Dec. 25, 1962 A. M. HILL 3,070,065

METHOD AND APPARATUS FOR COATING PIPES

Filed June 1, 1959

5 Sheets-Sheet 1

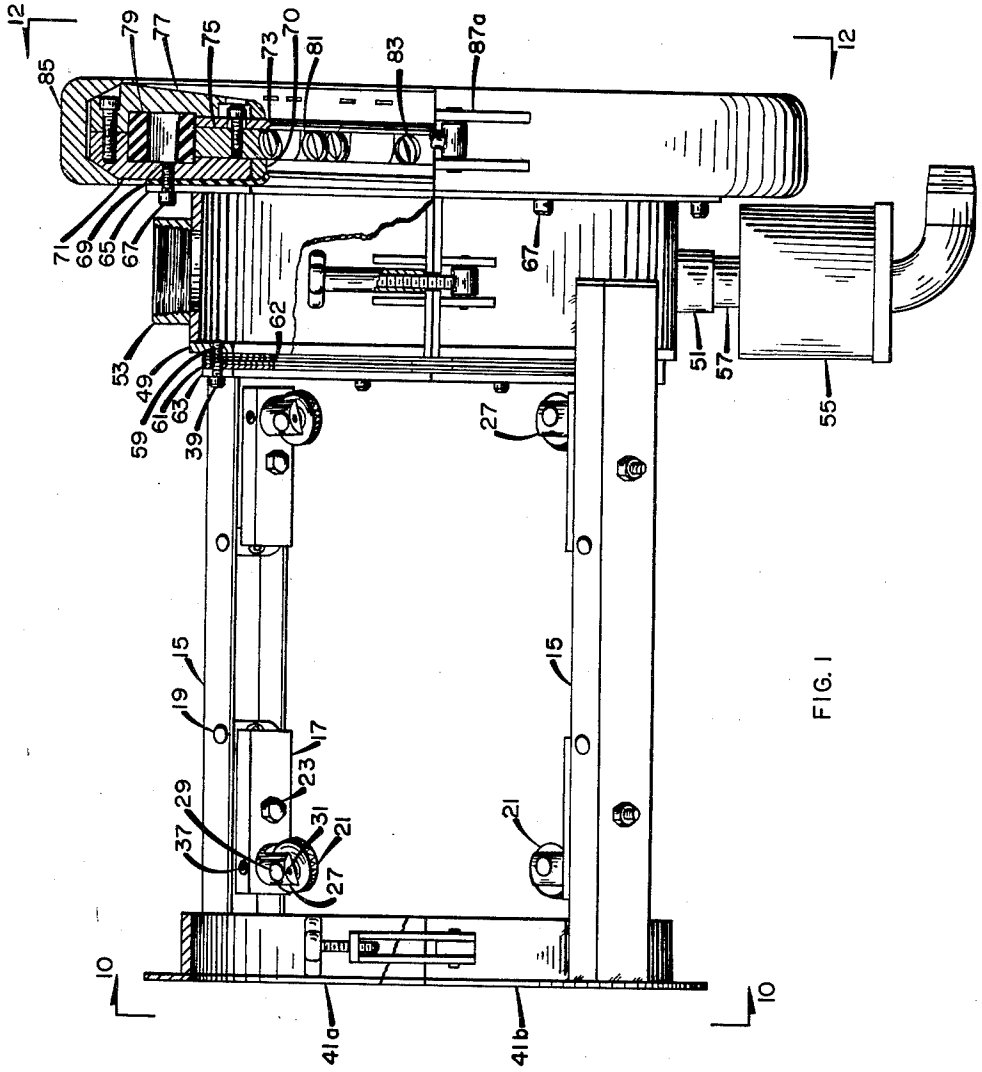


FIG. 1

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