Oct. 30, 1956 T. T. BUNCH 2,768,911

METHODS OF AND APPARATUS FOR APPLYING A STRIPE OF COATING MATERIAL TO AN ELONGATED ARTICLE

Filed Feb. 2, 1955 2 Sheets-Sheet 1

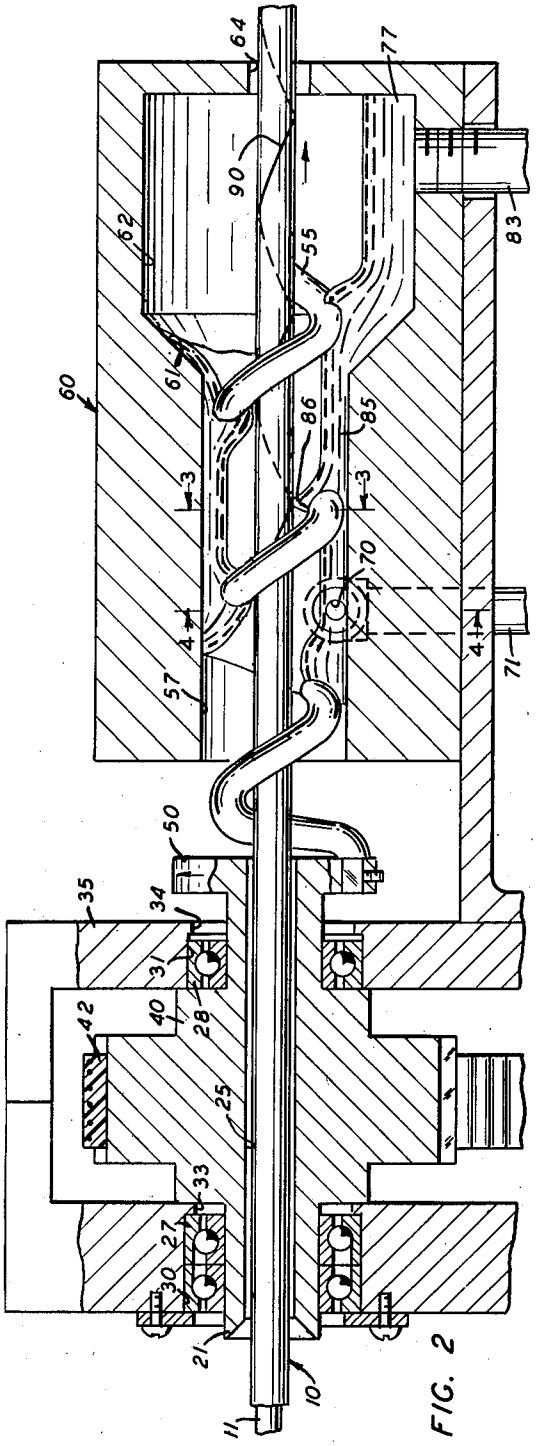


FIG. 2

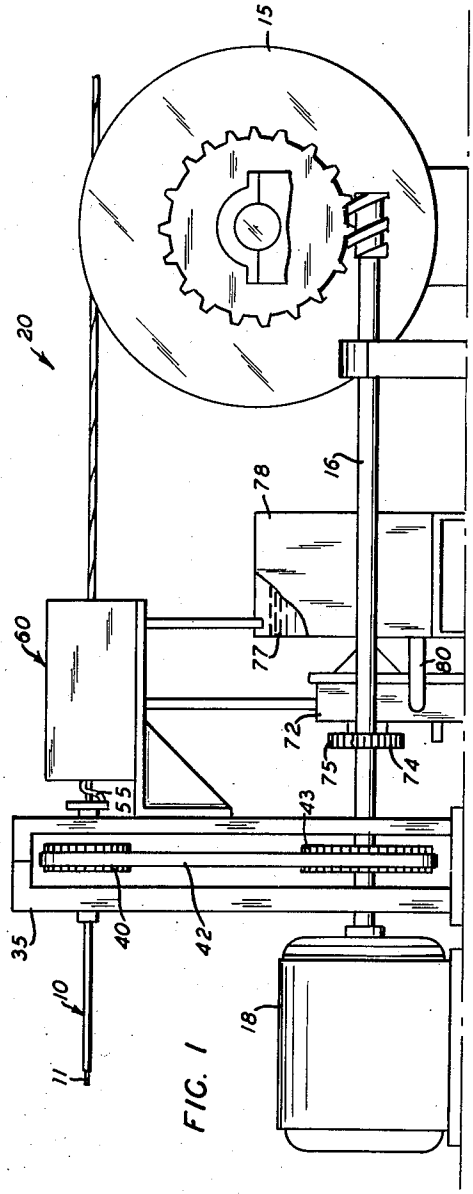


FIG. 1

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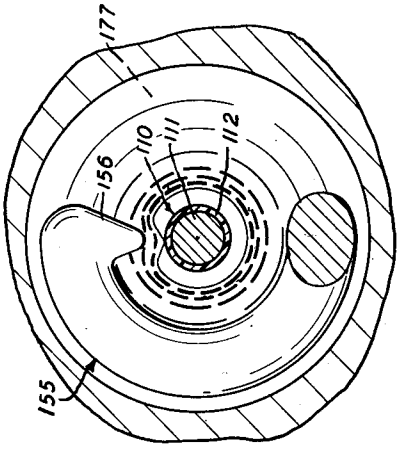


FIG. 6

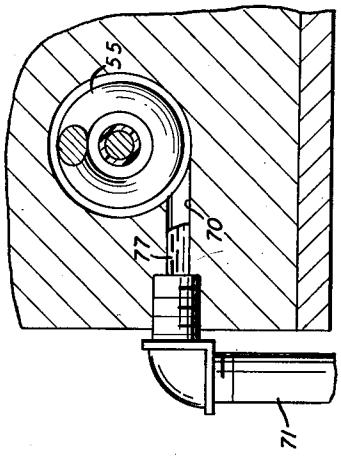


FIG. 4

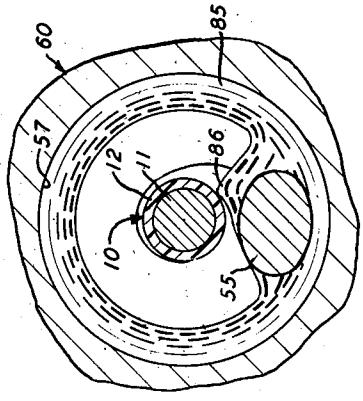


FIG. 3

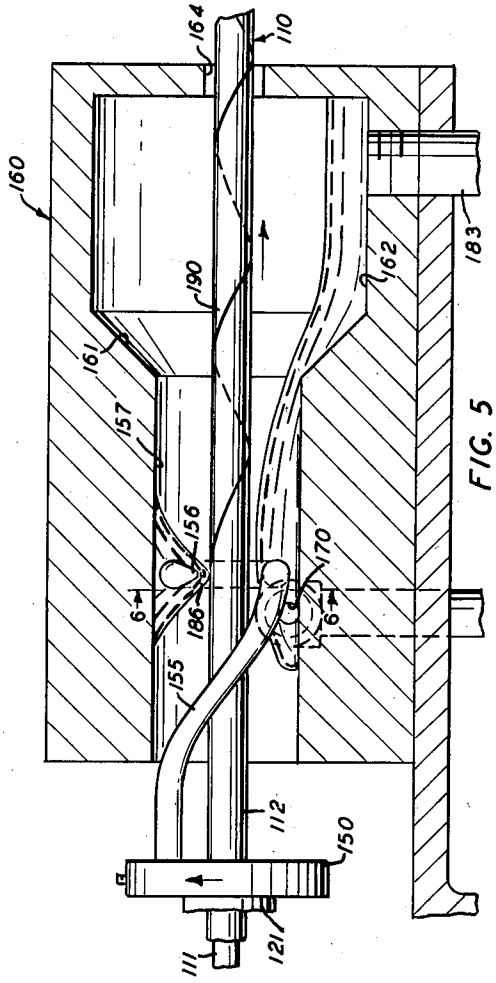


FIG. 5

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METHODS OF AND APPARATUS FOR APPLYING A STRIPE OF COATING MATERIAL TO AN ELONGATED ARTICLE

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10 Claims. (Cl. 117—212)

This invention relates to methods of and apparatus for applying a coating material to articles, and more particularly to methods of and apparatus for applying helical identification stripes to continuously advancing filamentary articles, such as insulated electrical conductors.

