July 13, 1948. P. F. McDERMOTT 2,445,231

METHOD OF AND APPARATUS FOR MAKING TUBULAR COVERINGS

Filed Sept. 9, 1944

Fig. 3.

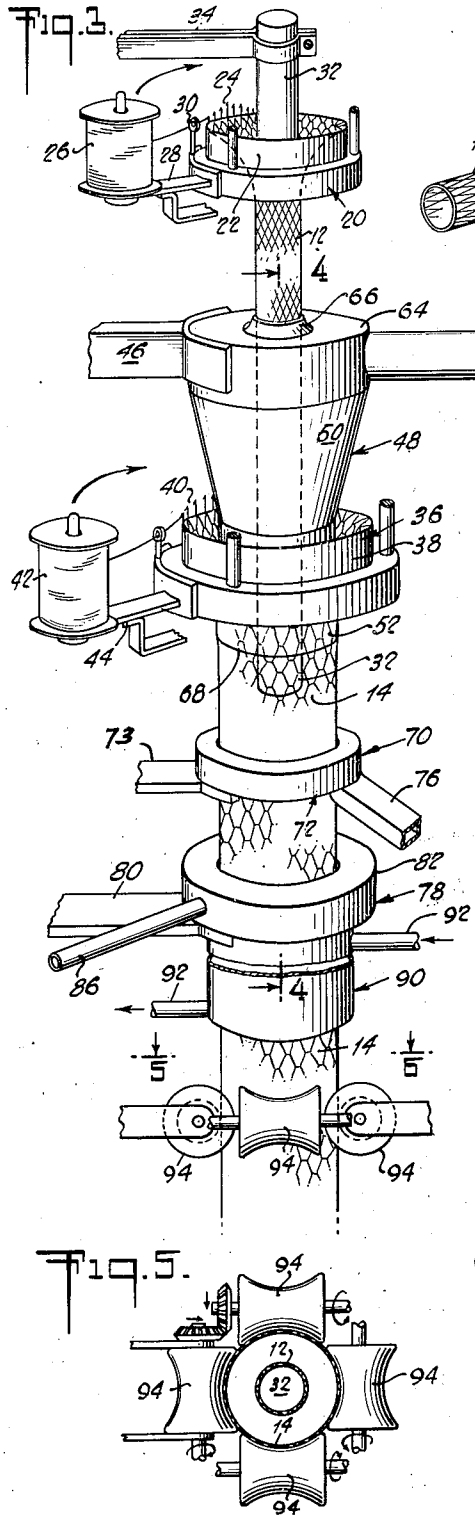
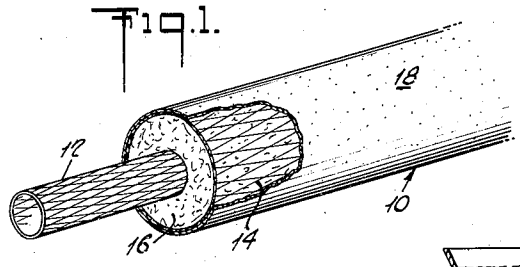


Fig. 1.



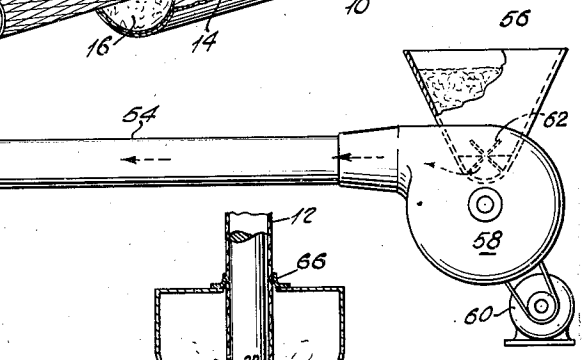


Fig. 4.

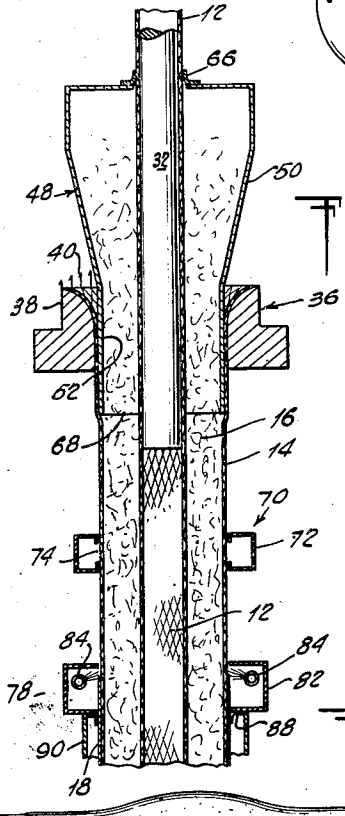


Fig. 2.

