuum hose to create substantially air-tight sealed communication between the vacuum hose and the system vacuum pipe.

10. The retractable hose central vacuum cleaning system as recited in claim 9 wherein the collet slidingly engages the compression sleeve.

11. The retractable hose central vacuum cleaning system as recited in claim 9 wherein the compression sleeve further comprises a radially outer threaded portion, and the radially inner surface of the collet comprises a threaded portion to enable threaded engagement with the compression sleeve so that the collet can be rotated to shift from the first position, where the radial inner surface of the collet is disengaged from the compression elements, to the second engaging position where the radially inner surface of the collet engages the tapered surface of the compression elements causing the compression elements to bend toward the flexible sleeve, deforming the flexible sleeve to constrict tightly around the vacuum hose to create substantially air-tight sealed communication between the vacuum hose and the system vacuum pipe.

12. The retractable hose central vacuum cleaning system as recited in claim 2 wherein the valve assembly further comprises a valve housing for enclosing the static valve seal.

13. The retractable hose central vacuum cleaning system as recited in claim 12 wherein the flexible sleeve comprises an integrally formed flange disposed to engage the valve housing.

14. A method for making a retractable hose central vacuum cleaning system comprising the steps:

providing a retractable vacuum hose having a tool end adapted to removably receive a vacuum cleaning tool for vacuuming debris, and an opposing retracting end;

forming a valve assembly having a receiving port for receiving the retracting end of the vacuum hose, wherein the vacuum hose is extendable through the receiving port and through the valve assembly;

wherein forming the valve assembly further comprises the steps:

forming a vacuum pipe connection port adapted to receive a system vacuum pipe that is in communication with a central vacuum source for creating a vacuum within the system vacuum pipe;

constructing a static valve seal disposed between the receiving port and the vacuum pipe connection port, the static valve seal being adapted for coupling the system vacuum pipe to the vacuum hose to create substantially air-tight sealed communication between the system vacuum pipe and the vacuum hose so that the vacuum generated by the central vacuum source can be communicated through the vacuum hose to the vacuum cleaning tool;

the static valve seal comprising a radially deformable flexible sleeve adapted for sealed communication with the system vacuum pipe, the flexible sleeve being

disposed for receiving the vacuum hose so that the vacuum hose can extend substantially coaxially through the flexible sleeve, into the system vacuum pipe; and

wherein the flexible sleeve is adjustable to radially deform from a first non-deformed configuration, where the vacuum hose can move substantially freely through the valve assembly and into a system vacuum pipe, to a second radially deformed configuration where the flexible sleeve is radially deformed to constrict tightly around the vacuum hose to create substantially air-tight sealed communication between the vacuum hose and the system vacuum pipe, and wherein the movement from first non-deformed configuration to the second radially deformed configuration enables a user to select and fix the vacuum hose length that extends outward from the receiving port of the valve assembly.

15. The method for making a retractable hose central vacuum cleaning system as recited in claim **14** wherein the static valve seal further comprises means for radially deforming the flexible sleeve, said deforming means being movable from a first non-deforming configuration where the vacuum hose can move substantially freely through the valve assembly, to a second deformed configuration to deform the flexible sleeve to constrict tightly around the vacuum hose.

16. The method for making a retractable hose central vacuum cleaning system as recited in claim **15** wherein the deforming means comprises a clamp having an adjustable clamp band disposed around the flexible sleeve, the clamp band being movable from a first non-deforming configuration, where the vacuum hose can freely move through the valve assembly, to a second radially deformed configuration to radially deform the flexible sleeve to constrict tightly around the vacuum hose to form a substantially airtight seal between the vacuum hose and the system vacuum pipe.

17. The method for making a retractable hose central vacuum cleaning system as recited in claim **16** wherein the clamp further comprises a clamp lever, wherein the clamp band is responsive to the clamp lever being shifted from a first position where the clamp band in untensioned, to a second position where the clamp band is tensioned to radially deform the flexible sleeve to constrict tightly around the vacuum hose.

18. The method for making a retractable hose central vacuum cleaning system as recited in claim **14** wherein the step of constructing the static valve seal further comprises the step of:

forming a compression sleeve coaxially disposed around the flexible sleeve, the compression sleeve having a plurality of spaced, cantilevered compression elements encircling the flexible sleeve, each compression element extending along the flexible sleeve to define a radially outer surface that tapers in an axial direction; and

forming an axially shiftable collet having a radially inner surface disposed around the compression sleeve, the collet being axially shiftable from a first position, where the radially inner surface thereof is disengaged from the compression elements, to a second engaging position where the radially inner surface of the collet engages the tapered surface of the compression elements causing the compression elements to bend toward the flexible sleeve, deforming the flexible sleeve to constrict tightly around the vacuum hose to create substantially air-tight sealed communication between the vacuum hose and the system vacuum pipe.

