Aug. 4, 1959 E. BEHRMAN 2,897,603

FLEXIBLE, EXTENSIBLE, AND COLLAPSIBLE TEXTILE FABRIC TUBE

Filed April 24, 1958 3 Sheets-Sheet 1

FIG-1

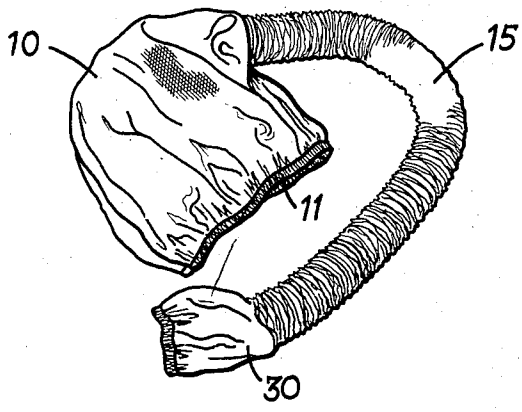


FIG-5

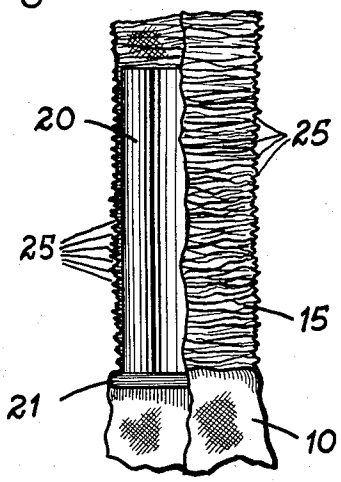


FIG-4

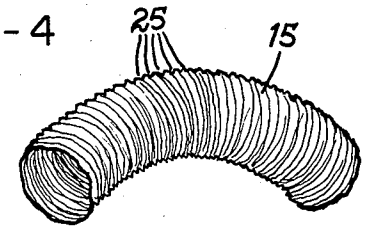


FIG-3

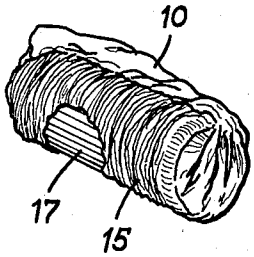
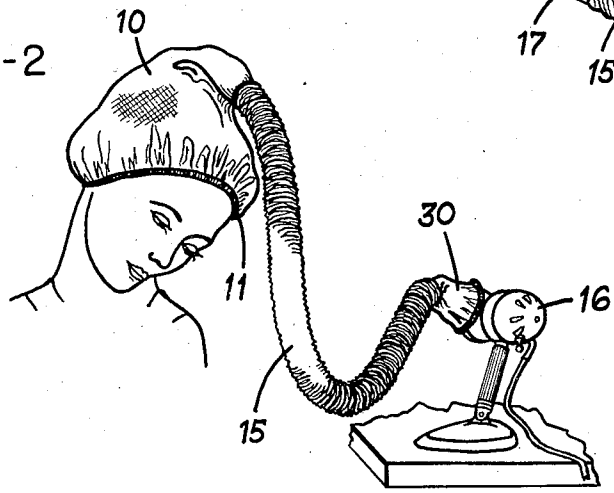


FIG-2



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FLEXIBLE, EXTENSIBLE, AND COLLAPSIBLE TEXTILE FABRIC TUBE

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FIG-6

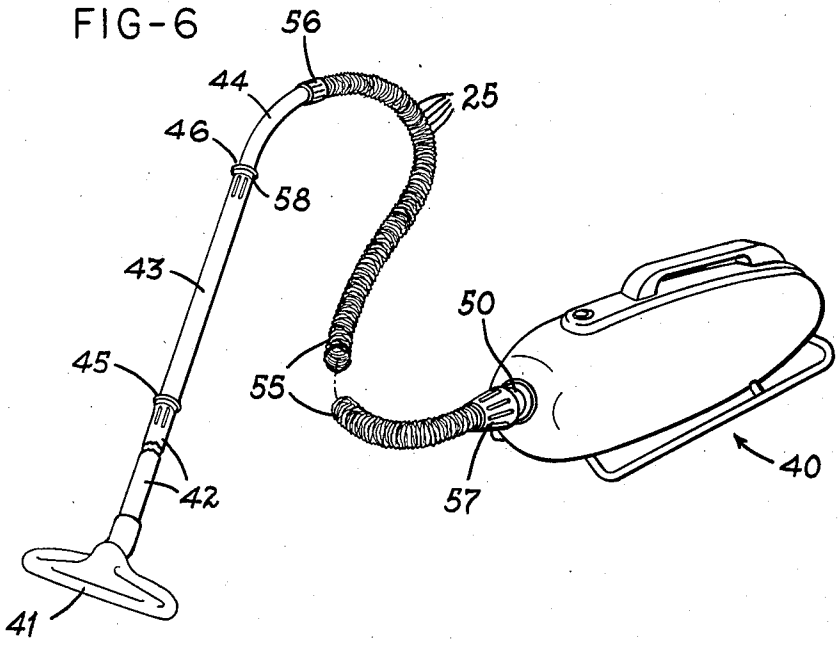
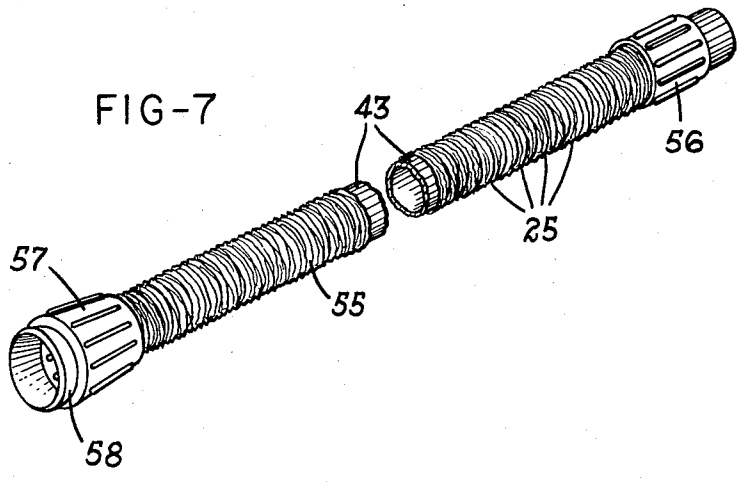