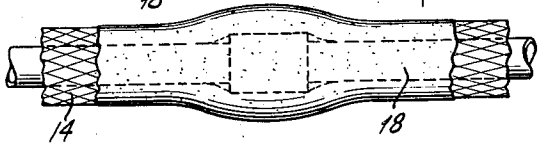


Fig. 5.

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METHOD OF AND APPARATUS FOR MAKING TUBULAR COVERINGS

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15 Claims. (Cl. 66—9)

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The present invention relates to flexible, tubular coverings and to a method and means for their manufacture.

The invention has for its principal object the provision of an improved, seamless, tubular covering for pipes, tubes and other similar members, and the provision of a novel apparatus and method for making the same. The tubular covering of the preferred embodiment of the instant invention is flexible and distortable to have the capability of being stretched or contracted to fit a pipe or tube line having portions of different diameter.

Another object of the invention is the provision of a tubular covering including a layer of filling material, preferably an insulating material such as asbestos or other fibers, and a distortable, tubular liner, the latter being resistant to high temperatures and to corrosive influences, whereby the covering may be employed under conditions where conventional materials are unsatisfactory.

A further object of the invention is the provision of a tubular covering having an inner liner comprising a stretchable, tubular fabric formed of metal strands, an outer confining sleeve and an intermediate filling preferably constituting a fibrous insulation. In the preferred embodiment the sleeve and liner are of seamless, tubular knitted construction. The product may, if desired, carry a coating layer applied over said sleeve to fill or substantially fill the interstices thereof to retard or prevent the passage of moisture into the filling.

A further object of the invention is the provision of a method and apparatus for fabricating a tubular product of the kind described above, the steps of the method being carried out in sequence, whereby the covering is completed in a single series of operations, and continuous production is obtained.

My invention will be more fully understood and further objects and advantages thereof will become apparent when reference is made to the more detailed description thereof which is to follow, and to the accompanying drawings in which:

Fig. 1 is a perspective view of a tubular covering in accordance with the instant invention;

Fig. 2 is an elevational view illustrating the application of the covering of Fig. 1 to a pipe line or tube line, having portions of different diameter;

Fig. 3 is a diagrammatic, perspective view of an apparatus embodying the invention and for carrying out the method thereof;

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Fig. 4 is a sectional view taken on the line 4—4 of Fig. 3; and

Fig. 5 is a sectional view taken on the line 5—5 of Fig. 3.

Referring now to the drawings, and particularly to Figs. 1 and 2, the product of the invention comprises a tubular covering 10 adapted particularly for use as an insulation for pipes, tubes and similar equipment. However, as will be appreciated, the product may serve many other purposes. Covering 10 includes an inner liner 12, an outer sleeve 14 and an intermediate filling 16. If desired, sleeve 14 may carry a coating layer 18.

Liner 12 and sleeve 14 are preferably of a stretchable, distortable character. For this purpose they are suitably fabricated by knitting flexible strands of a character to impart to the product any desired properties or characteristics. For example, where the covering is to be employed on pipes or the like subject to temperatures which would char or deteriorate organic fibers or inorganic fibers such as asbestos, strands of a suitable metal substantially permanently resistant to destruction or undue weakening at high temperatures are employed. For this purpose fine wires or cut strands of metals or alloys of metals such as conventional hard steels such as chrome, nickel steels and alloys such as nickel chrome alloys, nickel copper alloys and the like may be used. On the other hand, where the product is to be used for insulating or covering pipes or other members subject to lower temperatures, asbestos strands, or in some instances cotton strands or the like are suitable. Sleeve 14 may be fabricated from similar materials as the liner, but inasmuch as the outer surface of the covering is not ordinarily exposed to high temperatures, in many cases more conventional textile materials such as asbestos or cotton strands, serve satisfactorily. If metal is employed for either or both the liner and sheathing, relatively fine strands are preferred, say for example, those having a diameter of about .006", and the fabric is preferably knitted to have relatively small mesh openings, for example about $\frac{1}{16}$". However, it will be understood that the gauge of the strands and the size of the stitches may vary considerably from those given above, depending upon the particular application of the product, the character of the filling material and the like.