Some types of communication cables comprise a multiplicity of individually insulated electrical conductors, which must be provided with indicia for identifying particular individual conductors or special groups of conductors therein. One means of identifying the conductors involves the application of a helical stripe of paint of a contrasting color to the exterior surface of the insulation on the conductor. The helical stripe preferably should be applied immediately after the plastic insulation has been applied to the conductor in a conventional extrusion operation, while the plastic insulation is still soft due to the heat of the extrusion operation, so that the striping paint will penetrate the insulation and thereby mark the insulation permanently. Conventional apparatus, employing inking discs or pen points which contact the exterior surface of the plastic insulation to apply the helical stripe thereto, have been found unsatisfactory due to the fact that the inking discs and pen points tend to damage or distort the soft insulation.

It is an object of this invention to provide new and improved methods of and apparatus for applying coating material to articles.

Another object of this invention is to provide new and improved methods of and apparatus for applying helical identification stripes to continuously moving filamentary articles.

A method illustrating certain features of the invention may include the steps of moving an article relative to and in close proximity to the surface of a body of liquid coating material, and producing a swell on said surface immediately adjacent to the relatively moving article of such height that the crest thereof contacts the article.

Apparatus illustrating certain features of the invention may include means for holding a body of liquid coating material, means for moving an article relative to and in close proximity to the surface of said coating material, and means for producing a swell on the surface of said body of coating material immediately adjacent to the relatively moving article of sufficient height to cause the crest thereof to contact the article.

A complete understanding of the invention may be had from the following detailed description of methods and apparatus forming specific embodiments thereof, when read in conjunction with the appended drawings, in which:

Fig. 1 is a side elevation of apparatus forming one embodiment of the invention, with parts thereof broken away for clarity;

Fig. 2 is an enlarged, fragmentary, vertical section

taken along the longitudinal axis of a fluid holder forming a part of the apparatus shown in Fig. 1;

Fig. 3 is an enlarged, fragmentary, vertical section taken along line 3—3 of Fig. 2;

Fig. 4 is a fragmentary, vertical section taken along line 4—4 of Fig. 2;

Fig. 5 is a fragmentary, vertical section taken along the longitudinal axis of a fluid holder forming a part of an alternative embodiment of the invention, and

Fig. 6 is a vertical section taken along line 6—6 of Fig. 5.

Referring now to Fig. 1, a filamentary insulated conductor 10, such as copper wire 11 (Fig. 3) covered with a sheath 12 of plastic insulation, is continuously advanced longitudinally by a capstan 15 in the direction indicated by the arrow from a plastics extruder (not shown) in which the sheath of plastic insulation is applied. The capstan 15 is rotated continuously from a drive shaft 16 driven by an electric motor 18.

Positioned between the plastics extruder (not shown) and the capstan 15 is an applicator 20 for applying a helical stripe of a coloring fluid, such as ink or paint, to the exterior surface of the sheath 12. The applicator 20 includes a spindle 21 (Figs. 1 and 2) having a central, longitudinally extending bore 25 through which the insulated conductor 10 is advanced longitudinally in coaxial relation therewith. The spindle 21 is rotatably journaled at its ends in ball bearings 27 and 28 mounted in axially aligned annular recesses 30 and 31, respectively, adjoining circular apertures 33 and 34, respectively, formed in the vertical walls of a housing 35. Mounted on the intermediate portion of the outer periphery of the spindle 21 and keyed thereto for rotation therewith is a belt sprocket 40, which is operatively connected to the drive shaft 16 through a positive belt 42 and a belt sprocket 43.

The right hand end of the spindle 21, as viewed in Fig. 2, is provided with a flange 50 to which is secured fixedly, but removably, one end of a stripe applicator 55. The stripe applicator 55 is designed to surround the advancing insulated conductor 10 coaxially, and is made preferably from a relatively rigid, rod-like material, such as hard steel wire, or the like. The stripe applicator 55 is formed into a helix having a predetermined helix angle, the internal diameter of which helix is somewhat greater than the outer diameter of the sheath 12.