FIG-7



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FLEXIBLE, EXTENSIBLE, AND COLLAPSIBLE TEXTILE FABRIC TUBE

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FIG - 8

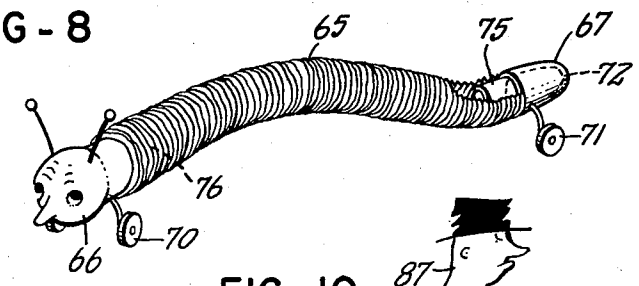


FIG - 9

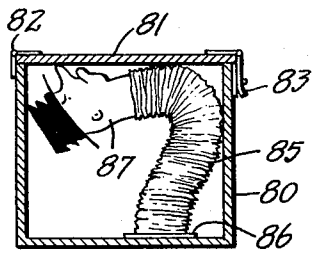


FIG - 10

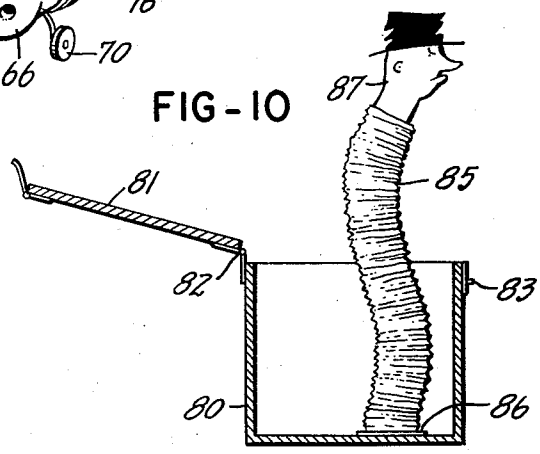


FIG - 11

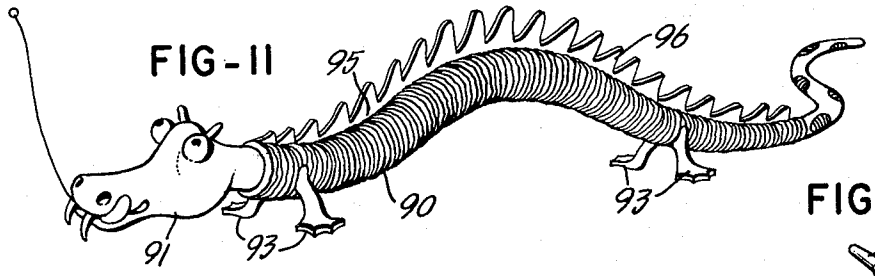


FIG - 12

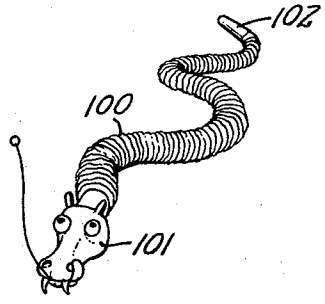


FIG - 13

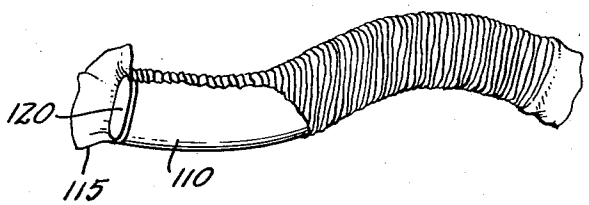
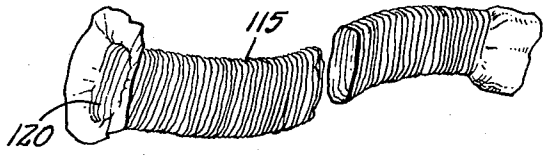


FIG - 14



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2,897,603

FLEXIBLE, EXTENSIBLE, AND COLLAPSIBLE TEXTILE FABRIC TUBE

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Application April 24, 1958, Serial No. 731,580

31 Claims. (Cl. 34—99)

This invention relates to collapsible and flexible enclosures, conduits and the like, and more particularly to a pneumatic device having an axially collapsible and extensible conduit or hose for conducting air to or from hair drying caps, cleaning attachments, and the like. This application is a continuation-in-part of my copending application, Serial No. 396,285, filed December 4, 1953, now abandoned.

One object of this invention is to provide a device for enclosing a person's hair after a shampoo, etc., and having a flexible fabric air conducting hose for introducing warm drying air from a blower or other source to the air for the purpose of drying the hair, the walls of the hose being configured or permanently pleated to provide longitudinal collapsiblity and extensibility of the hose as well as to maintain an open and self-sustained cross section during bending and flexing of the hose without internal bracing members.

Another object of this invention is to provide a device of the character described including a cap member for enclosing the hair and a flexible hose member for introducing drying air into the cap member, both the cap member and the hose member being flexible and collapsible, and the hose member being constructed so as to maintain an open cross section despite flexing and without internal structural bracing.

Another object of this invention is to provide a flexible unitary fabric air conducting hose with substantial axial collapsibility and extensibility in use, the wall of which are substantially permanently pleated or corrugated to provide for cross sectional rigidity against diametric collapsing of the hose despite bending or flexing thereof in use and without structural bracing other than such corrugations.

A still further object of this invention is to provide a device of the character described including a cap element, a hose element, and a container therefor in which the hose element is a fabric conduit of extreme flexibility and extensibility, and the cap element is made of collapsible fabric, and the container is adapted for containing the collapsed cap and providing a form on which the entire length of the collapsed hose may be stored.

Still a further object of this invention is to provide a flexible and axially extensible and collapsible fabric tube having substantially permanent pleats or corrugations in the walls thereof to stiffen or rigidify the tube against diametric collapsing to maintain an open cross section in use despite bending or flexing of the tube and without internal structural bracing.

A still further object of this invention is to provide a fabric air conducting conduit or hose of the character described adapted for use with vacuum cleaning devices and having in the walls thereof a series of contiguous circumferential substantially permanently set pleats or corrugations rigidifying and stiffening the hose against external atmospheric pressure to maintain an open cross section in use without internal structural bracing in the

hose, and providing for substantial axial collapsibility and extensibility in use.

A further object of this invention is to provide a flexible fabric hose of the character described consisting of two or more layers of woven synthetic fabric having substantially permanently set circumferential pleats or corrugations in each of the layers such that the pleats in one layer are interlocked with the pleats in the other layers to provide rigidifying and stiffening of the hose against diametric collapsing and substantial axial extensibility thereof.

A still further object of this invention is to provide in combination a flexible fabric pneumatic conduit of the character described and a substantially cylindrical form on which the conduit is stored to protect substantially permanently set pleats in the walls thereof, which container, preferably, forms in use an operative part of the pneumatic device with which the conduit is used.

Still another object of this invention is to provide a collapsible and extensible fabric conduit of the character described for use with a pneumatic device such as hair drying caps or vacuum cleaners, with the fabric of the conduit being coated or impregnated with resinous or other material to maintain in the walls thereof substantially permanently set circumferential pleats or corrugations to rigidify or stiffen said conduit against diametric collapsing in use and to provide substantial axial collapsibility and extensibility thereof.

Still another object of this invention is to provide a method of manufacturing devices of the character described including a flexible and collapsible hose member with pleats substantially permanently set in the walls thereof to maintain a self-sustaining open cross section in use and substantial axial collapsibility.

A still further object of this invention is to provide a flexible textile fabric tube member of the character described being substantially entirely composed of a synthetic textile fabric having in the walls thereof a plurality of substantially permanently heat-set contiguous peripheral pleats or corrugations to maintain a self-sustaining open cross section in use and to provide substantial axial collapsibility and extensibility.

Another object of this invention is to provide a self-sustaining open tube of synthetic fabric so configured as to maintain itself in an open cross section, notwithstanding flexing of said tube, and having in the walls thereof a series of contiguous peripheral permanently heat-set pleats or corrugations maintaining said tube, at rest, with a self-sustaining open cross section, said heat-set peripheral corrugations maintaining said tube in a particular cross sectional and/or axial configuration, depending upon the initial cross sectional and axial shape into which said corrugations and said tube are heat set, according to the transversely circular or non-circular section and the axially straight or curved configuration in which said contiguous peripheral corrugations or pleats were originally heat-set.

Other objects and advantages will be apparent from the following description, the accompanying drawing, and the appended claims.

