TANDEM, EXTENDABLE TUBING OR HOSE ASSEMBLY

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ABSTRACT

An tandem tubing assembly for a cleaning machine is disclosed comprising a flexible first tubing having a first diameter and configured as a flexible hose having a helical frame, a relaxed length and an extended length; a flexible second tubing having a second diameter substantially smaller than the first diameter of the first tubing and configured as a helical coil having a relaxed length and an extended length, wherein the second tubing, in its coiled form, is disposed inside the first tubing, and respective ends of the first tubing and the second tubing are coupled together such that the first and second tubings flex together and extend or contract together between the extended and the relaxed lengths.
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BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention generally relates to combinations of flexible tubing or hoses and, more particularly, to assemblies of extendable and contractible flexible tubing or hose for the transport of both gas and liquid material in cleaning equipment. One illustrative example of such equipment to be described is an apparatus for cleaning floors or upholstery.

[0003] 2. Description of the Prior Art

[0004] Equipment for cleaning floors or upholstery employing vacuum cleaning devices in combination with liquid dispensing capability have long been available in commercial products. Such cleaning devices are primarily marketed to institutional clients such as hotels, restaurants, office buildings and the like. In general, the vacuum cleaning device includes a long, flexible vacuum hose between the vacuum-generating machine and an attachment or cleaning head adapted to the type of floor or upholstery surface to be cleaned. In addition, the machine typically includes a reservoir for the liquid material such as a detergent, steam, or other cleaning fluid. The liquid material is pumped through a long, flexible tubing to the cleaning head to be dispensed during cleaning operations. The flexible tubing and the flexible vacuum hose are often attached to each other in some way to enable handling as a single hose assembly when extending it for operation or storing it when the equipment is not in use. In some cases the liquid tubing is attached to the outside of the vacuum hose. In other cases the liquid tubing is routed inside the vacuum hose. While the long composite tubing and hose assemblies enable cleaning operations over a wide area, storage and handling of the long composite tubing and hose assemblies is a cumbersome task, which reduces efficiency. In some cases, the awkwardness of handling or storing such tubing and hose assemblies may even become a safety issue.

[0005] In the prior art, a number of composite tubing and hose assemblies have been devised. For example, in U.S. Pat. No. 4,385,413 issued to Goldsmith for a “Carpet Cleaning System,” a solution line and a vacuum hose form a flexible composite line, wherein the solution line is attached to the exterior of the vacuum hose. In U.S. Pat. No. 4,517,404 issued to Hughes, et al. for a “Multipurpose Fluid Conveying Hose And Method For Making Same,” a smaller diameter liquid conveying hose is passed through the interior of the principal vacuum conveying hose, which may include a helical wire coil reinforcement structure. In another example, U.S. Pat. No. 4,998,317 issued to Passien for a “Combined Vacuum And Fluid Line,” a flexible fluid line is retained within a vacuum hose for dispensing fluid. The combined hose-and-line assembly, when attached to a vacuum machine, is freely rotatable at a connection point due to a swivel coupling incorporated into an end of the hose/line assembly attached to the vacuum machine and/or to the cleaning attachment. In yet another example, U.S. Pat. No. 6,260,232 issued to Nelson et al. for a “Surface Cleaning Apparatus,” an elongated, flexible tubing, located within a flexible vacuum hose, carries liquids to a cleaning head. The liquid-carrying tubing may be axially supported within the vacuum hose by a spiked hub assembly.

[0006] A prior art composite hose assembly is shown in FIG. 1A, in which a cleaning machine 10 is shown with the composite hose 12 connected thereto and attached at an opposite end to a cleaning attachment 14. The attachment 14 is shown in a first position 16, extending the composite hose 12 to its full length, and in a second position 18, wherein the composite hose 12 is formed into a loop 20 as the attachment 14 is brought nearer to the cleaning machine 10. The loop 20, depending on the length of the composite hose 12, may tend to remain on the floor where it requires extra effort to place it or coil it in an out-of-the-way position so as to prevent tripping over it or it being inadvertently left in a location that obstructs the cleaning operation underway.

[0007] A common deficiency of each of these examples of the prior art is that the combined vacuum hose and liquid tubing assembly, while flexible enough to permit ease of movement during cleaning operations are not readily extendable nor contractible in length during use or when setting up or ceasing operation of a job. The conventional composite hoses, because they are always disposed in a fixed length, are inconvenient and cumbersome to handle in proportion to their length. A longer composite hose, while it enables cleaning a larger area without moving the relatively heavy cleaning machine, is more easily entangled or likely to knock objects off their location on a table or stand, for example. Further, a long hose is more likely to be awkward to coil up or store while shutting down the equipment after an operation, because of its length and bulk. A short hose severely limits the range of the cleaning equipment.

