

April 2, 1963

F. T. ROBERTS ETAL

3,083,736

CORRUGATED HOSE WITH REINFORCEMENT IN ALTERNATE INNER CORRUGATIONS

Original Filed Feb. 20, 1959

3 Sheets-Sheet 1

Fig. 1

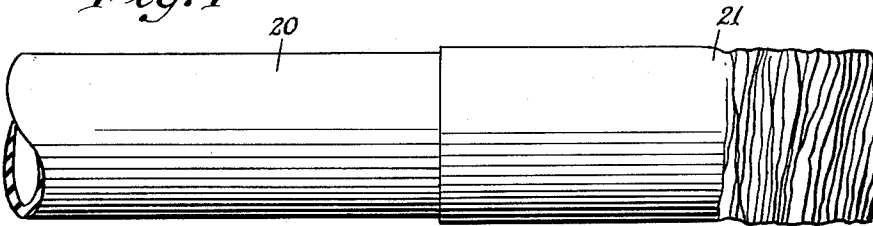


Fig. 2

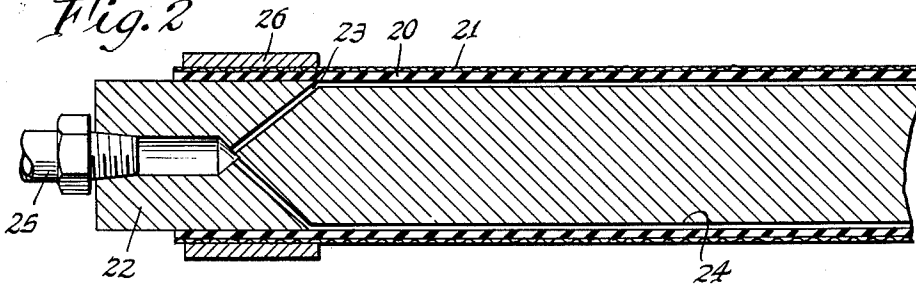


Fig. 3

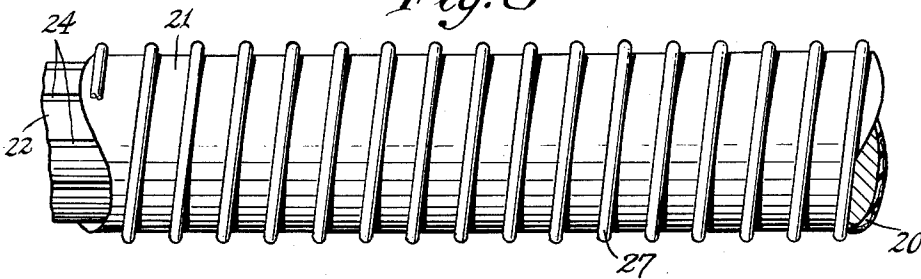
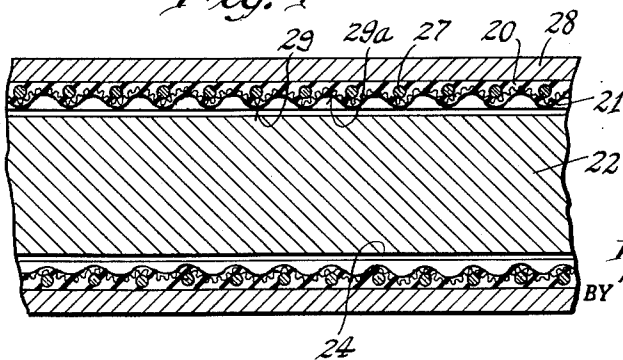