In the drawings—

Fig. 1 is a perspective view of a hair drying device embodying this invention;

Fig. 2 is a perspective view of the hair drying device of Fig. 1 in use;

Fig. 3 is a view partly broken away in section showing a collapsed hair drying cap and hose in the container for storing;

Fig. 4 is a fragmentary view of a hose embodying this invention;

Fig. 5 is a fragmentary view partly broken away show-

ing a hose embodying this invention partly collapsed onto a mandrel in manufacture;

Fig. 6 is a view showing a hose according to the invention in use with a vacuum cleaner;

Fig. 7 is a view partly broken away showing the hose of Fig. 6 partly collapsed upon a part of the vacuum cleaner apparatus of Fig. 6 as for storage;

Fig. 8 illustrates one form of a pull toy embodying a pleated tube according to this invention and configured to resemble a toy caterpillar for the amusement of a child;

Figs. 9 and 10 illustrate two views of a jack-in-the-box toy embodying an axially curved corrugated or pleated fabric tube member according to this invention, in the enclosed or compressed position and in the exposed position of the jack-in-the-box;

Fig. 11 illustrates another child's pull toy embodying the present invention with a pleated or corrugated fabric tube member in the form of a toy dragon;

Fig. 12 illustrates a further application of a corrugated fabric tube embodying this invention to a child's pull toy and the form of a permanently curved snake which, when at rest, maintains a curved configuration which does not substantially change as the snake is pulled;

Fig. 13 illustrates the manufacture of a pleated tube according to this invention for use in, for example, the embodiments illustrated in Figs. 9–12, in which the pleated tube is given, in addition to the permanently heat-set corrugations therearound, a permanently heat-set axial curvature and/or a non-circular cross section; and

Fig. 14 illustrates a tube embodying this invention, exemplarily provided from the method illustrated in Fig. 13, with both a permanently heat-set axial curvature and a permanently heat-set non-circular cross section.

The use of hot air blowing devices, etc., for the purpose of drying a person's hair after a shampoo is quite widespread. Such devices, however, frequently require the user to remain substantially immobile or stationary for extended periods during the drying operation. With a device embodying this invention, the wearer has ample freedom of movement during the drying operation to read, write, or otherwise move about in relative comfort without having to lie or sit stationary under a dryer.

Notwithstanding this, however, the device according to this invention is completely portable and collapsible into small compass for storage as in traveling, etc.

Referring to the drawings, which illustrate embodiments of the invention as applied to several uses, the application of this invention to a hair drying cap is illustrated in Figs. 1–3. The user's hair is enclosed in a cap member **10** having a substantially tight head-band **11** which may satisfactorily be formed from elastic material or may contain a drawstring closure and tightening device. The cap member **10** is connected by a flexible hose member **15** to a hair drying blower **16** or other source of forced air.

Satisfactory results have been obtained by making the cap member **10** out of a semi-porous nylon fabric and of sufficient size to enclose not only the hair of the wearer but also sufficiently large to expand and enclose a substantial portion of hot air blown thereinto by the dryer **16**. It will be understood, of course, that other suitable materials may be utilized for the cap **10**, but it should be noted that, if the material is substantially impervious, vent holes or other source of escape of air are provided so that constant circulation of drying air is maintained in and through the cap.

Satisfactory results have been obtained with the hose member **15** made from a single piece of light-weight woven fabric (which designation in this specification and the appended claims is meant to include textile materials which are woven, knitted, braided, felted, etc.), and which are capable of taking a permanent heat-set pleating. The fabric is first formed into a long cylinder of a length substantially greater than the length desired for the finished flexible hose member **15**. Satisfactory results are obtained with a hose member for a hair drying cap embodying this invention formed from a piece of nylon fabric approximately 50 inches long and 5 inches wide with the two long edges sewn together to form a cylinder approximately 1½ inches in diameter. To impart to the hose member the flexibility desired as well as sufficient resilient rigidity to maintain itself with a self-sustained open cross section without additional bracing or structural means, circumferential pleats or corrugations **25** are formed in the fabric cylinder.

A convenient method of manufacture, considering as exemplary a fabric cylinder of the size mentioned above, includes providing a rigid cylindrical mandrel **20** of approximately 2½ inches in diameter and approximately 8 inches long, and having a flange **21** at one end thereof.

With this tube sitting upright on the flange **21**, the fabric cylinder is first moistened with water and then forced down over the tube until substantially the entire length of fabric cylinder has been collapsed upon tube **20**. In this connection, it should be noted that the outside diameter of tube **20** is correlated with the desired diameter of the finished flexible hose **15** and with the initial diameter of the fabric tube before manufacture. Thus, if the tube **20** is of too great a diameter, it will not be possible to force the dampened fabric cylinder completely onto the tube. Alternatively if the diameter of tube **20** is too small with respect to the diameter of the fabric cylinder, the pleats formed by forcing the cylinder down over the tube will be too large or deep to provide satisfactory rigidifying of the fabric. The dimensions above for the tube **20** and the unpleated fabric cylinder are given merely as exemplary of one satisfactory arrangement embodying this invention.

After the fabric cylinder has been dampened and completely forced onto the tube **20**, forming circumferential pleats in the fabric as diagrammatically illustrated in Fig. 5, the tube and fabric are subjected to heat in order to heat and dry the fabric and permanently set therein the pleated configuration desired. The temperature utilized, as well as the amount of dampness and the length of drying time are carefully controlled at this point because, among other reasons, too low a temperature may not impart to the fabric the desired setting of the pleated configuration with sufficient permanence, whereas too great a temperature for too long a time may damage the fabric or the materials from which it is woven. Using a woven nylon fabric as described above, satisfactory results have been obtained by drying the tube **20** with the dampened fabric thereon at approximately 700° F. for approximately 2 minutes.

After such treatment, the pleated hose **15** is removed from around the tube **20** with the pleats **25** formed therein.

These substantially permanently set pleats or corrugations **25** impart considerable stiffening or rigidity against diametric collapsing forces to the hose **15** and provide for maintaining a self-sustained substantially open circular cross section of the hose, as in Fig. 4, for example, notwithstanding bending and flexing of the hose in use. The resiliency, extensibility, and flexibility of the hose imparted by the pleats **25** enable it to be moved and curved to a substantial degree in use without kinking and without collapsing in a diametric direction, yet the hose is completely free from internal structural bracing members.

It will be noted that the forming of the pleats **25** throughout the length of the hose **15** uses up a substantial amount of the original length of the fabric. For example, with a fabric cylinder of the length mentioned above, when formed into a flexible hose embodying this invention as described provides a pleated hose of approximately 30 inches in length. Notwithstanding this useable length of approximately 30 inches, the entire hose

can be collapsed to fit upon a tube such as 20 no longer than 3½ inches.

A hair drying device as illustrated including a hose 15, 30 inches long as well as the nylon cap member 10 described and a fabric sleeve 30 affixed to the other end of the hose 15 for fitting engagement with the source of air 16 can all be collapsed and stored as shown in Fig. 3 in and on a hollow tube 17 having a diameter of about 2½ inches and the length of about 3½ inches. The hose 15 is drawn down over the tube 17 to maintain in storage its pleated condition, while the sleeve 30 and cap 10 are placed inside the hollow tube as shown in Fig. 3.

