APPARATUS FOR INTIMATELY SHEATHING FOUNDATION BODIES WITH SHEET METAL JACKETS

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FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 5

FIG. 6
This invention relates to a method of and apparatus for applying metallic coverings or jackets to shafts, rollers, tubes and like foundation bodies. This application is a division of copending application Serial No. 25,993, now Patent No. 3,098,285, filed May 2, 1960, for "Method and Means for Applying Sheet Metal Jackets to Foundation Bodies," which is a continuation-in-part of prior copending application Serial Number 376, 177, filed August 24, 1953, for "Method and Means for Applying Sheet Metal Jackets to Foundation Bodies." An object of the invention is to provide a foundation body, such as a heavy-walled steel roller or tube with a jacket of sheet metal formed of stainless steel, or some other suitable alloy steel, or the like. A further object is to provide a method of applying a sheet metal jacket to a foundation body in such a manner that the resultant jacket is arranged in intimate contact with the surface of the foundation body so that the composite assembly may be machined to close tolerances without the possibility of the jacket slipping or moving upon the foundation body. A further object is to provide a method of the mentioned character which embodies a controlled application of a heating and cooling medium to the external surface while the roller is rotating with the foundation body in a lathe or the like, together with the application of mechanical pressure against the external jacket in a localized spiral path adjacent to the heating and cooling means. Still another object is to provide a method of the above mentioned character for producing a substantial homogeneous finished roll, shaft, tube, or the like, having a heavy-walled portion formed of steel or the like and a thin-walled outer jacket or covering in intimate contact with the foundation body permanently. Other objects and advantages of the invention will be apparent during the course of the following description. In the accompanying drawings, forming part of this application and in which like numerals are employed to designate like parts throughout the same: FIG. 1 is a central vertical longitudinal section through a cylindrical tubular foundation body formed of steel or the like; FIG. 2 is a similar view of the thin-walled covering or jacket to be applied to the foundation body shown in FIG. 1; FIG. 3 is an enlarged fragmentary vertical sectional view showing the application of the thin-walled jacket to the foundation body by the application of mechanical pressure; FIG. 4 is a side elevation, partly diagrammatic and partly in section, of apparatus employed in the practice of the method; FIG. 5 is a fragmentary end elevation, partly diagrammatic, of the apparatus shown in FIG. 4; and FIG. 6 is a fragmentary sectional view similar to FIG. 3, showing a modified form of foundation body and jacket according to the invention. In the drawings, for illustration, are shown preferred embodiments of the invention, attention is directed first, to FIGS. 1-5 wherein the numeral 10 designates a relatively thick-walled tube, roll, sleeve, or the like, preferably formed of steel and being very rigid in construction. A preformed thin-walled cylindrical tubular jacket 11 of stainless steel, alloy steel, or the like, is provided for free application endwise over the foundation body 10 at the start of the method. The jacket 11 has an internal diameter which is just large enough to allow the jacket to be telescoped over the foundation body 10 and the clearance between the jacket and foundation body is preferably held to a minimum amount necessary to allow initial free telescoping engagement of the two parts 10 and 11. As shown in FIG. 4, subsequent to the application of the jacket 11 to the foundation body 10 telescopically, these two elements are conventionally mounted for rotation in a turning lathe 12, having the usual headstock and chuck 13, and the usual tailstock 14. Suitable adapter means 15 are secured within the opposite ends of the tubular foundation body 10, as shown in FIG. 4 to secure the same firmly for rotation in the lathe under the driving influence of the chuck 13. Initially, at the start of the method, the jacket 11 and foundation body or tube 10 may be temporarily clamped together for rotation in unison in the lathe by external clamps 15', applied to the ends of the foundation body and jacket, or by removable clamping bands which may be applied around the periphery of the jacket 11 to initially secure it to the foundation body at the start of the method. The lathe 12 further comprises the usual longitudinal screw-feed means 16 for the feed carriage 17 having conventional right-angled guides 18 and 19, and a saddle 20 for the usual tool rest or holder 21. The lathe 12 is conventional in construction and operation and need not be described in full detail. Rigidly secured to the tool rest 21, as at 22, is a freely rotatable forming or pressure applying roller 23, which roller is vertically disposed and journaled for rotation upon a horizontal shaft 24', having its axis of rotation parallel to the axis through the chuck 13 and tailstock 14 and being preferably at the same elevation as such axis, see FIG. 5. The forming-roller 23 is shiftable radially toward and from the periphery of the jacket 11 in the usual manner by virtue of the guide 18 of the lathe and the conventional adjusting means for the tool carriage. When the lathe is in operation, the foundation body 10 and the jacket 11 turn in unison upon their common longitudinal axis, and the carriage 17 with forming-roller 23 is fed longitudinally of the jacket 11 at the desired rate which may be regulated in the usual manner by adjusting the conventional screw-feed means 16 of the lathe. By this arrangement the forming-roller 23 may be caused to traverse a spiral path of the desired pitch along the periphery of the jacket 11 from end-to-end of the latter, as should be obvious. Means are provided to apply heat and a suitable cooling medium to the periphery of jacket 11 in a localized region or path during rotation of the jacket and foundation body. Such means may comprise an oxygen-acetylene burner 24, or the like, disposed slightly in advance of the forming-roller 23 and extending radially of the jacket 11 near the top of the same. The cooling means may comprise a nozzle 25 adapted to direct a jet or stream of cold water radially against the periphery of the jacket 11 in a slight trailing relation to the forming-roller 23. The nozzle 25 is disposed radially of the jacket 11 and near the same and is spaced somewhat from the burner 24, axially of the jacket 11, as shown in FIG. 4. As shown in FIG. 5, the nozzle 25 is spaced about 45° circumferentially in advance of the burner 24, although this arrangement may be varied somewhat if desired. The burner 24 and cold water nozzle 25 are both rigidly
3,241,231