The stripe applicator 55 is received coaxially within a longitudinally extending, cylindrical chamber 57 formed in the left hand end, as viewed in Fig. 2, of a fluid holder 60. The right hand end of the chamber 57 communicates with a tapered counterbore 61 and a cylindrical chamber 62 having a diameter substantially greater than the diameter of the chamber 57. The right hand end of the chamber 62 is closed, except for a circular aperture 64, through which the longitudinally advancing insulated conductor 10 emerges. As shown in Fig. 2, the diameter of the chamber 57 is slightly larger than the external diameter of the stripe applicator 55 positioned therein.

A bore 70 extends through the wall of the stationary member 60 and communicates tangentially with the chamber 57. The bore 70 is conected by a pipe 71 to the discharge port of an adjustable, positive displacement, rotary pump 72 connected to the drive shaft 16 through gears 74 and 75. The drive shaft 16 is designed to operate the pump 72 continuously to deliver a coloring fluid, such as a colored marking ink 77, from a reservoir 78 to the chamber 57 in the fluid holder 60 at a predetermined constant flow rate. The reservoir 78 is connected to the intake port on the pump 72 by means of a pipe 80. A pipe 83 extends radially through the wall of the fluid holder 60 and communicates with the bottom of the chamber 62 formed therein. The pipe 83

is designed to return the marking ink **77** to the reservoir **78** as fast as it collects in the chamber **62**.

Operation

Let it be assumed that the motor **18** is energized and that the drive shaft **16** is driven at a predetermined speed to rotate the capstan **15** in a clockwise direction, as viewed in Fig. 1. The capstan **15** advances the insulated conductor **10** longitudinally from the plastics extruder (not shown) at a constant predetermined linear speed in the direction indicated by the arrow in Fig. 1. The advancing insulated conductor **10**, after emerging from the plastics extruder (not shown), passes axially through the bore **25** in the spindle **21**, axially through the stripe applicator **55** and the chamber **57** in the fluid holder **60**, and emerges through the circular aperture **64**.

The spindle **21** is rotatably driven at a constant predetermined speed to rotate the stripe applicator **55** continuously about its longitudinal axis within the chamber **57**. The rotational speed of the spindle **21**, by design, is such that the advance of the helix of the stripe applicator **55** is synchronized at or near the linear speed of the insulated conductor **10**.

In addition to driving the capstan **15** and the spindle **21**, the drive shaft **16** operates the pump **72** continuously at a predetermined rate, whereby the pump delivers a constant predetermined flow of the marking ink **77** to the chamber **57** through the bore **70**.

The continuously rotating stripe applicator **55** picks up the marking ink **77** and whirls it outwardly against and completely around the wall of the chamber **57** to form an advancing cylindrical shell **85** of marking ink inside the wall of the chamber. The thickness of the cylindrical shell **85** of the marking ink **77** may be varied by adjusting the rate of flow at which the marking ink is supplied to the chamber **57** by the pump **72**.

The frictional retardation of the advance of the cylindrical shell **85** of marking ink **77** along the wall of the chamber **57** cooperating with the continuously rotating, stripe applicator **55** creates a continuous helical wave **86** on the free surface of the cylindrical shell **85**. The helical wave **86** advances continuously from left to right, as viewed in Fig 2, at or near the speed of the longitudinally advancing insulated conductor **10**. The height of the crest of the helical wave **86** measured radially from the wall of the chamber **57**, is made by adjustment of the fluid supply flow such that the crest just touches the exterior surface of the sheath **12** of plastic insulation on the insulated conductor **10**, whereby a continuous helical stripe **90** of the marking ink **77** is applied thereto.

Assuming that the height of the crest of the traveling helical wave **86** of the marking ink **77** remains constant, the width of the stripe **90** applied to the exterior surface of the sheath of plastic insulation **12** is a minimum when the speed of advance of the traveling helical wave and the linear speed of the insulated wire are precisely matched. To increase the width of the helical stripe **90**, it is necessary to change the linear speed of the insulated conductor **10** or the rotational speed of the rotating spindle **21** slightly to cause the speed of advance of the traveling wave **86** of marking ink **77** to vary slightly from the synchronous speed.