A hose 15 formed from light nylon fabric and having the pleats 25 formed and substantially permanently set therein as described above will maintain its pleated condition and its flexible, self-sustaining characteristics, and extensibility almost indefinitely. This is aided if the pleated hose is always stored upon the tube as in Fig. 3. To combat a certain amount of elongation which may be caused by the hot air in use, satisfactory results have been obtained by occasionally moistening the hose 15 prior to storing in collapsed condition as in Fig. 3 and allowing it to dry on the tube 17.

It will accordingly be seen that this invention provides a useful hair drying device and flexible conduit for receiving and conducting hot air from a source of air to the head of the wearer. Additionally, the device is light in weight, permits great freedom of movement in use, and yet is collapsible into very small compass for storage. In particular, the absence of rigid bracing members or other structural elements in the flexible hose lend greatly to the advantages of this invention. This is particularly true when the light, pleated, extensible hose 15 is compared with other flexible air-conducting hoses which maintain an open cross-section without kinking, or collapsing, only by virtue of the use of heavy or rigid material from which they are made or with which they are braced. The advantages arising from a hose structure formed to be self-sustaining and flexible while yet being axially collapsible to but a fraction of its length gives great advantages over other forms of flexible conduits because of an absence of moving parts or bulky molded or woven material.

As shown in Figs. 6 and 7, the improved pleated flexible fabric conduit according to this invention is also suitable for use in devices other than the hair drying cap described above where a readily axially collapsible yet self-sustained air or fluid conduit is used. Circumferential corrugations in the walls of the fabric conduit provide rigidifying and stiffening against the external action of atmospheric pressure, as when a vacuum is maintained within the conduit, as well as when a superatmospheric pressure is blown through the conduit.

Thus, as shown in Fig. 6, such other devices include a vacuum cleaner having conventional mechanism for producing a vacuum, etc., indicated generally by the numeral 40 and a cleaning attachment 41 with hollow tubular handle sections 42—44 separable and interfitting at telescoping joints 45 and 46. The vacuum cleaner portion has a suction nozzle 50 to which is connected a flexible hose 55 for connecting the cleaning attachment 41, through the handle portions thereof, to the vacuum cleaner body 40.

The hose 55 carries at each end thereof conventional coupling members 56 and 57 of rubber or other suitable material for substantially air tight fitting over and around the handle element 44 and the suction nozzle 50 respectively. The hose 55, like the hose 15 previously described, has a plurality of contiguous circumferential pleats or corrugations in the walls thereof for providing the axial collapsibility and extensibility and the self-sustained open cross section according to the invention. For purposes of storing hose 55 when not in use, tubular handle element 43 is inserted into the hose 55, and the latter collapsed upon the tubular element 43 as in Fig. 7 in order to maintain and protect the pleats or corrugations in the hose.

To this end, the diameter of the suctional nozzle 50 and the coupling member 57 is greater than the diameter of the tubular handle element 43. Thus, in storage, the tubular element 43 can be inserted freely through the larger coupling 57 and into hose 55, as shown in Fig. 7, until the coupling 57 abuts against the flange 58 at one end of the tubular handle 43. The diameter of the tubular element 43, however, is substantially the same as the handle element 44, so that the hose 55 will be maintained completely collapsed on the element 43 by slipping the smaller coupling 56 over the non-flanged end thereof.

Of course, a separate storage mandrel or form may be provided for the hose 55 instead of one section of the vacuum cleaner handle tube, but it is convenient to correlate the length and diameter of one handle tube section with the length and diameter of the hose 55 so as to provide for storing the hose on a useful part of the vacuum cleaner apparatus. At noted above, the provision of some such storing form as the tube 43 or the tube 17 for a flexible fabric pleated conduit embodying this invention may be helpful not only to maintain the permanent set of the pleats 25 but also to avoid distortion of the fabric when in storage under some conditions.

Whereas an axially extensible and collapsible flexible pleated textile fabric tube has been described above as primarily for use in the nature of a pneumatic or fluid conduit, it will be understood that the self-sustaining open cross section of such tube and the axial collapsibility and extensibility thereof, along with its other advantageous characteristics, is not to be considered as useful only as a pneumatic or fluid conduit. For example, as illustrated in Fig. 8, a fabric tube according to this invention may be incorporated as the mid-section of a child's flexible pull toy instead of, as conventionally used for such flexible mid-sections, metal or plastic springs or other flexible members.

As indicated in Fig. 8, a toy caterpillar-like pull toy is provided having an elongated mid-section 65 comprising essentially a tube of synthetic fabric material peripherally provided with contiguous, substantially permanently heat-set, pleats or corrugations. To each end of such mid-section 65, which, by the virtue of this invention, maintains itself in a substantially self-sustaining open cross section despite flexing or collapsing or extending thereof, is attached in known manner, a head section 66 and a tail section 67 configured in a pleasing, if imaginative, representation of a caterpillar or bug or other toy (including, of course, such inanimate objects as a railroad train, etc.) satisfactorily fabricated of a molded plastic or other product and, preferably, including wheels 70 and 71 for the support thereof as a child's pull toy. Since the pleasing characteristics of such a pull toy have to do with its extensibility and collapsibility, and extra weight 72 is preferably provided in the tail section 67 of the toy illustrated in Fig. 8 primarily for the purpose of delaying acceleration of the tail section and increasing deceleration of the tail section when the toy is pulled across the floor by a child to emphasize the pleasing or amusing effect of the extensibility and/or collapsibility of the flexible mid-section 65 thereof.

Since the extensible mid-section 65 of the toy illustrated in Fig. 8 is composed essentially only of a pleated or corrugated fabric tube according to this invention—instead of, for example, a metal or plastic flexible or spring member, whether or not covered with fabric—there is nothing about this part of the toy which a young child can harm or permanently bend or which, on the other hand, can be the cause of hurt or misfortune to the child using the toy. As a matter of fact, since the fabric mid-section 65, however elongated it may be, maintains both its axial resiliency and its self-sustaining open cross sectional area as a result of the contiguous peripheral pleats in the fabric, according to this invention, the

child can even take the toy to bed with him without fear of damage or harm to either the child or the toy.

Preferably, however, in a toy such as is illustrated in Fig. 8, the plastic tail section **67** may satisfactorily include an elongated, more or less cylindrical mandrel portion **75** on to which the entire elongated corrugated fabric mid-section **65** may be collapsed for the storage and/or preservation thereof when not in use, as in the child's toy chest or storage arrangement. Such preferred structure also includes a collar **76** in the head member **66** of the toy into which the mandrel member **75** will fit with some frictional engagement, so that, for storage purposes primarily, the entire fabric mid-section **65** of the toy illustrated in Fig. 8 can be collapsed upon the mandrel portion **75** of the tail **67** and the mandrel portion **75** inserted for releasable, semi-permanent engagement into the collar portion **76** of head **66**. It should be understood that the foregoing arrangement may not be necessary to maintain the completely resiliency of the self-sustaining and non-kinking flexible elongated mid-portion **65** of the toy, but, for the purposes of prolonged periods of storage, the foregoing structure may be preferred.

A further use or embodiment for the corrugated or pleated axially collapsible and extensible fabric tube according to this invention is illustrated in Figs. 9 and 10 in which a jack-in-the-box type of toy is illustrated as utilizing one form of a pleated or corrugated tube embodying this invention to which has been imparted a permanently heat-set configuration which is axially curved when the tube is at rest. Thus, Figs. 9 and 10 illustrate a jack-in-the-box type of toy having an outer box **80** including an openable lid **81**, hinged at **82** and temporarily or releasably secured by a catch or latch **83**.