secured to a curved rigid yoke 26 which spans the top of the jacket 11, transversely, FIG. 5, in vertically spaced relation thereto. The lower end of the rigid yoke 26 is suitably rigidly secured to the lathe carriage 17 or tool rest in any conventional manner. The burner 24 and cooling nozzle 25 are suitably, respectively, supplied with gas and water, as shown, leading to suitable sources of gas and water under pressure, not shown.

As best shown, in FIG. 3, the forming-roller 23 has its periphery contoured to provide a leading smoothly rounded shoulder 27 blending into a beveled and axially tapered peripheral face 28. Upon engagement of the roller with the thin-walled jacket 11, while the jacket foundation body 10 are turning in the direction of the arrow, FIG. 5, the rounded shoulder 27 engages the jacket 11 and continually forces or presses the same radially inwardly into intimate contact with the side wall of the foundation body 10 along a continuous localized spiral path. The forming-roller 23 is feeding to the right or in the direction of the arrows, FIGS. 3 and 4, and the beveled peripheral face 28 of the forming-roller initially engages the jacket 11 and causes the jacket to be wedged radially inwardly toward the foundation body 10 as the jacket is firmly engaged by the rounded forming shoulder 27 of the roller 23, which is constantly rotating due to the contact with the jacket 11.

The general mode of operation of the apparatus in the practice of the method is as follows:

The initial assembly of the foundation body 10 and jacket 11 is mounted in the lathe for rotation, as described, and the elements 10 and 11 may be temporarily clamped together to prevent relative movement between them or slipage at the start of the method.

The carriage 17 is initially positioned at the left hand end as shown in FIG. 4, so that the forming-roller 23 may be shifted into forming engagement with the jacket 11 at or near the left hand end of the same. The heating burner 24 and cooling nozzle 25 will also be positioned at or near the left hand end of the work, FIG. 4, and when the lathe 12 is placed into operation the work will turn in the direction of the arrows or toward the observer in FIG. 4 and the carriage 17 with the elements 23, 24 and 25 will feed to the right.

As this takes place, the burner 24 will project intense heat upon the thin-walled jacket 11 in a spiral path and controllably to work rest 29, and this localized path in the spiral path is applied to the jacket 11 slightly in advance of the spiral path of contact of the forming-roller 23 with the jacket. The arrangement is such that the heat locally softens the jacket 11 somewhat just prior to engagement of the forming-roller with the jacket in the spiral path on the jacket which has been heated. The cooling nozzle 25 likewise projects a constant jet or stream of cold water or the like in a corresponding spiral path on the jacket 11 in slight trailing relation to the forming-roller 23. The arrangement is such that the burner 24 heats the jacket 11 in a continuous narrow or localized spiral path from end-to-end of the work and the forming-roller 23 engages the jacket 11 in trailing relation to the burner 24 and presses the somewhat softened jacket 11 inwardly against the foundation body 10 and forms the jacket in the manner illustrated in FIG. 3 in the spiral path, and continuously, so that the jacket assumes into intimate contact with the thick rigid side wall of the foundation body along the entire length of the work.