Fig. 4



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Fig. 5

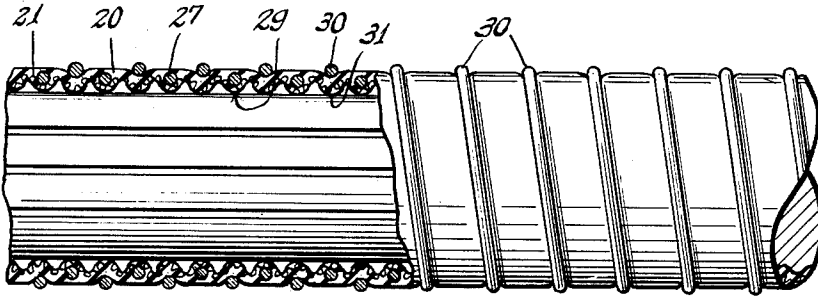


Fig. 6

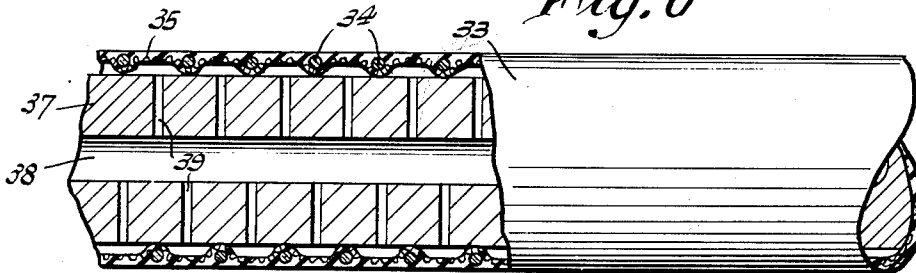
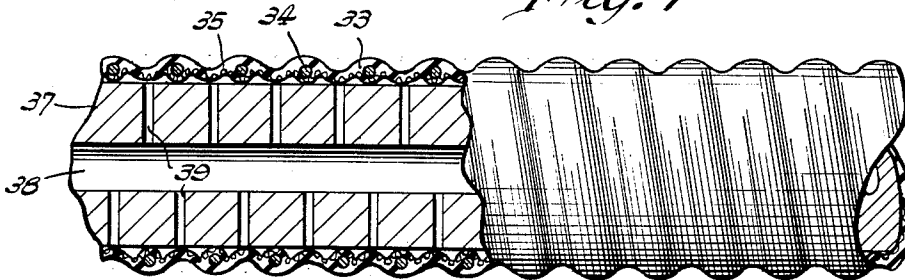


Fig. 7



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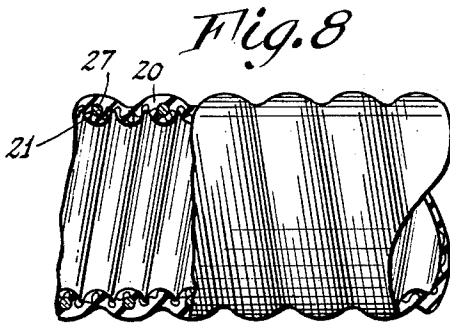
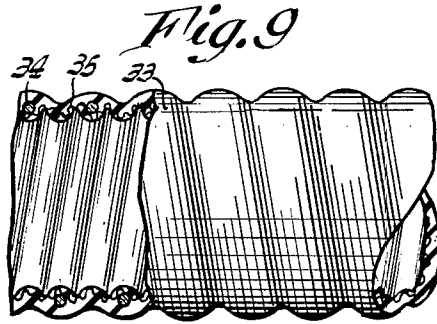
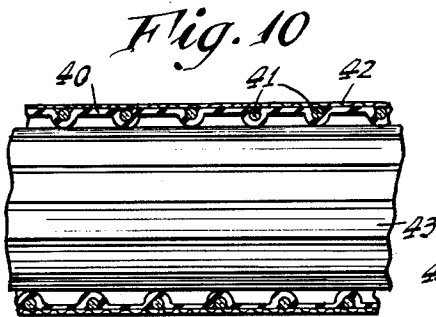
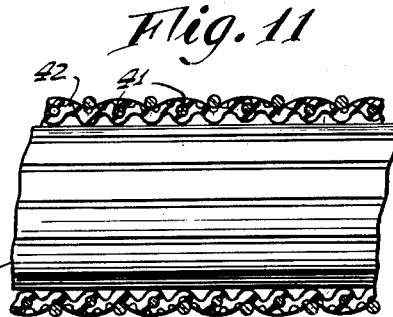
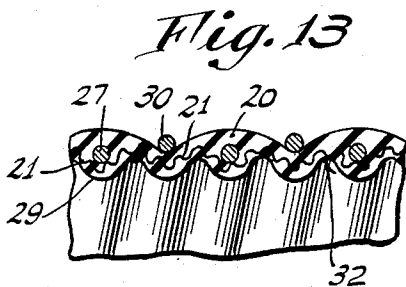
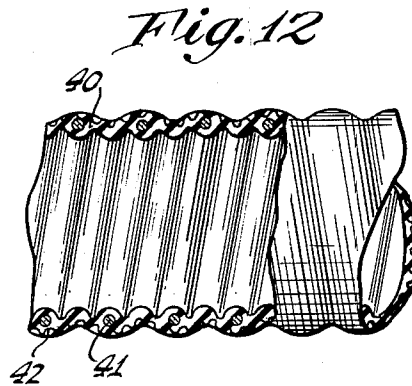
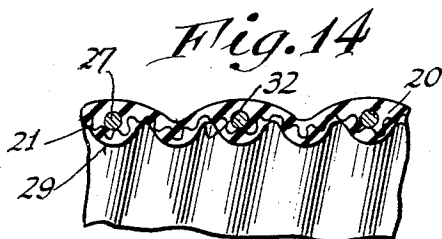
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CORRUGATED HOSE WITH REINFORCEMENT IN ALTERNATE INNER CORRUGATIONS