The enlarged chamber **62** is designed to catch the excess marking ink **77** after it has advanced through the chamber **57** so that the ink may be carried back to the reservoir **78** through the pipe **83**. The surface tension properties of the marking ink **77** and its adherence to the wall of the chamber **57** are such as to prevent it from dripping on the insulated conductor **10** as the conductor passes through the chamber **57**, and the ink flows into and down the wall of the chamber **62** to the bottom thereof.

Alternative embodiment

Illustrated in Figs. 5 and 6 is an apparatus forming an alternative embodiment of the invention. This apparatus is similar in construction to the apparatus shown in Figs. 1 to 4, inclusive, except for the construction of the stripe applicator.

Referring now to Figs. 5 and 6, the apparatus includes a rotatably driven spindle **121**, identical in construction to the spindle **21** and provided similarly with a flange **150** at the right hand end thereof. Secured fixedly, but removably, to the flange **150** for rotation therewith is one end of a stripe applicator **155**. The stripe applicator **155** is made preferably from a relatively rigid, rod-like material, such as hard steel wire, or the like. The left hand portion of the stripe applicator **155**, as viewed in Fig. 5, is formed into a helix having an internal diameter somewhat greater than the outer diameter of a sheath **112** of insulation on an insulated conductor **110**.

The right hand end portion of the stripe applicator **155**, instead of being helical as in the case with the stripe applicator **55**, is formed into a semicircle, the plane of which is perpendicular to the longitudinal axis of the continuously advancing insulated conductor **110**. Both the helical portion and the semicircular end portion of the stripe applicator **155** are concentric with respect to the longitudinal axis of the continuously advancing insulated conductor **110**. The extremity of the semicircular end portion of the applicator **155** is provided with a nodule **156** which projects radially inwardly toward the exterior surface of the insulation **112** on the advancing insulated conductor **110**, but is spaced slightly therefrom and does not contact the surface.

The unsupported portion of the applicator **155** is received coaxially within a longitudinally extending, cylindrical chamber **157** formed in the left hand end, as viewed in Fig. 5, of a fluid holder **160**. The fluid holder **160** is identical in construction to the fluid holder **60** heretofore described, and is provided likewise with a tapered counterbore **161** and a cylindrical chamber **162** having a diameter substantially greater than that of the chamber **157**. The right hand end of the chamber **162** is closed, except for a small circular aperture **164** through which the advancing insulated conductor **110** emerges.

As in the first-mentioned embodiment of the invention, the diameter of the chamber **157** is slightly larger than the exterior diameter of the stripe applicator **155** positioned coaxially therein. A tangentially positioned bore **170** and an outlet pipe **183** communicate with the chamber **157** and the chamber **162**, respectively, to provide means for circulating a predetermined flow of a marking ink **177**, in a manner identical to that described previously in relation to the first-mentioned embodiment of the invention.

Operation of alternative embodiment

In the operation of this embodiment of the invention, the spindle **121** is rotated continuously at a predetermined speed to rotate the stripe applicator **155** about its longitudinal axis by drive means identical to that described in connection with the first-mentioned embodiment of the invention. Similarly a pump is operated continuously to deliver a constant predetermined flow of the marking ink **177** to the chamber **157** through the bore **170**.

The continuously rotating stripe applicator **155** picks up the marking ink **177** as it is delivered through the tangentially oriented bore **170** and whirls it outwardly and completely around the wall of the chamber **157** to form an advancing cylindrical shell **185** of marking on the wall of the chamber. As in the first-mentioned embodiment of the invention, the thickness of the cylindrical shell **185** of marking ink **177** is adjustable by adjusting the rate of flow at which the marking ink is supplied to

the chamber 157. The thickness of the cylindrical shell 185 of marking ink 177 must be sufficient to completely submerge the nodule 156 without permitting the free surface of the cylindrical shell 185 to contact the exterior surface of the insulation 112.