[0008] What is needed is a tubing or hose assembly that would both extend and contract, so as to minimize the formation of a bulky and troublesome loop in the hose/tubing assembly. Such a feature would be less cumbersome to handle, is less likely to become tangled during use, and may be more easily stored, which contributes to the overall convenience and efficiency of operation of the cleaning equipment.

SUMMARY OF THE INVENTION

[0009] Accordingly, there is disclosed a tandem tubing assembly for a cleaning machine comprising a flexible, extendable first tubing having a first diameter and configured as a flexible hose having a resilient helical frame, a relaxed length and an extended length; a flexible, extendable second tubing having a second diameter substantially smaller than the first diameter of the first tubing and configured as a helical coil having a relaxed length and an extended length, wherein the second tubing, in its coiled form, is disposed inside the first tubing, and respective ends of the first tubing and the second tubing are coupled together such that the first and second tubings flex together and extend or contract together between the extended and the relaxed lengths. The cleaning machine may be adapted to cleaning interior or exterior surfaces of floors, upholstery, furniture, walls, windows and doors, ceilings, buildings, vehicles, walkways, stairways, roads, athletic playing surfaces and the like.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. 1A illustrates a prior art composite hose and tubing assembly as used with a prior art cleaning machine;
FIG. 1B illustrates a tandem tubing assembly according to one embodiment of the present invention;

FIG. 2 illustrates a more detailed view of one embodiment of the tandem tubing assembly shown in an extended position according to the present invention;

FIG. 3 illustrates a more detailed view of the embodiment of the tandem tubing assembly shown in FIG. 2 in a contracted position;

FIG. 4A illustrates a detail view of the construction of one embodiment of a first tubing in a contracted configuration for use in the embodiment of FIGS. 2 and 3;

FIG. 4B illustrates a detail cross section view A-A of the construction of one embodiment of a first tubing as shown in FIG. 4A;

FIG. 4C illustrates a detail cross section view B-B of a wall segment of the embodiment of the first tubing of FIG. 4A, but shown in an extended configuration; and

FIG. 5 illustrates a detail cross section view B-B (as in FIG. 4A) of a wall section of an alternate embodiment of a tandem tubing assembly according to the present invention, in which the second tubing, formed into a helical coil, is integrated into the structure of the first tubing to form the helical frame of the first tubing.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 1A, there is illustrated a prior art composite hose and tubing assembly, which will be briefly described to enable the reader to appreciate the advance in the art provided by the present invention as shown in the remaining figures and the accompanying detailed description. A composite hose and tubing assembly 12 is coupled between a cleaning machine 10 and a cleaning attachment 14. The composite hose and tubing assembly 12 is shown in a fully extended position 16 (see the phantom view in FIG. 1A) and in a non-extended position 18, wherein the composite hose and tubing assembly 12 is formed into a loop 20. The composite hose and tubing assembly includes a flexible vacuum hose 22 and a flexible liquid tubing 24 attached together along their common length and coupled to a cuff 26. The cuff 26 adapts the composite hose and tubing assembly 12 to the cleaning attachment 14. The flexible tubing 24 is connected to the cuff 26 via a branch tube 28. A valve lever 30 may be used to control the amount of liquid admitted to the cleaning attachment 14.

Since the composite hose and tubing assembly 12 illustrated in FIG. 1A is of a fixed length and cannot extend or contract from its fixed length, any excess length in a particular situation tends to gather on the floor or in the space between the cleaning machine 10 and the cleaning attachment 14. Thus, the loop 20 shown gathered on a floor 34 in FIG. 1A represents the excess length of the composite hose and tubing assembly 12 that is not necessary to reach from the cleaning machine 10 to the cleaning attachment 14. In practice, the loop 20 formed by the excess length of the composite hose and tubing assembly 12 is often cumbersome and unwieldy. Such loop 20 may thus be difficult to control and impair the efficiency and safety of operation of the cleaning machine 10.