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Original application Feb. 20, 1959, Ser. No. 794,602, now
Patent No. 3,028,276, dated Apr. 3, 1962. Divided
and this application June 30, 1961, Ser. No. 121,244
6 Claims. (Cl. 138-122)

The present invention relates to a hose.

This application is a division of our application Serial
Number 794,602 filed February 20, 1959, now Patent No.
3,028,276.

It is an object of the present invention to provide a
reinforced, flexible, elongate hose which is capable of
being coiled when not in use without injury to the hose
and which may be clamped to fittings without distorting
the reinforcing members incorporated therein.

It is a further object of the present invention to provide
a reinforced flexible hose having a high degree of flex-
ibility and durability, which is due at least in part to the
formation of internal and external corrugations or con-
volutions in the hose.

It is yet another object of the present invention to
provide an elongate flexible hose which is corrugated both
internally and externally and which, if desired, may have
a fabric reinforcement embedded therein or incorporated
on or adjacent to the surface thereof.

It is yet another object of the present invention to
provide a highly flexible, relatively light and durable
hose particularly adapted for use with portable vacuum
cleaners or in connection with exhaust systems where the
outlet of the vacuum cleaning system is located in the
baseboard of a room, or in the attic or basement of a
home.

In accordance with the present invention, an elongated
hose member having a relatively smooth molded outer
surface is provided containing a plurality of circumfer-
ential substantially rigid reinforcements disposed therein
and embedded in the elongated member in a predeter-
mined spaced relationship so that the hose is reinforced
throughout its length by the flexible reinforcing member.
The hose in its normal finished condition is made in rela-
tively long lengths with the reinforcements extending uni-
formly throughout the length of the hose. The rein-
forcing member is preferably in the form of a helically
coiled spring member in which the convolutions are axial-
ly spaced in a predetermined manner. In addition, the
hose may have incorporated therewith a fabric reinforcing
layer which may be embedded within the hose body or
bonded or embedded adjacent to or on the surface of
the hose.

The present application is a division of application
Serial No. 794,602 filed February 20, 1959, now Patent
No. 3,028,276, a continuation-in-part of applicants' co-
pending application Serial No. 720,190, filed March 10,
1958, which is in turn a continuation-in-part of applica-
tion Serial No. 621,093, filed November 8, 1956, now Pat-
ent No. 2,830,622. These previous applications describe
the general method for the manufacture of a hose, which
method is also utilized as the initial phase for the manu-
facture of the hose of the present invention. In the afore-
said prior applications, the hose is made by a novel