The nodule 156 moves in a circular path about the longitudinal axis of the advancing insulating conductor 110, and as it so moves it creates a small bulge 186 which projects radially inward from the free surface of the cylindrical shell 185 of marking ink 177. This bulge 186 travels in a circular path about the advancing insulated conductor 110, and the height of its crest, measured radially from the wall of the chamber 157, is adjusted so that its crest just touches the exterior surface of the insulation 112, whereby a continuous helical stripe 190 of the marking ink 177 is applied thereto. It will be understood that the bulge 186 of marking ink 177 does not advance longitudinally along the bore 157, but remains in the plane of the rotating nodule 156 on the extremity of the applicator 155.

The marking ink 177 forming the cylindrical shell on the wall of the chamber 157 flows continuously from left to right, as viewed in Fig. 4, into the enlarged chamber 162 where it is collected and recirculated through the pipe 183. The latter movement of the cylindrical shell 186 of marking ink 177 results from the impeller action of the helical left hand portion of the stripe applicator 155, as viewed in Fig. 5. The helix angle of the stripe 190 may be adjusted by adjusting either the speed of rotation of the spindle 121, or the linear speed of the continuously advancing conductor 110.

It will be understood that this invention is not limited to the application of helical stripes of ink to insulated conductors. It is readily apparent that the invention may be employed to apply stripes of ink or of other materials to various elongated articles having substantially circular cross sections, for example elongated rods, pipes and the like.

What is claimed is:

1. The method of applying indicia to the outer periphery of an elongated, generally cylindrical article, which comprises the steps of advancing such an article continuously in the direction of its length, forming a substantially cylindrical body of marking fluid concentrically about and having its free surface spaced from the advancing article, and producing a swell on the free surface of the cylindrical body of marking fluid immediately adjacent to the advancing article of such height that the crest thereof contacts the outer periphery of the article.

2. The method of applying a helical stripe to the outer periphery of an elongated, generally cylindrical article, which comprises the steps of advancing such an article continuously in the direction of its length at a predetermined linear speed, forming a substantially cylindrical body of a marking fluid concentrically about and having its free surface spaced from the advancing article, and propagating a continuous helical wave on the free surface of the cylindrical body of marking fluid immediately adjacent to the advancing article, which advances at a speed substantially equal to the linear speed of the article and is of a height such that the crest thereof contacts the outer periphery of the article.

3. The method of applying a helical stripe to an elongated, generally cylindrical article, which comprises the steps of advancing such an article continuously in the direction of its length, forming a substantially cylindrical body of marking fluid concentrically about and having its free surface spaced from the advancing article, producing a bulge on the free surface of said body immediately adjacent to the advancing article of a height such that the crest thereof contacts the outer periphery of the continuously advancing article, and simultaneously causing the bulge to rotate in an orbital path about the advancing article whereby a helical stripe of the marking fluid is applied thereto.

4. Apparatus for applying indicia to the outer periphery of an elongated, generally cylindrical article, which comprises a member provided with a cylindrical chamber, means for advancing such an article continuously through the chamber in substantially concentric alignment therewith, the diameter of the chamber being substantially greater than the outer diameter of the article, means for forming a cylindrical shell of marking fluid on the wall of the chamber with the free surface of said shell of marking fluid spaced from the outer periphery of the article, and means for producing a swell on the surface of the shell of marking fluid of such height that the crest thereof contacts the outer periphery of the article.

5. Apparatus for applying a helical stripe of marking fluid to the outer periphery of an elongated generally cylindrical article, which comprises a member provided with a longitudinally extending cylindrical chamber, means for advancing such an article continuously through the chamber in substantially concentric alignment therewith, the diameter of the chamber being substantially greater than the outer diameter of the article, means for forming a cylindrical shell of marking fluid on the wall of the chamber with the free surface of said shell of marking fluid being spaced from the outer periphery of the article, and means for propagating a helical wave on the surface of the shell of marking fluid, said wave traveling in the direction of the advance of the article at a speed substantially equal to the linear speed of the article and having a height such that the crest thereof contacts the outer periphery of the article.