Immediately subsequent to the described heating and forming of the jacket 11 on the foundation body 10, the cooling jet of water from the nozzle 25 is directed in a spiral path, locally upon the periphery of the jacket to cool and temper the same in trailing relation to the forming-roller 23, as described.

Thus, in essence, the jacket 11 and foundation body 10 are rotated in unison, and the jacket is heated locally in a continuous spiral path from end-to-end of the jacket and, while somewhat softened, the rotating roller 23 forces the jacket inwardly in the spiral path into contacting substantially homogeneous relation with the foundation body, and, immediately subsequent to this, in the same localized spiral path the jacket is quickly cooled. This cooling causes complete shrinkage of the jacket to the foundation body subsequent to forming of the jacket so that a substantially integral or homogeneous assemblage of the jacket and foundation body is obtained.

The thus assembled jacket and foundation body will never, subsequent to the completion of the method, separate or move relative to each other, even when the jacket is machined or ground to a very thin-walled condition. Sounding tests of the finished article will indicate that there is absolutely no space located between the jacket and foundation body when the method is carried out to completion.

Since the foundation body 10 is heavy or thick-walled, the local application of heat by the burner 24 will have no softening or deforming effect upon the foundation body, and, likewise, the pressure produced by the forming-roller 23 will have no measurable deforming influence upon the foundation body.

If preferred, in some instances, where it is desired to employ the rigid body 10 which does not have a very thick wall, such foundation body may be internally reinforced by conventional means during practice of the method to prevent any possible deformation of the foundation body. The jacket 11 is essentially thin-walled and, therefore, more readily deformable under the influence of the forming-roller 23 after the application of heat.

If the above described method tends to elongate the jacket 11 on the rigid foundation body 10, as will occur to some extent, the extreme ends of the work may be machined or trimmed off in any suitable manner after the completion of the method to produce a clean finished product.

The temporary clamping means for the foundation body and jacket used at the start of the method may be removed and dispensed with after the roller 23 has traversed a few spiral convolutions around the periphery of the work, and subsequent to this the jacket 11 can never move relative to the underlying foundation body 10.

In some instances where rollers or cylindrical foundation bodies of very large diameters are to be jacketed in accordance with the invention, it may be desirable to utilize, on the curved yoke, a plurality of the burners 24 in circumferentially spaced relation, instead of a single burner as illustrated. I contemplate using three or four of the burners to apply additional heat to the jacket 11 in the spiral path in some cases, instead of a single burner as shown. The additional burners may be mounted on the single yoke 26, in spaced relation. Additionally, if desired, a cooling jet of cold water or the like, not shown, may be directed on the forming-roller 23 to cool the same, but this is not necessary in most instances.

A wide variety of sizes of foundation bodies 10 and jackets 11 may be treated in accordance with the invention, as should be obvious.

In FIG. 6 there is shown a modified form of prefabricated rigid foundation body, in the form of a spreader roll 29 for textile manufacture and which roll has a thick or heavy wall of steel or the like provided externally with the jacket 31, which jacket has been formed therein during manufacture. A thin-walled metal jacket 31 of stainless steel or the like is adapted to be initially telescoped over the grooved spreader roll 29 with a minimum amount of clearance provided, just as described in the preferred form of the invention. The initial assemblage of the elements 29 and 31 is then mounted for rotation in unison in the lathe 12, in the identical manner previously described and the method of forming the jacket 31 and securing the same in intimate contact with the periphery of the grooved roll 29 is carried out in substantially the identical manner described previously in connection with the first form of the in-
invention. That is to say, the same arrangement of heating means or burners 24 and cooling means 25 on the yoke 26 is employed in connection with the work shown in FIG. 6, and a suitable forming-roller 32 and the rest 21 of the lathe is adapted to engage the initially cylindrical jacket 31 and to form the same into intimate contact with the spiral groove 30 of the spreader roll 29. The feed means 16 of lathe 12 may be readily adjusted so that the forming-roller 32 will follow the spiral groove 30 and press the heated jacket 31 into intimate contact with the grooved periphery of the roll 29, as indicated in FIG. 6, throughout the entire length of the roll 29.