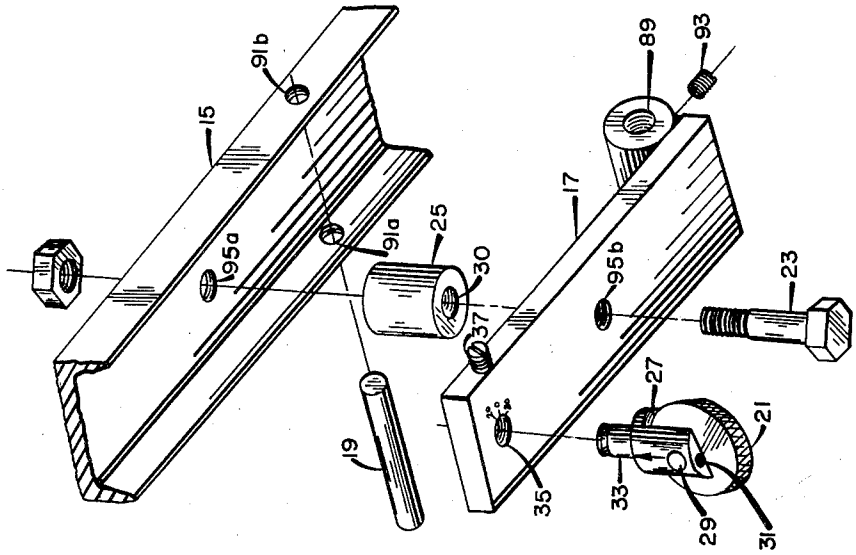


FIG. 3

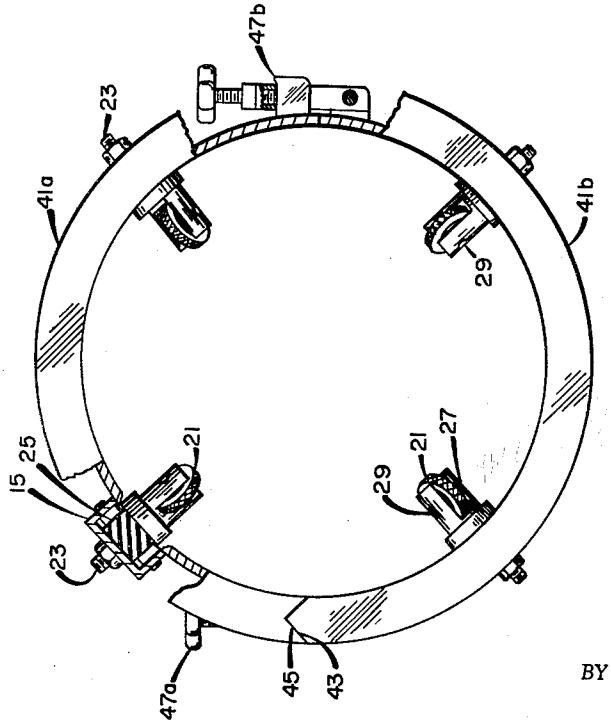


FIG. 2

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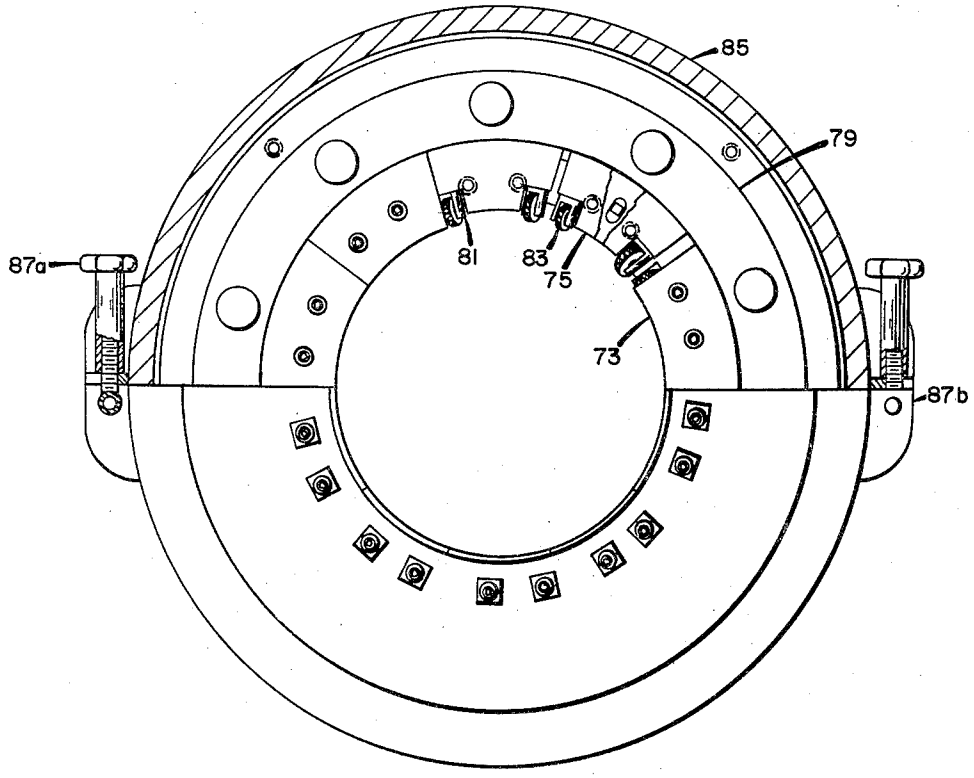