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method wherein a body of elastomeric material, prefer-
ably in sleeve or tubular form, is disposed on a mandrel
on which it may be expanded. Reinforcements are then
located on the exterior of the body and the mandrel is
slightly expanded to cause the body to grip the reinforce-
ments and hold them in place. Thereafter, the outer
layer may be positioned over the reinforcements and
tubular body. The outer layer may be of elastomeric
material having wear resisting or other desired proper-
ties or can be of fabric impregnated with elastomeric
material. The assembly is then removed from the man-
drel and inserted into a mold having a cylindrical cavity,
the ends of the body attached in an airtight manner to
the end portions of the mold, and fluid under pressure ap-
plied to the interior of the hose so as to cause the outer
layer to be pressed against the cavity of the mold to
form a smooth cylindrical outer surface, while the body
forming the interior of the hose is pressed into engage-
ment with the reinforcements so as to embed the same
therein and also pressed against the body forming the
outer portion of the hose so as to become united thereto,
at the same time forming a corrugated interior with the
reinforcements embedded in spaced corrugations within
the hose. The resulting product is one having a smooth
exterior surface and corrugations or convolutions spaced
along the interior surface of the hose.

In accordance with the present invention, applicants
have developed a product having improved flexing char-
acteristics and other desired properties by forming a
hose having internal corrugations as described above but
in which the outer surface thereof, while being smooth is
also corrugated, said corrugations being formed on the
outer surface of the hose, with additional internal cor-
rugations formed internally between those previously
present but without embedded reinforcements. This re-
sult is obtained by following the procedure in the afore-
mentioned prior applications to provide a hose body
having internal corrugations and a smooth cylindrical
outer surface but which is in the partially vulcanized
state, and thereafter forming surface corrugations in the
manner described below while completing the vulcaniza-
tion of the hose so that the resulting product is one in
which the corrugations are formed both internally and
externally of the hose.

The hose of the present invention is designed to be
formed and utilized in relatively long lengths of several
feet or greater and can be made in lengths as high as 25
to 50 feet depending upon the length of the mandrel
used. Such hose is useful in connection with the trans-
portation of fluids as for the filling of fuel oil tanks, for
attachment to gasoline pumps, for attachment to vacuum
cleaners or the like and many other uses where the hose
of long length is desired. The hose referred to may
readily be formed with fabric reinforcements embedded
therein as described below.

Other features and advantages of the invention will be
apparent from the specification and claims when con-
sidered in connection with the drawing, in which:

FIGURE 1 is a view in elevation illustrating the as-
sembly of a hose body with reinforcing fabric thereon.

FIG. 2 is a view in longitudinal transverse cross sec-
tion illustrating the assembly of the hose body upon a
mandrel upon which the hose is to be formed.

FIG. 3 is a view in elevation illustrating the assembly of

a reinforcing member over the body portion of the hose on the mandrel.

FIG. 4 is a longitudinal view in cross section illustrating the assembly of the hose body on the mandrel introduced into a cylindrical mold and forced against the interior of the mold cavity.

FIG. 5 is a view partly in elevation and partly in cross section illustrating the hose body formed in FIG. 4 in the first stage of fabrication into applicants' new product.

FIG. 6 is a view partly in elevation and partly in cross section illustrating another method of forming external corrugations into the hose body formed in FIG. 4.

FIG. 7 is a view partly in elevation and partly in cross section illustrating a further stage in the formation of external corrugations subsequent to that illustrated in FIG. 6.

FIG. 8 is a view partly in cross section and partly in elevation illustrating the structure of the final hose product made according to FIG. 5.

FIG. 9 is a view partly in cross section and partly in elevation illustrating the final form of the product made according to FIG. 7.

FIG. 10 is a view partly in cross section and partly in elevation illustrating an intermediate stage in the manufacture of a modified type of hose made in accordance with this invention incorporating a layer of fabric adjacent to the surface thereof.

FIGS. 11 and 12 illustrate in cross section two final stages in the manufacture of the modified form of the invention.

FIGS. 13 and 14 illustrate enlarged cross sectional views of a portion of FIG. 8.

