

March 23, 1937.

K. T. POTTHOFF

2,074,935

APPARATUS FOR COATING PIPES

Filed Nov. 18, 1930

4 Sheets-Sheet 1

Fig. 1.



Fig. 2.



Fig. 3.



Fig. 4.

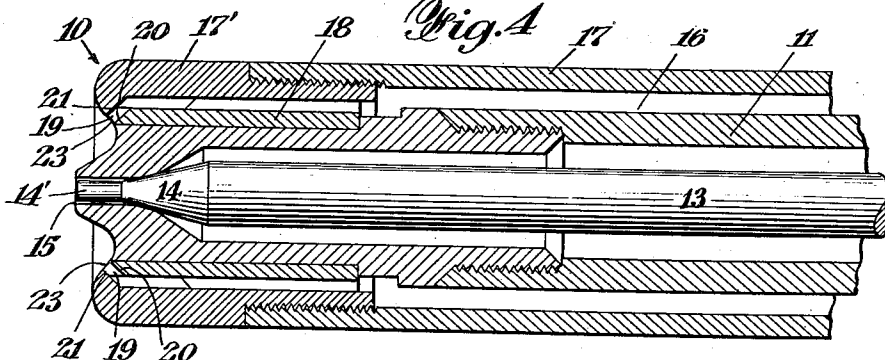


Fig. 5.

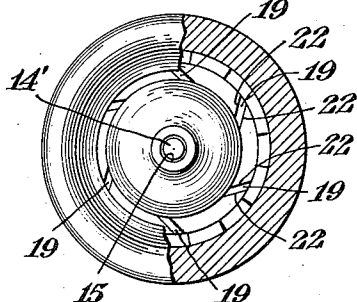
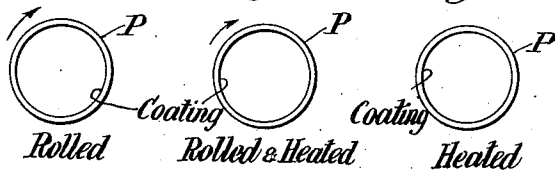


Fig. 6.

Fig. 7.

Fig. 8.