FIG. 4

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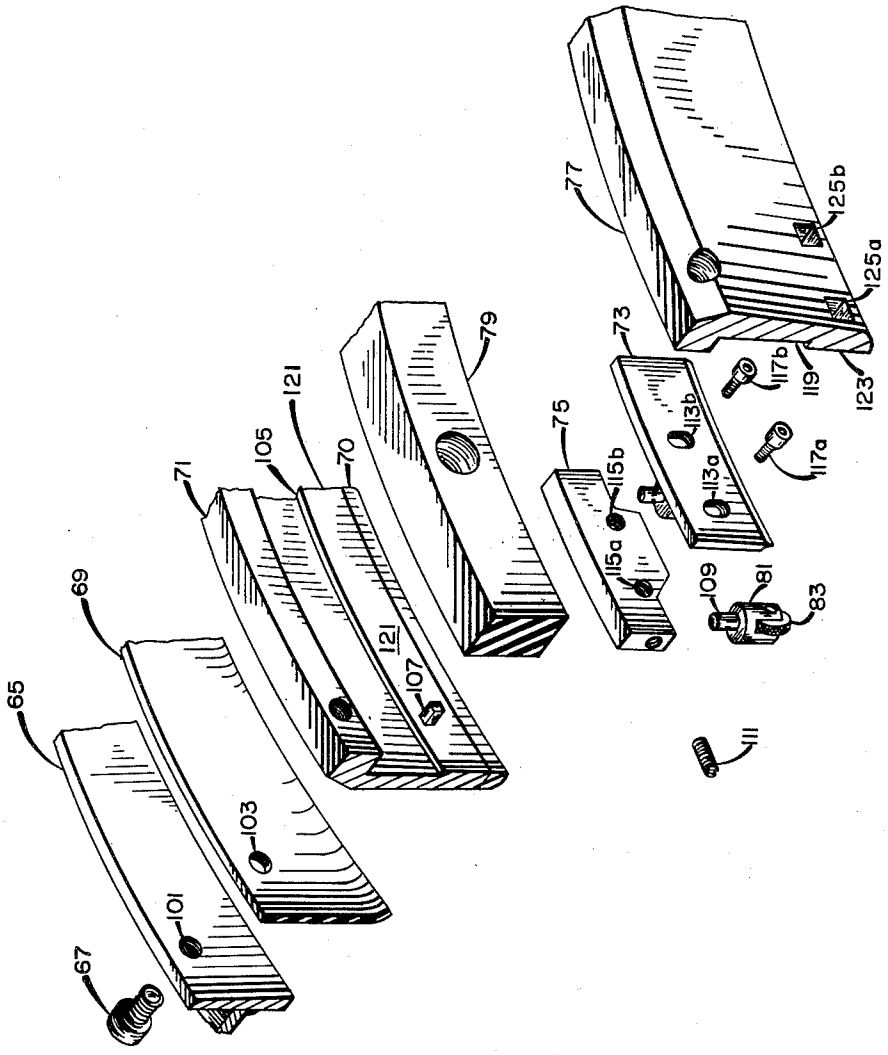