In accordance with the present invention, a preformed tubular hose body 20 of elastomeric material, such as vulcanizable rubber or synthetic rubber composition or a body of elastomeric plastic material, such as polyvinyl chloride is utilized. When a vulcanizable rubber composition is used, the material is set by vulcanization; while in using an elastomeric thermoplastic material, such as polyvinyl chloride, the material is set by cooling after the body material has been heated to a point above the softening temperature.

The tubular member is preferably formed by extrusion to the desired length, diameter and thickness. Alternatively, the tubular body may be formed from a sheet, the edges of which are overlapped and joined by means of an adhesive or otherwise. Over this tubular member, a layer of open mesh fabric 21 such as an open mesh braided material produced in a braiding machine or similar open mesh fabric is drawn as illustrated in FIG. 1. Where fabric reinforced hose is not desired, this fabric layer may be omitted. The tubular body with this fabric layer is then positioned over an elongated mandrel 22 as shown in FIG. 2. The mandrel is preferably provided with longitudinal surface channels 24 communicating with passages 23 which in turn communicates with a fitting 25 connected to a source of air or steam under pressure. The ends of the tubular body are clamped against the mandrel by means of clamping members or rings 26 so that the space between the mandrel and the tube will be airtight.

In the next step of the process, reinforcing member 27 is positioned over the assembly of FIG. 2 as shown in FIG. 3. This reinforcing member is preferably in the form of a helical spring with spaced convolutions which may be wound around the surface of the tube or which may be preformed with the desired degree of spacing. Alternatively the spring member may be preformed with its coils closed together and then positioned over the tube on the mandrel and stretched longitudinally so that the coils will have the desired spacing, the ends thereof thereafter being taped down against the tube on the mandrel. In order to maintain the proper spacing of the convolutions after the spring is applied, tubular layer 20 may be expanded slightly against the inner surface of the spring

by applying a slight degree of pressure against the interior of the tube by introducing air or other fluid under pressure through fitting 25 and passages 23 and channels 24. The reinforcing member may be of bare steel wire, or may if desired be coated with a layer of elastomeric material which will be compatible with the material of the tubular member 20 in order to facilitate the bonding and embedding of the reinforcing member during setting or vulcanization.

Thereafter, the assembly on the mandrel is introduced within a cylindrical mold member 28 as shown in FIG. 4 which may be in the form of a hollow pipe having a smooth interior surface or may be a two-part cylindrical mold. Air or steam under pressure is introduced internally of the tube 20 through inlet 25, passages 23 and channels 24 causing the tube to expand further and force it against the interior surface of the mold and around the convolutions of the reinforcing member. At the same time, heat is applied to the mold by introducing it into a heating chamber, or by the use of heated air or steam introduced internally of the tube, or both, causing the material of the tube to flow through the fabric reinforcement and conform to the surface of the mold. Fluid under pressure and heat is applied until partial vulcanization or curing of the elastomeric vulcanizable material is effected and the mold then allowed to cool, after which the pressure is reduced and the mandrel and tube withdrawn from the mold. In the case of a vulcanizable rubber compound, temperatures ranging from about 275° to 350° F. for a period of ten minutes will generally be sufficient to effect a partial vulcanization. Where thermoplastic material of the type of polyvinyl chloride is used, the assembly may be heated under a few pounds internal pressure at 250° to 350° F. to cause the material to conform to the surface of the mold and embed the convolutions of the reinforcement and the fabric, and the assembly is then allowed to cool. The foregoing procedure conforms substantially to that set forth in the aforesaid patent applications with the exception that the final assembly at this point is not completely cured except in the case of thermoplastic materials, such as polyvinyl chloride, which retains its thermoplastic properties in further processing as described below.

The resulting product, which is shown in position in the mold in FIG. 4 is an elongated smooth surfaced hose body in which reinforcing member 27 has become embedded in the elastomeric material and in which internal corrugations 29 have been formed as the result of the internal pressure which has been applied. Furthermore, the fabric reinforcing member 21 has also become embedded in the elastomeric material which has been forced through the fabric and against the surface of the mold. The fabric has been formed into a convoluted configuration conforming to the corrugations of the inner surface due to the fact that the fabric is restrained by the reinforcements and forced upward therebetween.