Inside box **80** is a corrugated fabric tube element **85** which has been given a permanently heat-set axially curved configuration as hereinafter described so that tube **85**, when at rest, will normally incline to a self-sustaining curvature to the right as indicated in Fig. 10. Tube **85** is permanently secured at **86** to the bottom of box **80**, but eccentrically thereof, and the tube **85** carries at the opposite end thereof a head **87** or other toy-like arrangement such as one might satisfactorily incorporate into a jack-in-the-box type of toy.

Curved and pleated tube **85**, being affixed at **86** to the bottom of box **80**, is bent or curved backwardly—i.e., against the normal at-rest heat-set position or curvature depicted in Fig. 10—and distorted out of its at-rest arrangement, as illustrated in Fig. 9, and the lid **81** of box **80** is closed and affixed by catch **83**. Upon releasing catch **83**, then, tube **85** (by virtue of the inherent resiliency imparted thereto by the contiguous peripheral corrugations therearound as well as by the springiness imparted thereto by being stored bent against its axially curved at-rest position) will spring upward and out of box **80** as depicted in Fig. 10 to perform a jack-in-the-box variety of effect.

As noted with regard to the tube **85** of the jack-in-the-box toy of Figs. 9 and 10, a permanent axial curvature for all or a part of the extent of a heat-set corrugated fabric tube embodying this invention may also be useful in the manufacture of other toys—e.g., the dragon illustrated in Fig. 11 and having a permanent or at-rest hump or axial curve in the body thereof. More particularly, such a dragon as illustrated in Fig. 11 and as constituting a child's pull toy, somewhat in the manner of the pull toy in Fig. 8, may satisfactorily comprise an elongated and more or less serpentine body portion **90** to either end of which is affixed a fabricated dragon's head **91** and tail **92** and including intermediately positioned feet **93**. The intermediate body portion **90** is provided substantially without internal or external bracing members and of the contiguously pleated or corrugated self-sustaining textile fabric.

During manufacture of the original elongated tube from which the median portion **90** of the dragon in Fig. 11 is fabricated, it may be convenient to produce such tube by sewing a tube out of an elongated but flat piece of synthetic fabric. Since such an arrangement requires the sewing of one seam, such seam can satisfactory, according to the embodiment illustrated in Fig. 11, be sewed along the lines spaced from the edge of the fabric so that, considering Fig. 11, such seam **95** may be placed to form the tube out of which the corrugated portion **90** is to be formed but at some space relation from the edge of the fabric so that an axial "dorsal fin" **96** may be produced on the toy being fabricated, which fin may either be cut into a configuration suggestive of the mythical pointed fin of a dragon or may be uncut and may be allowed to assume fin-like projections as the original tube from which it is formed is pleated on a mandrel, such as the mandrel **20** in Fig. 5, to produce the desired peripheral contiguous corrugations of body portion **90**. As discussed below, if a mandrel, such as **20** in Fig. 5, is axially curved for all or part of its extent, a dragon-type pull toy as illustrated in Fig. 11 can be produced with the central pleated section **90** thereof having an at-rest position which includes an upward hump or bend **96** for a realistic or enhanced appearance.

Also, and with particular regard to Fig. 12, if the permanent heat-set corrugations are imparted to the synthetic fabric textile tube as hereinbefore described on a mandrel (such as indicated below with regard to Figs. 13 and 14), which is axially curved in any desired manner, the at-rest configuration of the pleated or corrugated fabric tube may be made to conform to the same corrugation of the mandrel. Particularly, with regard to Fig. 12, a snake pull toy is illustrated in which a body portion **100** is substantially entirely comprised of the axially extensible and collapsible, yet axially curved, self-sustaining, peripherally corrugated or pleated flexible synthetic fabric textile tube embodying this invention. Since the tube **100** involved in the snake illustrated in Fig. 12 (made identifiable as a snake by virtue of a plastic or other head portion **101** and tail portion **102**) is normally curved, serpentine-like, as illustrated in Fig. 12 when at rest, pulling the snake-type toy at Fig. 12 along the floor results in substantial movement of the snake and a slithering-type movement of the corrugated textile portion thereof—yet, reptile-like, without permanently distorting the serpentine configuration of the body portion **100** of the toy. That is, the permanently heat-set configuration of the fabric body portion **100** is such that the snake, upon pulling, appears to wriggle through the permanently heat-set serpentine configurations, without, permanently, destroying them—all in the manner of a living reptile.

The axially curved permanent heat-set configurations of a peripherally pleated or corrugated, self-sustaining, axially extensible and collapsible tube of the character to which this invention relates—and particularly those axially curved configurations noted with regard to the foregoing remarks about Figs. 9–12 inclusive—may satisfactorily be achieved by initially forming the heat set peripheral corrugations in the originally collapsible or non-self-sustaining fabric tube on a mandrel which is itself axially or transversely configured in a manner which may be desired. For example, as illustrated in Fig. 13, a mandrel **110** is provided which, although otherwise like the mandrel **20** in Fig. 5 is axially curved in a simple or complex axial curve or serpentine configuration as may be desired. A fabric tube **115** is, after dampening and otherwise treating in the manner indicated previously with regard to the discussion of Fig. 5, forced over and around curved mandrel **110** to form the desired initial contiguous corrugations or pleats. Upon heat-setting of these corrugations and pleats in tube **115** fitted over serpentine mandrel **110**, a permanently heat-set config-

uration is imparted to the tube so that, the heat-set pleats or corrugations therein not only continue to maintain the tube in a condition of self-sustaining open cross-section, but also impart to the tube a configuration which, at rest, conforms to the serpentine or axially curved configuration of the mandrel **110**. Thus although the completed tube, in the manner of Fig. 13, may be distended or deformed from the serpentine configuration suggested in Fig. 13, nevertheless, when released from outside sources and allowed to return to a state of rest, will reassume the serpentine configuration indicated in Fig. 13 and, accordingly, the serpentine configuration of a toy snake (as in Fig. 12) or the hump **96** of a toy dragon (as in Fig. 11).

Also, if the mandrel **110** on which the peripheral heat set corrugations or pleats are formed, is of non-circular cross section as indicated in Fig. 13 (and as compared to the cylindrical mandrel indicated in, for example, Fig. 5), the permanently heat set configuration of the peripherally corrugated or pleated synthetic fiber textile fabric tube **115**, etc., may also be provided with a self-sustaining open cross section which is of a non-circular configuration. Thus, as will be noted from Fig. 13, the vertical dimension of the cross section of transverse area of mandrel **110** substantially exceeds the transverse dimension thereof to form an oval, or, if desired, elliptical, or other non-circular cross section. A fabric tube **115**, as illustrated in Fig. 14, formed on such a mandrel (and completely regardless of whether the mandrel was axially straight or curved or serpentine) will assume at rest a heat-set configuration—because of the peripheral heat-set contiguous corrugations in tube **115**—which substantially conforms to the cross sectional configuration of a mandrel **110** on which the tube is formed. For example, just as the hair drying conduit formed, as illustrated in Fig. 5, on a cylindrical mandrel **20** maintains itself, at rest, with a self-sustaining cross sectional configuration which is, generally, cylindrical, so also will a synthetic fiber textile fabric tube **115**, formed on a mandrel such as **110** having an oval or elliptical or other non-circular cross section, maintain itself after formation and when at rest in a cross sectional configuration, equally self-sustaining, generally corresponding to the cross sectional configuration of mandrel **110**.