FIG. 5

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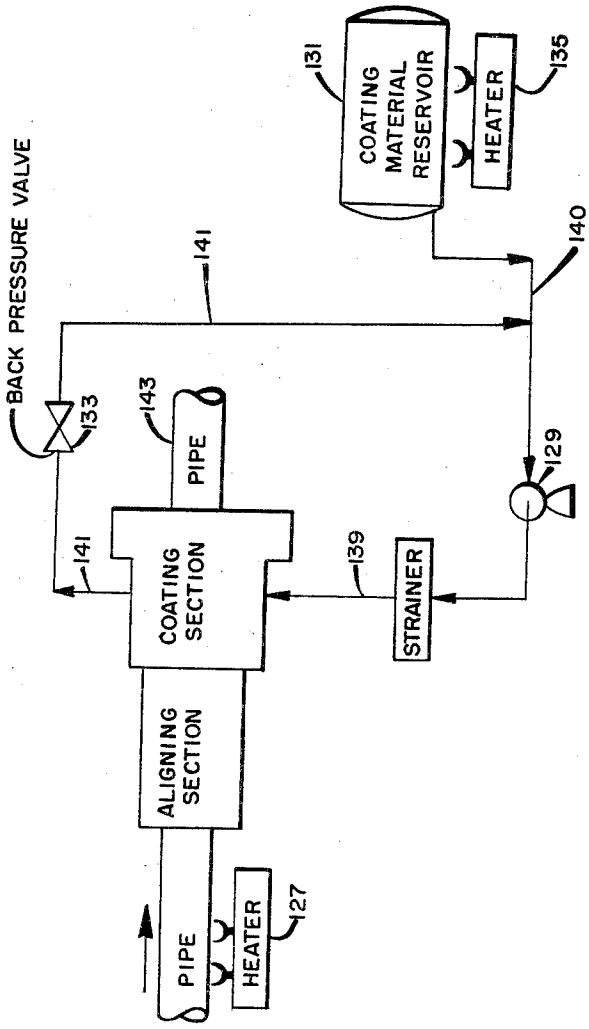


FIG. 6

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METHOD AND APPARATUS FOR COATING PIPES

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5 Claims. (Cl. 118—409)

This invention relates to a method and to an apparatus for applying a protective coating to the exterior of a pipe and more particularly to a method and to an apparatus for applying liquid coating material to a pipe which coating material subsequently hardens to form a protective coating about the pipe.

The invention will be described and illustrated as a method and as an apparatus for applying a coating material such as a coal tar-epoxy resin to a pipe. This type coating material is normally applied to the pipe as a viscous liquid. The coating material normally contains a catalyst. The catalyst and the temperature of the coating material determine the increment of time (pot life) necessary for the coating material to harden or cure. While the invention will be described as relating to the application of a particular type coating, it will be understood that the invention is of such breadth as to include the application of other coating materials, such as, for example, mastic materials, thermo-setting materials, and the like. It will be further understood that the coating material may form the protective coating per se or the coating material may form a portion of the protective coating. That is, the protective coating may include one or more layers of coating material and it may include one or more layers of wrapping material.

The apparatus of this invention may be briefly described as a framework including an aligning section and a coating section. The aligning section positions the axis of the pipe concentric with the axis of the coating section and allows the pipe to rotate as the pipe progresses through the coating section. The coating section applies the coating material, compresses the coating material against the pipe and subsequently removes the excess coating material and thus leaves a uniformly thick coating about the pipe.

It is therefore an object of this invention to provide a method and an apparatus to apply a coating material to a pipe such that the final protective coating is uniform and is continuous about the exterior of the pipe. A further object of this invention is to provide a novel aligning section which will align the pipe concentric with the coating section and which will allow the pipe to rotate as the pipe moves through the coating section. It is a still further object of this invention to provide a novel means to apply the coating material to the pipe such that the protective coating formed by the coating material is free of entrained air bubbles. Another object of this invention is to provide a novel means to distribute the coating material about the exterior of the pipe and to pack this material against the pipe. An additional object of this invention is to provide a novel doctoring means to remove the excess coating material from the pipe thus to leave a uniform coating on the pipe.

The present invention will be further illustrated by reference to the drawing in which:

FIGURE 1 is a side view, partially in cross-section, showing the pipe coating apparatus;

FIGURE 2 is an end view, partially in cross-section, taken along lines 10—10 of FIGURE 1;

FIGURE 3 is an exploded view of the aligning section roller assembly;

FIGURE 4 is an end view, partially in cross-section, of the coating section head taken along lines 12—12 of FIGURE 1;

FIGURE 5 is an exploded view partially in cross-section, illustrating how various elements within the pipe coating head fit with respect to each other; and

FIGURE 6 is a schematic representation of an apparatus for applying a protective coating material to a pipe line.