The partially vulcanized tubular assembly while still on the mandrel is removed from the mold and subjected to further treatment in order to form the external corrugations referred to above. As shown in FIG. 5, the partially vulcanized hose body, while still on the mandrel, is further modified to form external corrugations and the second set of internal corrugations and depressions between the convolutions of the embedded reinforcing member, by wrapping the tubular body externally between the reinforcement turns with a cord or wire 30. The cord may have the same or a greater or smaller diameter than the diameter of the reinforcement and is wrapped sufficiently tightly around the tube to depress the portion of the hose body between the reinforcement turns down toward and preferably to the surface of the mandrel. In this way as shown in FIG. 5, the assembly consists of mandrel 22, tubular body 20, fabric 21 embedded therein, reinforcement member 27 also embedded in the tubular body, internal corrugations or depressions

29, formed internally of the tube and in which the reinforcements are embedded, outer cord or wire wrapping 30, and corresponding internal depressions defining corrugations 31. While in this state the assembly is then vulcanized to complete the procedure by introducing it into a heated chamber and continuing the vulcanization at a temperature of 275° to 350° F. for an additional 20 to 40 minutes or so depending upon the exact nature of the vulcanizable compound. After the cord or wire 30 is removed, the final product will have the structure illustrated in FIG. 8. Preferably, steam or heated air for the vulcanization is also introduced under pressure through the mandrel during vulcanization or curing so that a certain amount of internal pressure is built up within the tubular body. This produces a refinement or modification of the internal structure of the hose as illustrated in the enlarged view shown in FIGS. 13 and 14.

It is sometimes desirable to draw a slight vacuum on the mandrel in order to form depressions between the reinforcing turns of the hose body prior to the application of a cord. This serves as a guide to insure proper positioning of the cord between the convolutions between the reinforcing turns. The effect of carrying out the vulcanization at this stage under internal pressure is illustrated in FIGS. 13 and 14. As shown in FIG. 13, when cord 30 is applied and the hose body drawn downward between the reinforcement turns a slight pinching occurs in the corrugation, in the area 32 between the depressed areas 29 and 31 with the result that a uniform internal curvature at this point is not obtained. When pressure is applied internally of the hose during vulcanization, the resulting forces tend to cause a slight elongation to occur between convolutions, at the same time causing area 32 between 29 and 31 to assume a greater degree of curvature thus eliminating the sharp crease or pinch which is shown in FIG. 13. Pressures from 5 to about 25 pounds per square inch are found to be adequate for this purpose. In using elastomeric thermoplastic materials, such as polyvinyl chloride, the internal pressure applied should be kept fairly low, generally not to exceed about 5 pounds per square inch.

A modified procedure for obtaining the product of the invention is illustrated in FIGS. 6 and 7. As shown in FIG. 6, a smooth surfaced hose body which is in a partially vulcanized state as produced in accordance with the procedure illustrated in FIGS. 1 to 4 is removed from the mandrel 20 and positioned upon mandrel 37. This mandrel is provided with an internal bore 38 and radially extending passages 39 which are so spaced that they will conform substantially to a position midway between the respective convolutions of the hose body when it is placed in the mandrel. The hose body referred to consists of elastomeric body portion 33, spaced reinforcements 34 and embedded fabric 35. Vacuum is then applied internally to the mandrel and the hose body drawn downward between convolutions to form an internally and externally corrugated structure illustrated in FIG. 7. This replaces the use of cord as shown in FIG. 5. While maintaining this vacuum, the assembly is introduced into a heating chamber and vulcanization completed in a manner described above. Upon the completion of vulcanization, the vacuum is released and the hose is removed from the mandrel. Removal may be facilitated by introducing air under pressure to cause a slight degree of expansion of the hose body to enable it to be more easily removed from the mandrel. The resulting product will have the structure illustrated in FIG. 9, which is quite similar to that shown in FIG. 8.

A modified form of the invention is illustrated in FIGS. 10, 11 and 12. In this construction, it is desired to produce a hose having a fabric layer at or close to the surface.