It has been found that the pleats or corrugations as described above stiffen or rigidify a synthetic fabric tube or conduit sufficiently to resist transverse deformation by atmospheric pressure, as when in use with a vacuum cleaner, as well as to maintain an open cross-section during flexing of the tube when used with a blower as in Fig. 2. When used with a vacuum cleaner, however, the fabric is considerably heavier than is the case with the hair drier described above. Satisfactory results have also been obtained with a pleated vacuum cleaner hose comprising several thicknesses of thin woven fabric. These several layers may be formed into a plurality of concentric separate tubes or they may be adhered together by a suitable binder or adhesive. In either case, upon the formation of the contiguous circumferential pleats or corrugations **25** simultaneously in all the layers, the pleats give an interlocking effect among the layers thereby providing further rigidity and stiffening against transverse collapse notwithstanding substantial axial extensibility and collapsibility of the fabric tubes.

As noted above, it is important that the fabric to be used be one in which the pleats or corrugations may be substantially permanently set to provide the desired stiffening and extensibility according to the invention during use. Such substantially permanent set is obtained even though it is convenient occasionally to dampen the conduit prior to storage in collapsed condition on a storage form such as **17** in order to counteract minor distortions which may occur when heated air is blown through the conduit.

It will be apparent that other materials than thin woven nylon fabric can be used to form a pleated flexible conduit according to this invention. For example, a similar cylinder, preferably seamless, of non-woven (e.g., felted, regenerated, extruded, etc.) synthetic material may be used. Synthetic fabrics, and nylon fabrics in particular, give highly satisfactory results because of the ease of imparting thereto the desired substantially permanent set into the pleated configuration, and because of the permanence with which the pleats **25** are retained by the fabric once they are formed on the mandrel **20** and subjected to a setting heat.

While nylon, Orlon, Dacron, rayon, and other polyamide, polyester, and polyacrylic synthetic fabrics have produced highly satisfactory results, the invention is not limited to these materials. It may be applied to fabrics of other synthetic or natural fibers and to fabrics coated or impregnated with various resin materials (such as, for example, with melamine resins which are conventionally used in the treating or finishing of synthetic fiber textile fabrics or the polyacrylic, polyamide, or polyester or other materials) which will impart a permanent heat set to pleats or corrugations formed in the fabric with suitable treatment such as heat treatment under pressure, etc. Also, the fabric used for a vacuum cleaner hose **55** embodying this invention is preferably substantially lacking in porosity. This may be satisfactorily obtained by coating or otherwise treating the fabric during manufacture of the hose, or by using a plurality of fabric layers as described above. Such porosity inhibiting treatment or coating or impregnating of the fabric may be achieved by the same coating or impregnation described above for conditioning the fabric to retain a permanent set in its pleated configuration. As also will be understood, the particular weight, thickness, plurality of layers, and/or extent or degree of plastic impregnation will, in a large measure, be determined, according to this invention, with due regard to whether the pleated or corrugated tube desired is to be a pneumatic or a fluid conduit, or otherwise to accentuate the properties of extreme springiness, resiliency, etc. In any case, however, the particular fabric chosen or desired (with or without the extra impregnation of a resin in the finishing or the preparation thereof) will be chosen, to provide the self-sustaining cross-sectional open area and the desired axial configuration resulting from the disclosed and claimed contiguous peripheral corrugations or pleats in the fabric tube, and with regard to the particular uses, including or in addition to those suggested above, to which this axially extensible and collapsible, transversely self-sustaining, peripherally permanently heat-set corrugated, textile tube may be put.

While the methods and articles herein described constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to these precise methods and articles, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. In a hair drying cap of the character described for use with a source of forced drying air and having a cap member, a flexible and axially collapsible conduit for conducting said air from said source to said cap member comprising a cylindrical flexible woven synthetic fabric tube for interconnecting said cap member with said source of air, said tube having a plurality of heat set circumferential pleats around said tube effecting rigidifying of said tube against transverse collapsing in use, said flexible fabric and said pleats cooperating to provide axial extensibility and collapsibility in said conduit, and the internal cross sectional area of said conduit being substantially unobstructed and free of rigid bracing members.

2. In a collapsible enclosure adapted to be filled with air under pressure from a source of compressed air, a

flexible transversely self-sustaining and axially collapsible conduit for conducting said air from said source to said enclosure comprising a substantially cylindrical tube having flexible synthetic fabric walls having a plurality of circumferential permanent heat set pleats in said walls effecting rigidifying of said tube against transverse collapsing, the internal cross section of said tube being substantially unobstructed and free of bracing members, and said pleats cooperating with said fabric to provide axial extensibility and collapsibility of said conduit.

3. In a hair drying cap of the character described for use with a source of forced drying air and having a cap member, a flexible, transversely self-sustaining and axially collapsible conduit for conducting said air into said cap member comprising a cylindrical flexible tube of resilient semipermeable synthetic woven fabric for interconnecting said cap member with said source of air, a plurality of circumferential permanently heat set pleats in the walls of said fabric tube for maintaining said tube in said transversely self-sustaining form, said walls of said fabric tube having only a single thickness of fabric and being substantially free of bracing members, and said pleats providing in said single thickness of fabric axial extensibility and collapsibility of said conduit.

4. In a collapsible enclosure adapted to be filled with air under pressure from a source of compressed air, a flexible, transversely self-sustaining and axially collapsible conduit for conducting said air from said source to said enclosure consisting only of a substantially cylindrical tube having flexible woven synthetic fabric walls with predetermined resiliency and permeability characteristics, a plurality of circumferential permanently heat set corrugations in said walls effecting rigidfying of said tube against transverse collapsing in use, said tube being substantially free of rigidifying and bracing members other than said corrugations, and said corrugations comprising approximately 30–40% of said fabric walls.

5. In a collapsible enclosure adapted to be filled with air under pressure from a source of compressed air, a flexible, transversely self-sustaining and axially collapsible conduit for conducting said air from said source to said enclosure consisting only of a substantially cylindrical tube having flexible synthetic fabric walls with predetermined resiliency and permeability characteristics, a plurality of circumferential substantially permanently heat set corrugations in said walls effecting rigidifying of said tube against transverse collapsing in use, said tube being substantially free of rigidifying and bracing members other than said corrugations, said corrugations comprising approximately 30–40% of said fabric walls, and said corrugations cooperating with said flexible fabric providing approximately 30–40% axial extensibility of said tube in the absence of permanent deformation of said corrugations.

6. The method of making a flexible transversely self-sustaining and axially collapsible conduit of the character described, which comprises the steps of forming a hollow tube of flexible woven synthetic fabric having predetermined inherent resiliency and deformability characteristics, wetting said fabric tube temporarily modifying said inherent resiliency and deformability characteristics thereof, forcing into said wet tube a mandrel having an outside transverse dimension a predetermined amount less than the internal dimensions of said tube, axially compressing said tube on said mandrel forming a plurality of circumferential corrugations in the fabric walls of said tube, subjecting said compressed tube on said mandrel to heat while maintaining said compressed and corrugated form effecting creasing and permanent heat set distortion of said fabric into said compressed corrugated form, and removing said mandrel producing said finished conduit as a circumferentially corrugated woven synthetic fabric tube of self-sustaining open cross-section and substantial axial extensibility and collapsibility.