Referring now to the drawing, and particularly to FIGURE 1, in which identical numerals designate identical parts, the aligning section includes guide frame bars 15. Each guide frame bar 15 includes one or more guide roller assemblies. The guide roller assembly includes a roller arm 17, an arm pivot pin 19, rollers 21, anchor bolt 23, arm actuator 25 (FIGURE 3), and roller fork 27. The roller 21 is mounted within the roller fork 27 by means of a roller axle 29. The roller axle 29 is held within the roller fork by means of axle set screw 31. The roller fork 27 includes a shank 33 (FIGURE 3), which fits within a shank hole 35 in the roller arm 17. An orientation set screw 37 is located within the roller arm 17. The orientation set screw is adapted to protrude into the shank hole 35 and to engage the shank 33. The anchor bolt 23 extends through the roller arm 17 and guide frame bar 15. This bolt positions the arm actuator 25 between the roller arm 17 and the guide frame bar 15. The arm actuator 25 is constructed of a resilient material such as, for example, rubber. The aligning section is adapted to connect to the coating section by bolts 39 (FIGURE 1). The aligning section is fabricated with upper half 41*a* and a lower half 41*b*. The lower half 41*b* has an end 43 (FIGURE 2) engageable with an end 45 of the upper half 41*a*. The two halves are held together by latch means 47*a* and 47*b*.

The chamber 49 (FIGURE 1) includes a fluid inlet coupling 51 and a fluid exit coupling 53. A strainer 55 is connected to the fluid inlet coupling 51 by pipe 57. The chamber 49 has holes 59 for receipt of bolts 39. A sealing gasket 61 is positioned between the sealing gasket clamp ring 63 and the chamber 49. The sealing gasket 61 may comprise a plurality of individual gaskets. The inner edge 62 of the sealing gasket 61 is adapted to form a fluid-tight fit about the exterior of the pipe. The chamber 49 has a flange 65 which is adapted to reecive cap screws 67. A wiper ring 69 is positioned between the flange 65 and the back plate 71. The wiper ring, in combination with the washer 70, form a frusto-conical chamber about the exterior of the pipe. The segment 75 and segment blade 73 are adapted to slide radially inward and radially outward with respect to back plate 71 and face plate 77. The resilient member 79 is adapted to urge the segment 75 and segment blade 73 radially inward. Each segment 75 includes two segment roller forks 81 and two segment rollers 83. The clamp ring 85 fits around the outer edge of the back plate 71 and face plate 77. The clamp ring is held in place by clamp ring latches 87*a* and 87*b*.

A detailed and disassembled view of the roller guide assembly is shown in FIGURE 3. The guide roller assembly may be connected to the guide frame bar 15 by positioning the roller arm 17 within the guide frame bar 15 such that the roller arm hole 89 is aligned with the arm pivot holes 91*a* and 91*b*. The arm pivot pin 19 is then positioned within the roller arm hole 89 such that the arm pivot pin 19 protrudes into or through the arm pivot holes 91*a* and 91*b*. The arm pivot pin set screw 93 is then screwed into the roller arm 17 until the pivot pin set screw 93 engages the arm pivot pin. The arm actuator 25 is positioned between the roller arm 17 and the guide frame bar 15 such that the arm actuator hole 30 is aligned with the anchor bolt holes 95*a* and 95*b*. The anchor bolt 23 confines the roller arm 17 with

respect to the guide frame bar 15. The roller fork 27 has a shank 33 which fits within the shank hole 35. The roller may be oriented by placing the shank 33 within the shank hole 35 and by tightening the orientation set screw 37. Indicia means may be placed on the guide fork 27 and on the roller arm 17 to indicate the orientation of the guide roller with respect to the roller arm. The arm actuator 25 has been shown as a rubber cylinder. Obviously many equivalent materials or many equivalent devices as, for example, a torus spring, a leaf spring, or the like may be used.

The assembly of the wiper ring 69, back plate 71, segment blade 73, segment 75, resilient member 79, face plate 77 and segment rollers 83, is shown in FIGURE 5. The flange 65 is attached to, and may form a part of, the chamber 49, The cap screw 67 is adapted to pass through the flange hole 101, the wiper ring hole 103, and to thread into a hole on the back side of the back plate 71 (see FIGURE 1). The cap screws 67 position the wiper ring and the back plate with respect to the chassis of the pipe coating apparatus. The resilient member 79 fits within the back plate groove 105. The segment 75 is placed over the guide 107. This guide fits within a groove in the back side of the segment 75 (not shown). The guide 107 within the groove in the segment 75 restricts the movement of the segment 75 to inward and outward movement along a radial path. The segment roller fork 81 includes a segment roller shank 109 which fits within a segment roller hole (not shown) in the segment 75. The segment roller fork is oriented by placing the segment roller shank 109 within the segment roller hole in the segment 75 and tightening the segment set screw 111. The segment blade 73 has segment blade holes 113*a* and 113*b* which are preferably oblong in shape. These segment blade holes 113*a* and 113*b* are aligned with segment holes 115*a* and 115*b*. The segment cap screws 117*a* and 117*b* fix the segment blade 73 with respect to the segment 75. The face plate 77 confines the resilient member 79 within the back plate groove 105 and the face plate groove 119. The face plate also confines the segment blade 73 and segment 75 between the back plate face 121 and the face plate face 123.