6. Apparatus for applying a helical stripe of marking fluid to the outer periphery of an elongated generally cylindrical article, which comprises a member provided with a longitudinally extending cylindrical chamber, means for advancing such an article continuously through the chamber in substantially concentric alignment therewith and at a predetermined linear speed, the diameter of the chamber being substantially greater than the outer diameter of the article, means for supplying marking fluid to the interior of the chamber, a helical element mounted for rotation concentrically within the chamber between the wall of the chamber and the outer periphery of the advancing article, and means for rotating the helical element at a predetermined speed whereby the marking fluid supplied to the chamber is formed into a cylindrical shell on the wall of the chamber with the free surface of said shell spaced from the outer periphery of the article, said helical element being submerged in the cylindrical shell of marking fluid and propagating a helical wave on the free surface thereof which travels in the direction of the advance of the article at a speed substantially equal to the linear speed of the article and has a height such that the crest thereof contacts the outer periphery of the article.

7. Apparatus for applying a helical stripe of marking fluid to the outer periphery of an elongated, generally cylindrical article, which comprises a body member provided with a longitudinally extending cylindrical chamber, means for advancing such an article continuously through the chamber in substantially concentric alignment therewith and at a predetermined linear speed, the diameter of the chamber being substantially greater than the outer diameter of the article, means for supplying marking fluid to the interior of the chamber, a helically-shaped, rod-like member mounted for rotation concentrically within the chamber between the wall of the chamber and the outer periphery of the advancing article, and means for rotating the rod-like member at a predetermined speed whereby the marking fluid supplied to the chamber is formed into a cylindrical shell on the wall of the chamber, said rod-like member being submerged in the cylindrical shell of marking fluid and propagating a helical wave on the surface thereof which travels in the direction of the advance of the article at a

speed substantially equal to the linear speed of the article and has a height such that the crest thereof contacts the outer periphery of the article.

8. Apparatus for applying a helical stripe of marking fluid to the outer periphery of an elongated, generally cylindrical article, which comprises a member provided with a longitudinally extending cylindrical chamber, means for advancing such an article continuously through the chamber in substantially concentric alignment therewith, the diameter of the chamber being substantially greater than the outer diameter of the article, means for forming a cylindrical shell of marking fluid on the wall of the chamber, the free surface of said shell of marking fluid being spaced from the outer periphery of the article, and means for producing a bulge on the surface of the shell of marking fluid, which travels in an orbital path in a plane substantially transverse to the longitudinal axis of the advancing article and is of a height such that the crest thereof contacts the outer periphery of the article.

9. Apparatus for applying a helical stripe of marking fluid to the outer periphery of an elongated, generally cylindrical article, which comprises a member provided with a longitudinally extending cylindrical chamber, means for advancing such an article continuously through the chamber in substantially concentric alignment therewith, the diameter of the chamber being substantially greater than the outer diameter of the article, means for forming a cylindrical shell of marking fluid on the wall of the chamber, the free surface of said shell of marking fluid being spaced from the outer periphery of the article, and a continuously rotating agitator provided with an inwardly projecting protuberance submerged in the shell of marking fluid for producing a bulge on the surface of the shell of marking fluid, said bulge rotating in an orbital path in a plane substantially transverse to the longitudinal axis of the advancing article and having a height such that the crest thereof contacts the outer periphery of the article.

10. Apparatus for applying a helical stripe of marking fluid to the outer periphery of an elongated generally cylindrical article, which comprises a member provided with a longitudinally extending cylindrical chamber, means for advancing such an article continuously through the chamber in substantially concentric alignment therewith and at a predetermined linear speed, the diameter of the chamber being substantially greater than the outer diameter of the the article, an agitator formed from a stiff rod-like material and provided with a helically-shaped initial portion and a semicircular end portion, said agitator being mounted for rotation concentrically within the chamber between the wall thereof and the outer periphery of the advancing article, means for rotating the agitator continuously at a predetermined speed, means for supplying marking fluid to the interior of the chamber at a predetermined rate of flow, whereby the marking fluid is formed through centrifugal force into a substantially cylindrical shell having a depth sufficient to submerge the agitator and having its free surface spaced from the outer periphery of the article, and an inwardly projecting protuberance formed on the semicircular end portion of the agitator, said protuberance being completely submerged in the shell of marking fluid and designed to produce on the free surface of said shell a bulge of a height such that the crest thereof contacts the outer periphery of the advancing article, which rotates in an orbital path about the article so as to apply a helical stripe of marking fluid thereto.

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