The method may be practiced in substantially the identical manner in connection with foundation bodies, tubes, rollers, shafts, and the like, having various external or peripheral shapes.

It is to be understood that the forms of the invention shown and described are to be taken as preferred examples of the same, and that various changes in the shape, size and arrangement of parts, as well as changes in the order or sequence of method steps, may be resorted to without departing from the spirit of the invention or the scope of the sub-joined claims.

What is claimed is:

1. Apparatus for use in applying a thin-walled stainless steel jacket to a relatively thick-walled steel tube comprising: means to support the jacket and tube and to rotate the same in unison while the jacket is telescoped over the tube, carriage means connected for parallel movement longitudinally of the jacket and tube during rotation of the latter, a forming-tool on said carriage means engageable with the periphery of the jacket to exert an inward radial pressure on a small area of the jacket in a progressive spiral path during rotation of the jacket to progressively force the jacket into more intimate contact with the tube along said spiral path, heating means on said carriage means to apply heat to a small local area of the periphery of the jacket in the progressive spiral path in advance of said forming-tool, and means on said carriage means to cool a small local area of the periphery of said jacket in the progressive spiral path and in trailing relation to said forming-tool, said heating means, forming-tool and cooling means being successively operative in the order named along the spiral path.

2. Apparatus for use in applying a thin-walled stainless steel jacket to a thick-walled steel tube according to claim 1, and wherein said forming-tool is a roller rotatably mounted upon the carriage means in opposed relation to said jacket, and said carriage means carrying said roller, heating means and cooling means connected for movement laterally of said jacket and tube to maintain said roller in pressure-exerting contact with the jacket to form the jacket.

3. Apparatus for use in applying a thin-walled stainless steel jacket to a thick-walled steel tube according to claim 1, and wherein said forming-tool is a roller journaled for rotation upon the carriage means and having a beveled peripheral portion tapering in the direction of longitudinal feed of said carriage means and a rounded peripheral forming-shoulder in trailing relation to said beveled portion.

4. Apparatus for applying a thin-walled metal jacket to a rigid generally cylindrical foundation body comprising: means to support and rotate the jacket and foundation body in unison upon the longitudinal axis of the foundation body and with the jacket telescoped over the foundation body, carriage means, means to feed the carriage means longitudinally of the jacket and foundation body while the latter rotate in unison, a forming-roller carried by the carriage means and engageable with the periphery of the jacket to apply constant inward-forming pressure thereto in a progressing spiral path on said jacket, a yoke connected to the carriage means and extending above and transversely of only a portion of the periphery of said jacket and foundation body, a substantially point source burner secured to said yoke for constantly directing heat forward and upon a small area of said jacket in a progressing spiral path in advance of said forming-roller, and a substantially point source nozzle connected to said yoke spaced longitudinally from said burner for constantly directing cold water upon a small area of said jacket in a progressing spiral path in trailing relation to said forming-roller, said burner, forming-roller, and nozzle arranged in lateral spaced relation on said yoke and being successively operative upon said jacket in a spiral path in the order named for progressively shrinking the jacket into intimate contact with the foundation body.

5. Apparatus for use in applying a thin-walled metal jacket in intimate contact with a thick-walled substantially cylindrical foundation body, comprising means to support and rotate said jacket and foundation body in unison while said jacket is telescoped over the foundation body with a minimum clearance between the jacket and body, carriage means movable lengthwise of the axis of rotation of the jacket and foundation body and parallel thereto, a support connected to said carriage means for movement therewith and extending partially around the jacket and foundation body in spaced relation, heating means connected to said support for directing heat on a small area of the jacket, a pressure applying means connected to said carriage means and extending into contact with a small area of the jacket for exerting inward-forming pressure thereto, cooling means connected to said support for directing cooling media on a small area of the jacket, said heating means, pressure applying means and cooling means being successively operative in the order named upon said jacket in a progressive spiral path for shrinking the jacket on the foundation body.

6. Apparatus for applying a thin-walled metal jacket to a rigid generally cylindrical foundation body as set forth in claim 4 in which said forming-roller is spaced longitudinally between said burner and said nozzle.

7. Apparatus as set forth in claim 6 in which said nozzle is connected laterally between said forming-roller and said burner.

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