The pipe coating apparatus described herein has solved many problems associated with the application of epoxy-resin coatings to the exterior of pipe lines, some of which are as follows:

The Coating Sag Problem

The coating sag problem is a condition wherein the coating material tends to flow to the bottom of the pipe after the coating material is applied to the pipe and prior to the time the coating material has acquired its final set. The aligning section of the pipe coating apparatus is adapted to allow the pipe to rotate as the pipe emerges from the coating section. The solution to this coating sag problem involves more than simply imparting a rotary motion to the pipe as the pipe emerges from the coating section. The tendency of the coating material to sag after the pipe leaves the coating section depends on numerous variables, such as for example, the viscosity of the coating material and the pot life of the coating material. The coating sag problem is mitigated as the coating material viscosity increases and as the coating material pot life decreases. A solution to this problem requires apparatus which can be adapted to allow the pipe to pass through the aligning section and to pass through the coating section at a predetermined rotational speed. If the coating sag problem is negligible, the pipe may be passed through the coating apparatus without imparting a rotary motion to the pipe. Conversely, if the coating sag problem is severe, the rotary motion may be coordinated with the linear motion as the pipe emerges from the coating section. The aligning section rollers 21 may be oriented to meet any particular coating sag problem. The aligning section rollers may be oriented to allow the pipe to be rotated in a clockwise or in a counterclockwise direction.

The Coating Fish Eye Problem

The coating fish eye problem involves the formation of gas bubbles within the coating material which remain within the thin layer of coating material until after the pipe leaves the coating section. The coating section described herein has minimized this problem by a novel combination of elements. The coating section is constructed with a coating material inlet pipe 139 (FIGURE 6) and a coating material exit pipe 141. The coating material inlet pipe 139 is located on the bottom of the coating section. The coating material enters the coating section from the bottom side thereof and any entrapped gas tends to rise within the coating section. The coating material pump 129 may supply more coating material to the coating section than can be applied to the pipe exterior. The excess coating material, along with any entrapped gas, flows out of the coating section by way of the exit pipe 141. This reduces the possibility of gas being entrapped within the coating material that is applied to the pipe. In addition to this feature, a back pressure valve 133 is placed on the exist line 141. This valve maintains a positive pressure within the coating section. This pressure forces the coating material into intimate contact with the pipe exterior. The coating section also includes a frusto-conical shaped wiper ring 69 (FIGURE 1). This wiper rings 69 performs two functions. The wiper ring removes a portion of the excess coating material from the exterior of the pipe while it presses the remaining coating material against the pipe.

The Coating Drag Problem

Experience has indicated that occasionally a particle of foreign material will stick beneath the segment blade 73 and drag in the finished coating. Adjustment holes 125*a* and 125*b* (FIGURE 5) have been provided in the face plate 77 which allows the operator to position a pry bar (screw driver) within this hole and lift the one particular segment blade to allow the foreign particle to pass through the segmented orifice.

The Uniform Coating Problem

This problem involves the application of a coating which has a uniform thickness along and about the pipe exterior. The coating applying section includes a plurality of segment blades 73 which form a doctoring edge (orifice) through which the pipe passes. The doctoring edge applies the finishing touch to the coating material. A segmented doctoring edge for pipe coating apparatus is not new. The novelty of the disclosed doctoring edge resides in a provision for moving the individual segment blades 73 in a radial path as the blades move inward and outward while simultaneously actuating all the blades with a common means. The segment 75 is attached directly to the segment blade 73 and thus provides for a definite and exact dimension between the pipe and the doctoring edge of the segment blade. The segment blade 73 moves in unison with the segment 75. The segment rollers 83 are adapted to be rotated with respect to the segment 75 and are preferably rotated and set at the same angle with respect to the longitudinal axis of the coating apparatus as the aligning section rollers 21. This feature allows the segment 75 and segment blade 73 to move radially inward and radially outward without binding against each other or against the radial spline guide 107 as would be the case if the segment rollers 83 were aligned with the longitudinal axis of the pipe.