Particularly for high temperature applications, filling 16 is suitably a heat-resistant, fibrous material, preferably asbestos fiber, although other materials may be employed, such as glass fibers, mineral wool fibers and the like. For low tem-

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perature applications other materials of either an organic or inorganic nature are suitable and may be selected from the many known materials for similar uses such as wood fibers, cotton fibers and the like.

Coating 18 may be employed to retard or prevent the penetration of moisture into the filling or to give the covering a finished appearance, or for other purposes. Materials such as bitumens, rubbers, glues, vinyl resins, sodium silicate, natural or synthetic gums or resins, etc. may be used for this purpose, the selection of the coating depending upon the particular characteristics desired. The coating fills or substantially fills the interstices of the covering but is preferably permitted to penetrate only a short distance, if at all, into the filling.

Referring now to Fig. 2, the adaptability of a covering, in which the liner and sleeve are composed of a knitted or similar distortable, stretchable fabric to conform to pipe lines or the like having sections of different diameter, is illustrated. Due to the characteristics of the liner and sleeve, the covering may be supplied in relatively great lengths and forced endwise over a pipe line, the covering expanding as necessary to pass over couplings or other fittings. After a section of the covering is applied, longitudinal tension on the covering will stretch it, causing it to closely embrace the line in all portions. If a coating is to be employed on a covering of this type, it will be appreciated that the coating should also be of a stretchable character such, for example, as the vinyl resin referred to above.

Referring now particularly to Figs. 3–5 inclusive, the apparatus for the manufacture of products as described above, and for carrying out the method of the instant invention comprises a device 20 for fabricating a tubular liner 12. Device 20 is preferably, as illustrated, a circular knitting machine of known type, including a stationary cylinder 22, carrying needles 24. One or more spools 26 of the strand material from which the liner is to be fabricated are supported from the machine as indicated at 28, to be rotated around cylinder 22, the strand extending from the supply through guide 30 to the knitting point.

Located centrally of knitting machine 20 to extend axially through cylinder 22 in position to have the fabric knitted therearound, is a cylindrical core member or rod 32 of a diameter substantially equal to the inner diameter of the liner. Core 32 may be supported by bracket 34.

A second machine 36 is located below and in substantial axial alignment with machine 20 for fabricating sleeve 14. Machine 36 is also preferably a circular knitting machine, similar to device 20 with the exception that it is of a larger diameter to knit a tubular fabric of the diameter of sleeve 14. The machine includes a cylinder 38, needles 40 and a strand supply 42 supported as, for example, on bracket 44 for rotation around the cylinder. Core member 32 extends to machine 36 to pass axially through its cylinder 38, and extend some distance therebelow, as indicated in Figs. 3 and 4.

The drives for machines 20 and 36, supporting members, and other conventional operating parts such as the needle cam structure and the like have not been shown, and the knitting machine elements referred to above have been shown only diagrammatically as such features may be of any conventional or known type and, per se, form no part of the invention.

Supported between knitting machines 20 and 36, as by bracket 46 is a member 48 having an upper hopper section 50 and a lower, substantially cylindrical forming section 52 extending through the knitting machine cylinder and projecting some distance therebelow to terminate in an open mouth 68 a short distance above the lower end of core member 32. Forming section 52 is of substantially the diameter of the knitted sleeve to be made on machine 36. Hopper section 50 is connected through a conduit or tube 54, with a suitable supply of filling material 16. Suitably the supply for this purpose includes a hopper 56 in communication with the intake of a fan or blower 58, the latter to be driven as by motor 60. A metering device or the like 62 of any known type, may be employed to control the quantity of the filling material fed to the forming member through conduit 54, or any other suitable means may be employed for this purpose. The upper end of section 50 is closed by end plate 64, the latter having a central opening to permit core 32 and the knitted liner surrounding it to pass through end plate 64. The space between the end plate and the liner is preferably sealed by flexible sealing member 66 to prevent any substantial escape of the filling material conveyed under air pressure into device 48.

A suction device 70 is preferably employed below, but adjacent mouth 68 of forming member 52 to remove dust and excess air. This device comprises a circular housing 72 surrounding the sleeve and having an inwardly opening suitably continuous air intake port 74. Housing 72 is connected through line 76 to a suction fan or other means to obtain continuous withdrawal of air through port 74. Suction device 70 may be supported by bracket 73.