7. In a collapsible hair drying cap of the character described for use with a source of forced drying air, the combination which comprises a flexible fabric cap member having predetermined permeability characteristics, a flexible and collapsible fabric conduit member of substantially circular cross-section, said conduit member having a plurality of circumferential pleats around the walls thereof for maintaining said substantially circular cross section during flexing of said conduit and in the absence of any additional bracing and rigidifying members, means for connecting one end of said conduit member to said cap member, means for connecting the other end of said conduit member to said source of forced drying air, said conduit member providing flexible and extensible interconnection for conducting said air from said source into said cap member, and a containing and forming member for maintaining said circumferential pleats in said conduit member and for containing said cap member when collapsed and not in use, said containing and forming member including a cylindrical body having an outside diameter a predetermined amount less than the inside diameter of said conduit member and being adapted to be inserted into said conduit member for maintaining said pleated form thereof while said cap member is inserted in collapsed condition into said containing member.

8. As a new article of manufacture, an axially collapsible and extensible flexible tube of synthetic woven fabric having in the walls thereof substantially permanently heat set contiguous circumferential pleats, the pleated portions of said walls extending substantially throughout the length of said tube providing stiffening of said tube to maintain a self-sustained open cross-section in the absence of other bracing members.

9. An extensible and flexible pneumatic conduit of the character described comprising a substantially tubular body of synthetic woven nylon fabric, said body being substantially permanently heat set pleated circumferentially to form a plurality of contiguous circumferential corrugations throughout substantially the entire length of said body, and the internal cross sectional area of said conduit being substantially unobstructed and free of rigid bracing members.

10. An extensible and flexible pneumatic conduit of the character described consisting of a substantially tubular body of nylon fabric, said body being substantially permanently heat set pleated circumferentially to form a plurality of contiguous circumferential corrugations throughout substantially the entire length of said body, and the internal cross sectional area of said conduit being substantially unobstructed and free of rigid bracing members.

11. The method of manufacturing an axially extensible and flexible tube of the character described which comprises the steps of forming a cylinder of woven synthetic nylon fabric material, dampening said fabric cylinder, drawing said cylinder over a cylindrical mandrel having a predetermined diameter less than the diameter of said nylon fabric cylinder to form contiguous circumferential pleats substantially throughout the length of said fabric cylinder, and heat treating said pleated cylinder while on said mandrel to impart a substantially permanent set to said pleats.

12. The method of manufacturing an axially extensible and flexible tube of the character described which comprises the steps of forming a tube of synthetic woven fabric material, wetting said fabric tube, drawing said tube over a cylindrical mandrel having a predetermined outer transverse dimension less than the inner transverse dimension of said fabric tube to form contiguous circumferential pleats substantially throughout the length of said fabric tube, and heat treating said pleated tube while on said mandrel to impart a substantially permanent set to said pleats.

13. In a vacuum cleaning device of the character described having a suction nozzle source of vacuum and a cleaning attachment, the combination which comprises an

axially collapsible and extensible flexible hose member for connecting said cleaning attachment to said suction nozzle, said hose member being formed substantially entirely of a tubular body of synthetic woven fabric, contiguous substantially permanent heat set circumferential pleats in said tubular body throughout substantially the entire length thereof providing rigidity against diametric collapsing to maintain a self-sustained open cross-section against the action of external atmospheric pressure, said tubular body being substantially free of internal bracing elements, and coupling members at each end of said hose member for substantially air tight fitting respectively with said suction nozzle and said cleaning attachment.

14. In a vacuum cleaning device of the character described having a suction nozzle source of vacuum and a cleaning attachment, the combination which comprises an axially collapsible and extensible flexible hose member for connecting said cleaning attachment to said suction nozzle, said hose member being formed substantially entirely of a tubular body of synthetic fabric, contiguous substantially permanent circumferential pleats in said tubular body throughout substantially the entire length thereof providing rigidity against diametric collapsing to maintain a self-sustained open cross-section against the action of external atmospheric pressure, said tubular body being substantially free of internal bracing elements, a rigid cylindrical hollow handle member for said cleaning attachment, means for connecting said handle member to said cleaning attachment in substantially air tight manner for conducting air from said cleaning attachment through said handle member, the diameter of said handle member being less than the diameter of said suction nozzle and the length of said handle member being at least as great as the length of said hose member when substantially totally axially collapsed, coupling means at one end of said hose member for substantially air tight interfitting with said suction nozzle, additional coupling means at the opposite end of said hose member for substantially air tight fitting with said handle member, said handle member being adapted to be inserted into said hose member and to retain said hose member thereon in axially collapsed condition for maintaining said permanent pleats in said hose member during storage thereof between uses.

15. In a vacuum cleaning device of the character described having a suction nozzle source of vacuum and a cleaning attachment, the combination which comprises an axially collapsible and extensible flexible hose member for connecting said cleaning attachment to said suction nozzle, said hose member being formed substantially entirely of a tubular body of synthetic fabric, contiguous substantially permanent circumferential pleats in said tubular body throughout substantially the entire length thereof providing rigidity against diametric collapsing to maintain a self-sustained open cross-section against the action of external atmospheric pressure, said tubular body being substantially free of internal bracing elements, a rigid cylindrical hollow handle member for said cleaning attachment, means for connecting said handle member to said cleaning attachment in substantially air tight manner for conducting air from said cleaning attachment through said handle member, the diameter of said handle member being less than the diameter of said suction nozzle and the length of said handle member being at least as great as the length of said hose member when substantially totally axially collapsed, coupling means at one end of said hose member for substantially air tight interfitting with said suction nozzle, additional coupling means at the opposite end of said hose member for substantially air tight fitting with said handle member, said handle member being adapted to be inserted into said hose member through said suction nozzle fitting means for maintaining in storage said permanent pleats in said hose member, and a flange at one end of said handle member for retaining said hosed member on said handle member in collapsed condition when said handle member is inserted into said hose member.

16. A pneumatic device of the character described utilizing forced air and comprising in combination means providing a source of forced air, attachment means for utilizing said forced air to perform work, axially collapsible and extensible flexible conduit means interconnecting said source of forced air with said attachment means, substantially the entire length of said conduit means consisting of a tubular woven synthetic fabric body having contiguous circumferential substantially permanent heat set pleats therein for rigidifying said body against diametric collapsing and providing said axial collapsibility and extensibility thereof, said conduit means being substantially free of bracing members other than said pleats for maintaining an open cross-section in use.

17. A pneumatic device of the character described utilizing forced air and comprising in combination means providing a source of forced air, attachment means for utilizing said forced air to perform work, axially collapsible and extensible flexible conduit means interconnecting said source of forced air with said attachment means, substantially the entire length of said conduit means consisting of a tubular synthetic fabric body having contiguous circumferential substantially permanent pleats therein for rigidifying said body against diametric collapsing and providing said axial collapsibility and extensibility thereof, said conduit means being substantially free of bracing members other than said pleats for maintaining an open cross-section in use, and a substantially cylindrical storage form member for retaining said conduit means in axially collapsed condition in storage when not in use to maintain therein said permanent pleats, said form member having a predetermined outside diameter less than the inside diameter of said conduit means and a length at least as great as the length of said conduit means when completely axially collapsed.

18. As an article of manufacture, a tubular textile body, the length of which body is substantially greater than its transverse dimension and having a substantially arcuate cross section, the walls of said tubular body being formed substantially entirely of interwoven synthetic fibrous material, which material inherently lacks the requisite rigidity to form a tubular body of self-sustaining open cross section in the absence of separate bracing members, and said walls of said tubular body including contiguous peripheral corrugations having folds formed in said synthetic material in permanently heat set condition, which corrugations impart axial collapsibility and extensibility thereof and peripheral rigidifying for maintaining a self-sustaining open cross section in said tubular body notwithstanding axial collapsing and extending and bending thereof.