A much improved protective coating is obtained by using the method as illustrated in FIGURE 6. A pipe heater 127 is used to preheat the pipe 143. The pipe 143 enters the aligning section wherein the pipe is cen-

tered with respect to the coating section. The pipe **143** then enters the coating section. The coating material pump **129** pumps coating material from the coating material reservoir **131** through a strainer and into the coating section. The coating material pump **129** preferably pumps more coating material to the coating section than can be applied to the pipe **143**. The excess coating material is forced out the fluid exit line **141**. The back pressure valve **133** maintains a constant pressure within the coating section. The excess coating material passes through the back pressure valve **133** and returns to the section line **140** of the coating material pump **129**. A reservoir heater **135** is used to maintain the temperature of the coating material at an optimum temperature.

While a limited number of embodiments of the invention have been shown and described herein, it is to be understood that the illustrations and description are merely illustrative of the invention, which is not limited to the specific embodiments but encompasses all modifications and equivalents falling within the scope of the appended claims.

I claim:

1. A segmented doctoring edge orifice for applying a uniform layer of a liquid material to the exterior surface of a pipe comprising a plurality of segments, a plurality of roller forks rotatably mounted within said segments, means to lock said roller forks with respect to said segments at a predetermined degree of rotation, a roller mounted within each of said roller forks, a segment blade connected to each of said segments, said rollers being arranged to engage said pipe in advance of said segment blades, guide means supporting said segments such that said segments move inward and outward with respect to said pipe along a radial path, said segments being positioned relative to said pipe solely by the engagement of said rollers with said pipe and a common resilient means connected to the outer edge of said segments for moving said segments inward with respect to said pipe.

2. A segmented doctoring edge orifice for applying a uniform layer of a liquid material to the exterior of a pipe comprising a plurality of segments, roller means engageable with said pipe connected to each of said segments, a segment blade connected to each of said segments and positioned to spread said layer of liquid material after said pipe has passed said roller means, guide means adapted to receive said segments to form an orifice and allow said segments to move inward and outward along a radial path, said segment blades being held a preset distance from said pipe solely by said roller means and a common resilient means in said guide means arranged to urge said segments inward.

3. A doctoring orifice for applying a liquid material to the exterior surface of a pipe comprising a plurality of segments having rollers thereon for engaging said pipe, a segment blade having a smooth doctoring edge thereon connected to each of said segments such that said doctoring edge is adjacent each of said rollers and is held a predetermined distance from said pipe solely by means of said rollers, said rollers being arranged to engage said pipe in advance of said doctoring edges, a back plate connected to a face plate forming a band having a slot in the inner face thereof, said slot adapted to slidably hold said segments and said segment blades and guide said segments and said segment blades along a radial path, and resilient means acting against said band and acting against said segments and said segment blades for moving said segments and said segment blades radially inward.

4. A doctoring orifice for applying a liquid material to the exterior surface of a pipe comprising a plurality of segments having rollers thereon for engaging said pipe, a segment blade having a doctoring edge thereon connected to each of said segments such that said doctoring edge is adjacent said rollers and is held a predetermined distance from said pipe solely by means of said rollers, said rollers being arranged to engage said pipe in advance of said doctoring edges, a back plate connected to a face plate forming a chamber to operatively hold said segments and said segment blades, and resilient means connected to said chamber and connected to said segments for moving said segments radially inward.

5. An apparatus for applying a uniform layer of a viscous liquid to the exterior of a pipe including a pipe aligning section, a coating section attached to said aligning section, a chamber in said coating section, a pipe inlet and outlet in said chamber in axial alignment with said pipe aligning section, a gasket in said inlet adapted to form a fluid-type seal about said pipe, a wiper ring in said outlet adapted to spread a layer of said viscous liquid on said pipe as said pipe emerges from said chamber, a circular doctoring edge connected to said chamber adjacent said outlet, said doctoring edge comprising a plurality of segments having a smooth curved edge, a circular housing for said segments, resilient means in said housing arranged to urge said segments inward, rollers attached to said segments, and arranged to engage said pipe and position said doctoring edge in relation to said pipe, said rollers being positioned to engage said pipe between said wiper ring and said doctoring edge, a coating liquid inlet at the bottom of said chamber and a fluid outlet at the top of said chamber.

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