Below the suction device, a coating applying means 78 may be mounted on bracket 80 to apply coating layer 18 where such is desired. The coating means may take any suitable form but, as shown, includes housing 82 enclosing a spray ring 84, connected with any suitable source of coating supply (not shown) by coating line 86. Housing 82 carries a flexible seal 88 which wipes the coating and prevents the formation of a layer of excessive thickness. Directly below the coating device, a setting chamber 90 surrounds the covering. The setting chamber may be of any construction and length required to dry the coating materials applied by device 78. As shown, chamber 90 is in the form of an extended tube having inlet and outlet ports 92 through which a setting medium such as steam, hot air or the like may be circulated from any suitable source of supply (not shown) to completely, or substantially completely, set the coating before the covering leaves the lower end of the chamber.

The product is withdrawn downwardly through the several operating portions of the apparatus by a suitable take-off means comprising, for example, two pairs of opposed, concave, knurled rolls 94, located at substantially right angles to one another to contact a sufficient area of the covering to exert the necessary drawing force without unduly crushing it. However, in lieu of the construction shown, opposed, parallel, relatively closely set take-off rolls may be employed or traction belts or the like may be substituted. The take-off rolls may be driven in any suitable manner in timed relationship to the knitting operations by suitable means not shown in detail.

In the operation of the apparatus described above, and in carrying out the method of the instant invention, strand material of the kind se-

lected for liner 12 is supplied from spool 26 and is fabricated into a seamless, tubular fabric around core member 32 by knitting machine 20. At the beginning of the operation, a sufficient amount of the liner is first knitted by machine 20 to extend to machine 36. Machines 20 and 36 are then operated at such comparable speeds as to fabricate their respective tubular products at the same longitudinal rate. Knitting machine 36 forms its tubular fabric from the selected strands supplied by spool 42, the fabric embracing cylindrical forming section 52 of member 48, as indicated particularly in Fig. 4. Coincident with these operations, blower 58 is operated to set up an airstream in conduit 54 and the selected filling material is supplied from hopper 56 to the blower and is carried with the airstream into hopper section 50. The airstream, in addition to serving as a conveyor for the filling, forces the filling into the forming section where it is packed between the section and the sleeve to snugly fill the space. It will be understood that the density to which the fibers are packed will depend upon the quantity of filling material supplied and the force of the airstream, both of which are subject to control.

The operation of take-off means 94 is timed with that of the knitting machines to draw sleeve 16 off from the end of the forming member and liner 12 from the end of core member 32. The filling material delivered into the forming member is carried forwardly with the liner and sleeve, by the force of the airstream and by the drawing action of liner 12, through mouth 68 to be confined between the liner and sleeve 14. The air carried with the filling material escapes through the meshes of the sleeve and is drawn off by suction means 70, the latter also serving to collect and remove any dust given off by the filling material.

Where it is desired to provide a coating layer 18 on the outside of the tubular covering, the selected coating material is applied by device 78 in amounts to give the selected thickness of the layer. The coating is quickly dried as the covering is drawn through drying chamber 90 thus preventing undue absorption by the filling. Suitably the coating is supplied in a relatively viscous condition to retard absorption.

The flexible, tubular covering formed in a continuous length as described above, may be cut into units of any suitable size for selected purposes. The thickness of the annular filling layer 16 and the inner and outer diameters of the tubular covering may be controlled, as will be obvious, by proper selection of the several parts of the apparatus.

As has previously been noted, fabricating devices 20 and 36 are preferably knitting machines to provide a tubular covering with an inner liner and outer sleeve of great extensibility and distortability. However, in lieu of the knitting machine shown, braiding machines or the like may be substituted to provide a product having many of the advantages of the knitted product. It will also be appreciated that different combinations of materials may be used for the inner liner and outer sleeve to provide special effects. Also other changes and modifications may be made in the construction shown without departing from the scope of the invention as defined by the subjoined claims.

What I claim is:

1. In the method of making a tubular covering, the steps comprising knitting a seamless, distortable, tubular liner, knitting a seamless, distortable, tubular sleeve surrounding said liner to define an annular space between the sleeve and liner and substantially simultaneously therewith pneumatically conveying a loose filler into the space between said liner and sleeve.

2. In the method of making a tubular covering, the steps comprising knitting a seamless liner of metallic strands, knitting a seamless, distortable sleeve around said liner and spaced therefrom to define a space between said liner and sleeve and substantially simultaneously therewith pneumatically conveying a loose, fibrous insulating material into said space.

3. In the method of making a flexible, tubular covering, the steps comprising knitting a tubular liner, knitting a tubular sleeve around a hollow forming member with said liner passing through said forming member and spaced therefrom, and delivering a loose filling material into the space between said liner and said sleeve through said forming member.