Referring to FIG. 1B there is illustrated a tandem tubing assembly for a cleaning machine according to one embodiment of the present invention. The tandem tubing assembly 38 is shown coupled to a cleaning machine 36 and attached at an opposite end to a cleaning attachment 40. As will be apparent in FIG. 1B, the tandem tubing assembly 38 is not only flexible (i.e., is easily bendable), but its length is also extendable and contractible. The cleaning attachment 40 is shown in a first position 42, extending the tandem tubing assembly 38 to its full length, and in a second position 44, wherein the tandem tubing assembly 38 is contracted to a relaxed length as the attachment 40 is brought nearer to the cleaning machine 36. The tandem tubing assembly 38 may be coupled to the cleaning attachment 40 via a cuff 46. A valve lever 48 may be provided to control the liquid materials used in the cleaning operation. An important feature of the invention is that the formation of a loop in the tandem tubing is avoided, along with the disadvantages of the prior art composite hose and tubing assembly, which tends to gather upon the floor 34 as described above, as its length contracts or relaxes from the first position 42 to the second position 44.

Referring to FIG. 2 there is illustrated a more detailed view of one embodiment of the tandem tubing assembly shown in an extended position, according to the present invention. The tandem tubing assembly 50 includes a first tubing 52 configured as a flexible hose having a resilient helical frame (not shown in this figure) and a second tubing 54 configured as a flexible helical coil and disposed within the first tubing 52. In the illustrative embodiment the first tubing 52 may be used as a vacuum or air hose or tubing and has a first outside diameter of, for example, approximately one-quarter inch (an outside diameter of the tubing itself). When formed into a helical coil, the outside diameter of the helical coil of the second tubing 54 is slightly smaller than the inside diameter of the first tubing 52, both when the tandem tubing assembly 50 is extended and when it is contracted.

In most embodiments of the tandem tubing assembly 50, the second tubing 54 itself has a substantially smaller diameter than the first tubing. In this illustrative example, the ratio of the outside diameter of the first tubing to the outside diameter of the second tubing (before being formed into a helical coil) is approximately eight-to-one. This condition is required so that the flow rate of air or other gas through the first tubing 52 is maintained substantially unimpeded by the presence of the helically coiled second tubing 54 within the inside of the first tubing 52. This ratio may vary, however, depending on the particular application defined for the tandem tubing assembly 50. In general, the ratio should equal or exceed approximately five-to-one, in practical tandem tubing assemblies, in order that the second tubing 54 may be readily formed into a helical coil without introducing kinks, sharp bends or abnormal stresses in the material, and without materially impairing its ability to convey liquid materials in both the extended and contracted configurations.

The first tubing 52 may be fabricated of a tubular PVC membrane disposed over a length of PVC-insulated spring wire formed into a resilient helical coil. The PVC-insulated spring wire helical coil is used as a frame for the
first tubing 52. In one process, the PVC insulation of the spring wire coil and the inside surface of the PVC membrane may be cemented together with a suitable solvent while the spring wire helical coil, disposed within the tubular membrane, and the tubular membrane are both held in an extended configuration. Upon contact the PVC materials bond and the bond is allowed to set. After the set has occurred, the extended assembly is allowed to relax, wherein the spring wire contracts, folding the membrane between the adjacent coils of the spring wire to form the first tubing 52.

The second tubing 54, fabricated from a semi-rigid plastic tubing material, may be formed into a helical coil having an outside diameter slightly smaller than the minimum inside diameter of the first tubing. The tandem tubing assembly 50 may be formed by inserting the coiled second tubing 54 inside the first tubing 52 and coupling the respective ends together as will be described. When assembled together, the combined first and second tubing 52, 54 are extendable and contractible as a single unit of hose.

[0024] Continuing with FIG. 2, the first tubing 52 may be terminated in a first cuff 56, which in turn is connected to a receiver tube 58. In the following description, the term ‘pigtail’ will be taken to mean an uncoiled length of the second tubing 54. Attached to the receiver tube 58 is a valve assembly 60, operable by a lever 62, for controlling the release of liquid from the second tubing 54. The liquid material is conveyed via a first pigtail 64 through a side wall passage 78 of the first cuff 56 and a first coupling 66 into a cleaning attachment that is attached to the receiver tube 58. The cleaning attachment is not shown in FIG. 2, but is similar to the cleaning attachment 40 illustrated in FIG. 1B. The valve assembly 60 is provided to dispense the liquid through a second coupling 68 into the cleaning attachment. The first tubing 52 may further be terminated in a second cuff 70, which in turn is coupled to the cleaning machine (not shown in FIG. 2, but see reference number 36 in FIG. 1B). A second pigtail 74 of the second tubing 54 is routed through a side wall passage 78 of the second cuff 70, to be connected to a reservoir (not shown) in the cleaning machine via a third coupling 76.