19. The method for making a retractable hose central vacuum cleaning system as recited in claim **18** wherein the compression sleeve further comprises a radially outer threaded portion, and the radially inner surface of the collet comprises a threaded portion to enable threaded engagement with the compression sleeve so that the collet can be rotated to shift from a first position, where the radially inner surface of the collet is disengaged from the compression elements, to a second engaging position where the radially inner surface of the collet engages the tapered surface of the compression elements causing the compression elements to bend toward the flexible sleeve, deforming the flexible sleeve to constrict tightly around the vacuum hose to create substantially air-tight sealed communication between the vacuum hose and the system vacuum pipe.

20. A retractable hose central vacuum cleaning system comprising:

a retractable vacuum hose having a tool end adapted to removably receive a vacuum cleaning tool for vacuuming debris, and an opposing retracting end;

a valve assembly having a receiving port for receiving the retracting end of the vacuum hose, wherein the vacuum hose is extendable through the receiving port and through the valve assembly;

the valve assembly further comprising:

a vacuum pipe connection port adapted to receive a system vacuum pipe that is in communication with a central vacuum source for creating a vacuum within the system vacuum pipe;

a static valve seal disposed between the receiving port and the vacuum pipe connection port, the static valve seal being adapted for coupling the system vacuum pipe to the vacuum hose to create substantially air-tight sealed communication between the system vacuum pipe and the vacuum hose so that the vacuum generated by the central vacuum source can be communicated through the vacuum hose to the vacuum cleaning tool;

the static valve seal comprising a radially deformable flexible sleeve adapted for sealed communication with the system vacuum pipe, the flexible sleeve being disposed for receiving the vacuum hose so that the vacuum hose can extend substantially coaxially through the flexible sleeve, into the system vacuum pipe; and

wherein the flexible sleeve is adjustable to radially deform from a first non-deformed configuration, where the vacuum hose can move substantially freely through the valve assembly and into the system vacuum pipe, to a second radially deformed configuration where the flexible sleeve is radially deformed to constrict tightly around the vacuum hose to create substantially air-tight sealed communication between the vacuum hose and the system vacuum pipe, and, wherein the movement from first non-deformed configuration to the second radially deformed configuration enables a user to select and fix the vacuum hose length that extends outward from the receiving port of the valve assembly.

21. The retractable hose central vacuum cleaning system as recited in claim **20** further comprising a clamp having an adjustable clamp band disposed around the flexible sleeve, the clamp band being movable from a first non-deforming configuration, where the vacuum hose can freely move through the valve assembly, to a second radially deformed configuration to radially deform the flexible sleeve to constrict tightly around the vacuum hose to form a substantially air-tight seal between the vacuum hose and the system vacuum pipe.

22. The retractable hose central vacuum cleaning system as recited in claim 20 wherein the static valve seal further comprises:

a compression sleeve coaxially disposed around the flexible sleeve, the compression sleeve having a plurality of spaced, cantilevered compression elements encircling the flexible sleeve, each compression element extending along the flexible sleeve to define a radially outer surface that tapers in an axial direction; and

an axially shiftable collet having a radially inner surface disposed around the compression sleeve, the collet being axially shiftable from a first position, where the radially inner surface thereof is disengaged from the compression elements, to a second engaging position where the radially inner surface of the collet engages the tapered surface of the compression elements causing the compression elements to bend toward the flexible sleeve, deforming the flexible sleeve to constrict tightly around the vacuum hose to create substantially air-tight sealed communication between the vacuum hose and the system vacuum pipe.

23. The retractable hose central vacuum cleaning system as recited in claim 22 wherein the compression sleeve further comprises a radially outer threaded portion, and the radially inner surface of the collet comprises a threaded portion to enable threaded engagement with the compression sleeve so that the collet can be rotated to shift from a first position, where the radially inner surface of the collet is disengaged from the compression elements, to a second engaging position where the radially inner surface of the collet engages the tapered surface of the compression elements causing the compression elements to bend toward the flexible sleeve, deforming the flexible sleeve to constrict tightly around the vacuum hose to create substantially air-tight sealed communication between the vacuum hose and the system vacuum pipe.

* * * * *