4. In the method of making a flexible, tubular covering, the steps comprising knitting a tubular liner, knitting a tubular sleeve around a hollow forming member with said liner passing through said forming member and spaced therefrom, delivering a loose, fibrous filling material to said forming member to form a layer around said liner, and carrying said liner and sleeve forwardly to draw said sleeve from said forming member whereby said layer is confined between said liner and sleeve.

5. In the method of making a flexible, tubular covering, the steps comprising fabricating a flexible, tubular liner, fabricating a flexible, tubular sleeve around a hollow forming member with said liner passing through said forming member and spaced therefrom, delivering a loose, fibrous filling material to said forming member to form a layer around said liner, and carrying said liner and sleeve forwardly to draw said sleeve from said forming member whereby said layer is confined between said liner and sleeve.

6. In the method of making a flexible, tubular covering, the steps comprising fabricating a tubular liner of metallic strands, fabricating a tubular sleeve around a hollow forming member with said liner passing through said forming member and spaced therefrom, delivering a loose, fibrous filling material to said forming member to form a layer around said liner, and carrying said liner and sleeve forwardly to draw said sleeve from said forming member whereby said layer is confined between said liner and sleeve.

7. In the method of making a flexible, tubular covering, the steps comprising knitting a flexible, tubular liner around a core, knitting a tubular sleeve around a hollow forming member surrounding said core and spaced therefrom, delivering a loose, fibrous filling material to said forming member to form a layer around said liner and core, and carrying said liner and sleeve forwardly to draw said sleeve from said forming member and said liner from said core, whereby said layer is confined between said liner and sleeve.

8. In the method of making a flexible, tubular covering, the steps comprising fabricating a tubular liner, fabricating a tubular sleeve around a hollow forming member with said liner passing through said forming member and spaced therefrom, and pneumatically delivering and compressing a loose filling material into the space between said liner and said sleeve through said

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forming member, and carrying said liner and sleeve forwardly to draw said sleeve from said forming member, whereby said layer is confined between said liner and sleeve.

9. In the method of making a tubular covering, the steps comprising fabricating a seamless, stretchable, tubular liner, fabricating a seamless, stretchable, tubular sleeve surrounding said liner to define a space between said liner and sleeve, pneumatically conveying a loose filler into the space between said liner and sleeve, and applying a coating layer to said sleeve.

10. In the method of making a flexible, tubular covering, the steps comprising knitting a tubular liner of metallic strands around a core, knitting a tubular sleeve around a hollow forming member with said core passing through said forming member and spaced therefrom, delivering a loose, fibrous insulating material to said forming member to form a layer around said liner and core, carrying said liner and sleeve forwardly to draw said sleeve from said forming member and said liner from said core, with said insulating material confined therebetween, and applying a layer of coating material to said sleeve.

11. In an apparatus for the manufacture of a flexible, tubular covering, means for fabricating a hollow, tubular, flexible liner, a hollow forming member including an open mouth, said member being in position for said liner to extend therethrough spaced from the walls thereof, means for fabricating a tubular, flexible sleeve around said forming member, means for delivering a loose filling material into said sleeve, and means for moving said sleeve and liner forwardly as they are fabricated to draw said sleeve from said forming member, whereby said filling material is confined between said sleeve and liner.

12. In an apparatus for the manufacture of a flexible, tubular covering, means for knitting a tubular liner, a hollow forming member having an open mouth and in position to have the liner extend therethrough spaced from the walls thereof, means for knitting a tubular sleeve around said forming member, means for supporting said liner within said forming member, means for pneumatically delivering a loose filling material into said sleeve, and means for moving said sleeve and liner forwardly as they are knitted.

13. In an apparatus for the manufacture of a flexible, tubular covering, an extending core member, means for knitting a tubular liner around said core member, a hollow forming member having an open mouth, said core member extending through said forming member and spaced from the walls thereof, means for knitting a tubular sleeve around said forming member, means for pneumatically delivering a loose filling material into said forming member, and means for moving said sleeve and liner forwardly as they are knitted to draw said sleeve from said forming member and said liner from said core member whereby said filling material is confined between said liner and sleeve.

14. In a method of making a tubular covering, the steps comprising, fabricating a tubular liner, fabricating a sleeve around the liner with a space defined between the sleeve and liner, and substantially simultaneously thereafter conveying loose, fibrous material into said space and compacting it to form a substantially homogeneous fibrous mass therein.

15. In a method of making a tubular covering, the steps comprising, fabricating a tubular liner, fabricating a sleeve around said liner with a space defined between the sleeve and liner, and pneumatically conveying a loose, fibrous material downwardly into said space and compacting it to form a substantially homogeneous fibrous mass therein.

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