[0025] The first and second cuffs 56, 70 may be fabricated from a molded plastic material that is flexible and includes internal threads within the larger end thereof to enable them to be threaded onto the ends of the first tubing 52. The internal threads of the first and second cuffs 56, 70 are formed with the same pitch as the helical coils of the first tubing 52. The side wall passage 78 in both of the first and second cuffs 56, 78 are configured to provide an air-tight seal between the respective first and second tubing 52, 54. In the embodiment shown, the full, extended length of the tandem tubing assembly 50 may be ten feet, for example. This length may be measured between the shoulders 57, 71 respectively of the first and second cuffs 56, 70 when the tandem tubing assembly 50 is extended to its maximum full length.

[0026] Referring to FIG. 3 there is illustrated a contracted view of the embodiment of the tandem tubing assembly 50 of the present invention shown and described in conjunction with FIG. 2. All of the structures of FIG. 3 are the same as the structures described for FIG. 2 and bear the same reference numbers. FIG. 3 differs only in that the tandem tubing assembly 50 is shown in a relaxed or contracted (i.e., collapsed) configuration. It will be observed that the adjacent helical coils of the second tubing 54 are approximately in contact with each other as shown in the illustration. In the embodiment shown, the full, contracted or collapsed length of the tandem tubing assembly 50 may be approximately three feet, for example. This length may be measured between the shoulders 57, 71 respectively of the first and second cuffs 56, 70 when the tandem tubing assembly 50 is contracted to its minimum full length. It will be appreciated that the ability of the tandem tubing assembly 50 to extend (as shown in FIG. 2) and contract (as shown in FIG. 3) all but eliminates the formation of a cumbersome and unwieldy loop formed in the prior art composite vacuum hose and liquid tubing, which has a fixed length, that connects a cleaning attachment to a cleaning machine. Further, as will be appreciated by persons skilled in the industrial arts, the lengths of the tandem tubing assembly in the extended and contracted configurations may be varied to suit the application and will also be dependent upon the materials and methods utilized in the fabrication of the various components of the tandem tubing assembly. Moreover, the diameters of the respective tubings or hoses may depend on the above factors as well as the types of gas or liquid materials to be conveyed through them, the flow rates and pressures thereof, and the like.

[0027] Referring to FIGS. 4A and 4B there are illustrated detail views of the construction of one embodiment of a first tubing in a contracted configuration for use in the embodiment of FIGS. 2 and 3. The first tubing 90, shown in a contracted configuration in FIG. 4A and cut to a length 92, further includes, as shown in FIG. 4B, an outside diameter 94 and an inside diameter 96. FIG. 4B represents the cross section view A-A of FIG. 4A.

[0028] Referring to FIG. 4C there is illustrated a detail cross section view of a wall segment of the embodiment of the first tubing of FIG. 4A, as taken at section B-B, but shown with the first tubing in an extended configuration. The segment 100 of the first tubing 90 includes a cross section view of four adjacent coils of the helical frame (typ. 106) and the PVC membrane 104. At each rib 102 formed by a helical coil, the cross section includes the spring wire 106, a layer of PVC insulation 108 around the spring wire 106, and a bond region 110 formed by the joining of the adjacent surfaces of the PVC membrane 104 and the PVC insulation 108.

[0029] FIG. 5 illustrates a detail cross section view B-B (as in FIG. 4B) of a wall section of an alternate embodiment of a tandem tubing assembly in its extended configuration according to the present invention, in which the second tubing, formed into a helical coil, is integrated into the structure of the first tubing to form the helical frame of the first tubing. In other words, the spring wire helical frame is replaced by the second tubing, itself formed into a helical coil. The segment 120 of the first tubing includes a cross section view of three adjacent coils of the helical second tubing 122 (typ. three places) and the PVC membrane 124. At each rib 126 formed by a helical second tubing 122, the cross section includes the second tubing 122 and a bond region 128 formed by the joining of the adjacent surfaces of the PVC membrane 130 and the PVC material of the second tubing 122. The structure of this alternative embodiment thus integrates the second tubing 122 with the first tubing in a way that minimizes any restriction in the flow of air or gas through the first tubing, while providing for the conveying of a liquid material through the interior 132 of the second
tubing 122 portion of the tandem tubing assembly. The restriction is minimized because the second tubing 122 is no longer within the first tubing but is part of the wall of the first tubing. The integrated structure also enables a reduction in weight and an increase in the flexibility of the tandem tubing assembly, attributes that enhance the efficiency and ease of use of the tandem tubing assembly.