19. As a new article of manufacture, an axially collapsible and extensible flexible fabric tube formed of synthetic textile fibers selected from the group consisting of polyamide, polyester, polyacrylic, and rayon synthetic fibers, said synethetic fabric inherently lacking the requisite rigidity to form a tube of self-sustaining open cross section in the absence of separate bracing members, said tube including in the walls thereof peripheral substantially contiguous permanently heat set pleats substantially throughout the entire length of said tube imparting axial collapsibility and extensibility of said tube and peripheral rigidifying thereof for maintaining a self-sustaining open cross section in said tube notwithstanding axial collapsing and extending and bending thereof.

20. As a new article of manufacture, an axially collapsible and extensible flexible fabric tube formed of synthetic texture fibers selected from the group consisting of polyamide synthetic fibers, said synthetic fabric inherently lacking the requisite rigidity to form a tube of self-sustaining open cross section in the absence of sepa-

rate bracing members, said tube including in the walls thereof peripheral substantially contiguous permanently heat set pleats substantially throughout the entire length of said tube imparting axial collapsibility and extensibility of said tube and peripheral rigidifying thereof for maintaining a self-sustaining open cross section in said tube notwithstanding axial collapsing and extending and bending thereof.

21. As a new article of manufacture, an axially collapsible and extensible flexible fabric tube formed of synthetic textile fibers selected from the group consisting of polyester synthetic fibers, said synthetic fabric inherently lacking the requisite rigidity to form a tube of self-sustaining open cross section in the absence of separate bracing members, said tube including in the walls thereof peripheral substantially contiguous permanently heat set pleats substantially throughout the entire length of said tube imparting axial collapsibility and extensibility of said tube and peripheral rigidifying thereof for maintaining a self-sustaining open cross section in said tube notwithstanding axial collapsing and extending and bending thereof.

22. As a new article of manufacture, an axially collapsible and extensible flexible fabric tube formed of synthetic textile fibers selected from the group consisting of polyacrylic synthetic fibers, said synthetic fabric inherently lacking the requisite rigidity to form a tube of self-sustaining open cross section in the absence of separate bracing members, said tube including in the walls thereof peripheral substantially contiguous permanently heat set pleats substantially throughout the entire length of said tube imparting axial collapsibility and extensibility of said tube and peripheral rigidifying thereof for maintaining a self-sustaining open cross section in said tube notwithstanding axial collapsing and extending and bending thereof.

23. As a new article of manufacture, an axially collapsible and extensible flexible fabric tube formed of synthetic textile fibers selected from the group consisting of rayon synthetic fibers, said synthetic fabric inherently lacking the requisite rigidity to form a tube of self-sustaining open cross section in the absence of separate bracing members, said tube including in the walls thereof peripheral substantially contiguous permanently heat set pleats substantially throughout the entire length of said tube imparting collapsibility and extensibility of said tube and peripheral rigidifying thereof for maintaining a self-sustaining open cross section in said tube notwithstanding axial collapsing and extending and bending thereof.

24. As a new article of manufacture, an axially collapsible and extensible flexible fabric tube formed of synthetic textile fibers selected from the group consisting of polyamide, polyester, polyacrylic, and rayon synthetic fibers, said synthetic fabric inherently lacking the requisite rigidity to form a tube of self-sustaining open cross section in the absence of separate bracing members, said tube including in the walls thereof peripheral substantially contiguous permanently heat set pleats substantially throughout the entire length of said tube imparting axial collapsibility and extensibility of said tube and peripheral rigidifying thereof for maintaining a self-sustaining open cross section in said tube notwithstanding axial collapsing and extending and bending thereof, said pleats comprising approximately 30–40% of the axial extent of said tube providing for substantial axial extensibility thereof in the absence of permanent deformation of said pleats.

25. An extensible and flexible tubular body of the character described consisting substantially entirely of a plurality of layers of woven synthetic fabric, said layers including permanently heat set peripheral corrugations forming a series of substantially contiguous peripheral pleats throughout substantially the entire length of said body, and the internal cross sectional area of said tubular body being substantially unobstructed and free of rigid bracing members.

26. In an articulated toy of the character described having a plurality of flexibly articulated sections, a flexible and axially collapsible and extensible tubular body for interconnecting said articulated sections, said body being formed substantially entirely of a tubular section of synthetic textile fabric inherently lacking requisite rigidity to maintain itself in self-sustaining open cross sectional area, and a plurality of substantially contiguous peripheral corrugations in said tube body throughout substantially the entire length thereof and permanently heat set into said fabric for imparting said axial collapsibility and extensibility and for maintaining a self-sustaining open cross section in said body notwithstanding axial collapsing and extending and flexing thereof.

27. A flexible and extensible tubular body member for incorporating into an articulated toy, said tubular member being formed substantially entirely of synthetic textile fabric inherently lacking requisite rigidity to maintain itself in self-sustaining open form, and a plurality of peripheral pleats in said tubular body throughout substantially the entire extent thereof and permanently heat set into said fabric forming contiguous corrugations for providing said flexible and extensible tubular body and maintaining said tubular body distended in self-sustaining open form.

28. As an article of manufacture, a flexible tubular body having an arcuate but non-circular cross section, the walls of said tubular body being formed substantially entirely of synthetic fiber textile material which inherently lacks the requisite rigidity to maintain said tubular body in self-sustaining open cross section, and said walls of said tubular body including peripheral corrugations formed in said textile material in permanently heat set condition for maintaining said tubular body in said self-sustaining non-circular open cross section and for imparting axial collapsibility and extensibility to said body.

29. As an article of manufacture, a tubular textile body, the length of which body is susbtantially greater than its transverse dimension and having a substantially arcuate cross section, the walls of said tubular body being formed substantially entirely of interwoven synthetic fibrous material, which material inherently lacks the requisite rigidity to form a tubular body of self-sustaining open cross section in the absence of separate bracing members, and said walls of said tubular body including contiguous peripheral corrugations having folds formed in said synthetic material in permanently heat set condition, which corrugations impart axial collapsiblity and extensibility thereof, and peripheral rigidifying for maintaining a self-sustaining open cross section in said tubular body notwithstanding axial collapsing and extending and bending thereof, and said tubular body also having a permanently heat set axial curvature when at rest and not subjected to axially distorting tensions.

30. The method of manufacturing an axially extensible and flexible tube of the character described and having a self-sustaining open arcuate but non-circular cross section which comprises the steps of forming a tube of synthetic textile fabric of a length substantially greater than the final desired length of said tube, drawing said tube over a mandrel having said arcuate non-circular cross section and predetermined outer transverse dimensions less than the inner transverse dimensions of said fabric tube, forming contiguous peripheral pleats substantially throughout the length of said fabric tube on said mandrel, and heat treating said pleated tube while on said mandrel for imparting a substantially permanent heat set to said pleats and said fabric tube for maintaining said self-sustaining cross section.

31. The method of manufacturing an axially extensible and flexible tubular body of the character described and having a self-sustaining open cross section and a sub-

stantially axial curvature when at rest which comprises the steps of forming a tube of synthetic fabric, drawing said tube over a mandrel having an axial curvature corresponding to said at rest curvature of said tube and predetermined outer transverse dimensions less than the inner transverse dimensions of said fabric tube, forming on said mandrel contiguous peripheral pleats substantially throughout the length of said fabric tube and heat treating said pleated tube while on said mandrel for imparting a substantially permanent heat set to said pleats and to

said fabric for maintaining said open cross section and at rest axial curvature.

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