As shown in FIG. 10, a tubular vulcanizable or thermoplastic elastomeric hose body 40 of the type described above is positioned over mandrel 43 which may be of the type illustrated in FIG. 2. Reinforcement turns 41 are

then applied over the tube body, and over the reinforcement is applied a layer fabric 42. This may be a layer of braid which is braided directly on to the hose over the reinforcement in a conventional braiding machine or may be a layer of fabric wrapped and overlapped over the reinforcement or may be a preformed tubular fabric. Since this fabric is applied at the surface of the hose, it need not necessarily be of the open mesh type described in connection with FIGS. 1 to 4 since it is not necessary to drive the material of the tube through the fabric to any great extent. Of course, an open mesh fabric may be utilized if desired. The resultant assembly is then introduced into a cylindrical mold cavity as described in connection with FIG. 4 and expansion and semi-curing carried out in the same manner as described above with the result that partial vulcanization or semi-curing of elastomeric material takes place with the formation of a smooth surfaced product. The structure of this product is illustrated in FIG. 10. When a fairly close mesh tubular fabric is utilized, a mold is not absolutely necessary since the fabric will be sufficiently strong to form the mold and retain the cylindrical structure desired when heated air is introduced into the mandrel to expand the elastomeric material into engagement with the fabric. However, it is preferable to use a mold so that there can be no surface irregularities and to insure suitable embedding of the fabric in the surface. This is particularly true when a thermoplastic material, such as polyvinyl chloride, is utilized which can flow under a slight degree of pressure as long as temperatures above the softening point are utilized. When vulcanizable materials such as rubber are used, however, it is generally preferred to utilize a mold. The resulting product as produced in accordance with FIGS. 10 and 11, is one in which a layer of fabric is embedded at or close to the surface of the tubular body which while being smooth to conform to the surface of the mold cavity will still show the pattern structure of the fabric. At this point the hose is corded down in the manner illustrated in FIG. 5 to form intermediate depressions and external corrugations and thereafter vulcanized to complete the cure as described above. The resulting product is illustrated in FIG. 12 and is one which conforms substantially to that shown in FIG. 8 with the exception that fabric 42 is embedded at the outer surface of the hose. Where internal steam or air pressure is utilized during the vulcanization, a further refinement of the internal structure of the hose which would conform to that illustrated in FIG. 14 is obtained.

If desired, instead of utilizing cording to obtain the intermediate corrugations, vacuum may be applied in the manner described in connection with FIGS. 6 and 7 in which case the product will be substantially that shown in FIG. 9 with the exception of the position of the fabric which is adjacent to or at the outer surface of the hose.

If desired also, a plurality of layers of fabric may be utilized, for example, a layer of open mesh fabric of the type described in connection with FIGS. 1 to 4 may be applied beneath the reinforcing turns and a second layer of fabric applied over the reinforcing turns with the result that the open mesh fabric will become embedded within the hose body beneath the reinforcing turns and the second layer of fabric, which may be of a close mesh and ornamental type will be embedded or anchored at the surface of the hose.

We claim:

1. An elongated reinforced hose comprising a tubular body of elastomeric material having reinforcements therein, said body having internal and external corrugations, there being twice as many internal corrugations as external corrugations with alternate internal corrugations aligned with the external corrugations and said reinforcements being embedded in said aligned corrugations.

2. An elongated reinforced hose comprising a tubular body of elastomeric material having thickened portions forming a set of internally projecting convolutions having

wire reinforcements embedded therein, the body between said convolutions being depressed to form a second set of convolutions having an internal diameter equal to the internal diameter of the first set of convolutions.

3. A hose according to claim 2 comprising a layer of fabric embedded adjacent to the surface of the hose. 5

4. A hose according to claim 2 comprising a layer of fabric embedded between the reinforcements and the inner surface of the hose.

5. A hose according to claim 2 wherein the elastomeric material comprises a vulcanized rubber.

6. A hose according to claim 2 wherein the elastomeric material comprises polyvinyl chloride.

References Cited in the file of this patent

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