[0030] While the invention has been shown in only one of its forms, it is not thus limited but is susceptible to various changes and modifications without departing from the spirit thereof. For example, the cleaning machine equipped with a tandem tubing assembly according to the present invention may be adapted to cleaning interior or exterior surfaces of floors, upholstery, furniture, walls, windows and doors, ceilings, buildings, vehicles, walkways, stairways, roadways, athletic playing surfaces and the like. Thus, different sizes or configurations of an extendable and contractible tandem tubing assembly, or tandem tubing assemblies fabricated from different materials or fabricate using different processes may be devised for different applications while still employing the principles of the present invention.

[0031] Moreover, the extendable and contractible tandem tubing assembly may also be adapted to spraying applications wherein the larger tubing or hose is configured for conveying a gas such as air with a positive pressure and the smaller, helical tubing is configured for conveying materials such as paint or foam-in-place insulation, or chemicals for treating or fertilizing lawns, plants and trees, nursery or agricultural fields, groves, orchards and the like. The tandem extendable tubing assembly may also be used as duct work for conveying air or gas and liquid materials between enclosures that move relative to one another, such as during transport (e.g., semi-trailer trucks), or other devices such as a space suit worn by an astronaut and a space craft.

What is claimed is:
1. A tandem tubing assembly for a cleaning machine, comprising:
   a flexible first tubing having a first diameter and configured as a flexible hose having a resilient helical frame, a first relaxed length and a first extended length;
   a flexible second tubing having a second diameter substantially smaller than the first diameter of the first tubing and configured as a helical coil having a second relaxed length and a second extended length; wherein the second tubing, in its coiled form, is disposed inside the first tubing and respective ends of the first tubing and the second tubing are coupled together such that the first and second tubings flex together and extend or contract together between the respective extended and relaxed lengths.
2. The apparatus of claim 1, wherein the first and second relaxed lengths are substantially equal.
3. The apparatus of claim 1, wherein the first and second extended lengths are substantially equal.
4. The apparatus of claim 1, wherein the first tubing is biased in a contracted configuration toward the first relaxed length by the helical frame and resiliently extendable to the first extended length in opposition to a tension force provided in the helical frame of the first tubing.
5. The apparatus of claim 4, wherein the first tubing comprises a continuous, tubular, flexible membrane attached to the helical frame when the helical frame is extended to the first extended length, wherein the membrane remains attached to the helical frame when the helical frame is allowed to contract to the first relaxed length.
6. The apparatus of claim 1, wherein the second tubing is disposed entirely within the first tubing.
7. The apparatus of claim 1, wherein the second tubing is disposed entirely within the first tubing and integrated with the first tubing.
8. The apparatus of claim 1, wherein the second tubing is formed into a helical coil and biased in a contracted configuration toward the first relaxed length and resiliently extendable to the first extended length in opposition to a tension force provided in the helical coil of the second tubing.
9. The apparatus of claim 8, wherein the second tubing forms the helical frame of the first tubing and is integrated with the wall of the first tubing.
10. The apparatus of claim 1, wherein the second tubing is not attached to an inside wall of the first tubing except at a point near an end where the second tubing passes through the wall of the first tubing.
11. The apparatus of claim 1, wherein the second tubing is attached to a wall of the first tubing at a point near an end where the second tubing passes through the wall of the first tubing at the respective end.
12. The apparatus of claim 1, wherein the second tubing, being of sufficient strength and resiliency and coiled into an extendable and contractible helix, forms the helical frame of the first tubing.
13. The apparatus of claim 1, wherein the second tubing forms the helical frame of the first tubing and is integrated with the wall of the first tubing.
14. The apparatus of claim 1, wherein the first and second tubings are terminated at respective first and second couplings to a cleaning attachment at a first end of the tandem tubing assembly and are terminated at respective third and fourth couplings for connection to the cleaning machine at a second end of the tandem tubing assembly.
15. The apparatus of claim 14, wherein the first tubing provides passage for air under a vacuum generated within the cleaning machine.
16. The apparatus of claim 15, wherein the first valve is coupled to a suction head for applying the vacuum in the first tubing to a surface being cleaned.
17. The apparatus of claim 14, wherein the second tubing provides passage for liquid under a pressure generated within the cleaning machine and controlled by a second valve.
18. The apparatus of claim 17, wherein the second valve is coupled to an attachment to the first end of the tandem tubing assembly for dispensing a liquid material conveyed in the second tubing to a surface being cleaned.
19. The apparatus of claim 18, wherein the attachment applies a vacuum and dispenses the liquid to a surface being cleaned.
20. The apparatus of claim 1, wherein the cleaning machine is adapted to cleaning a surface of at least one object selected from the group consisting of a floor, a curtain, an upholstery, an item of furniture, a building interior, a building exterior, a vehicle interior, a vehicle exterior, a walkway, a stairway, a roadway, and an athletic playing field.