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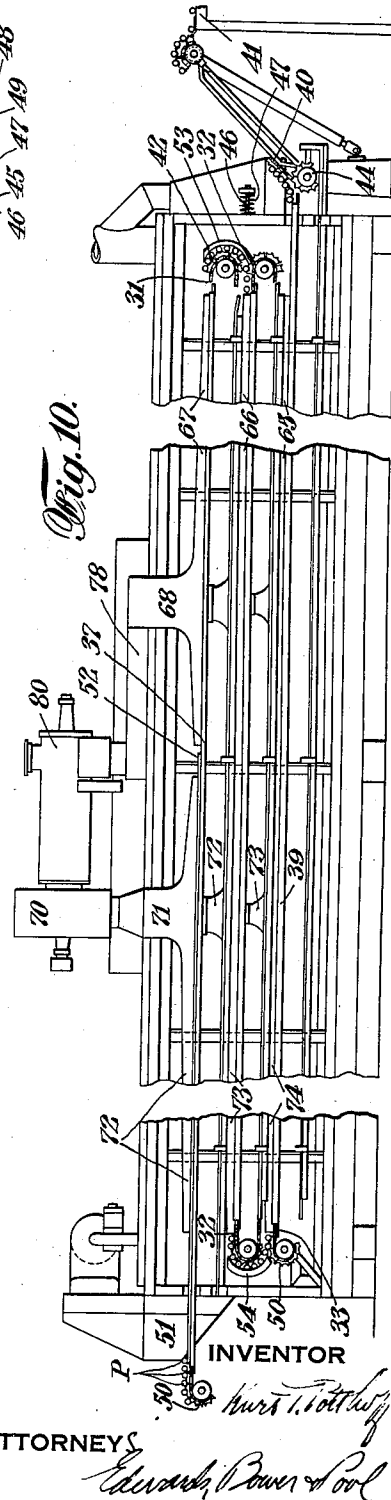
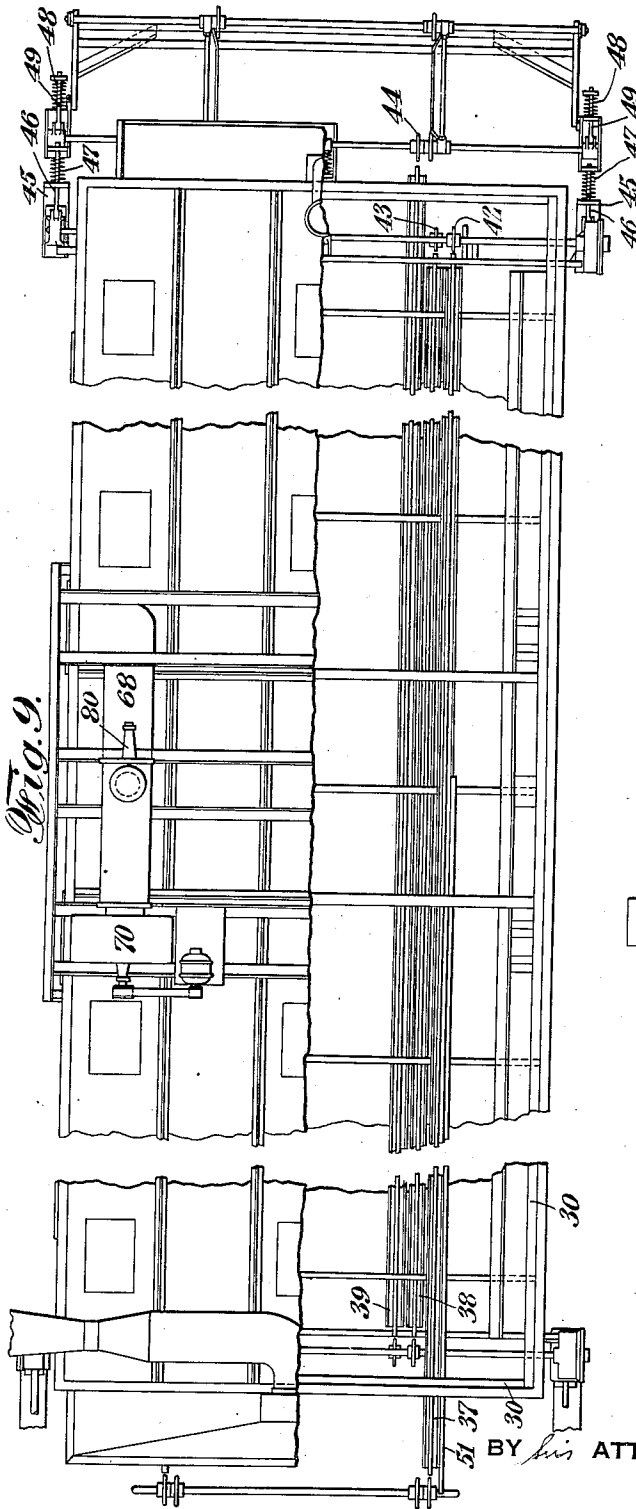
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4 Sheets-Sheet 2



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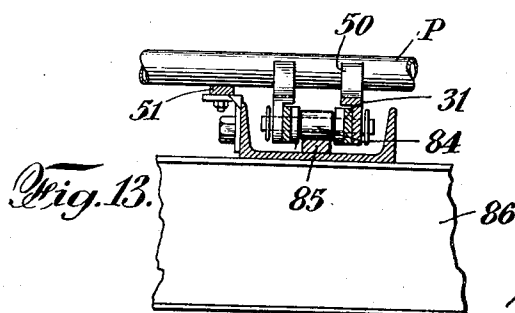
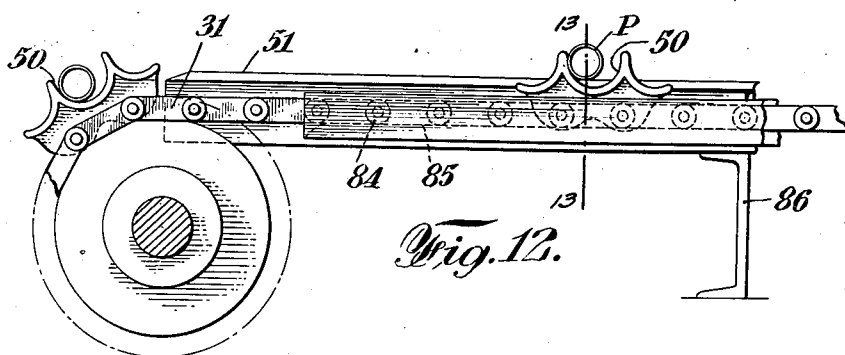
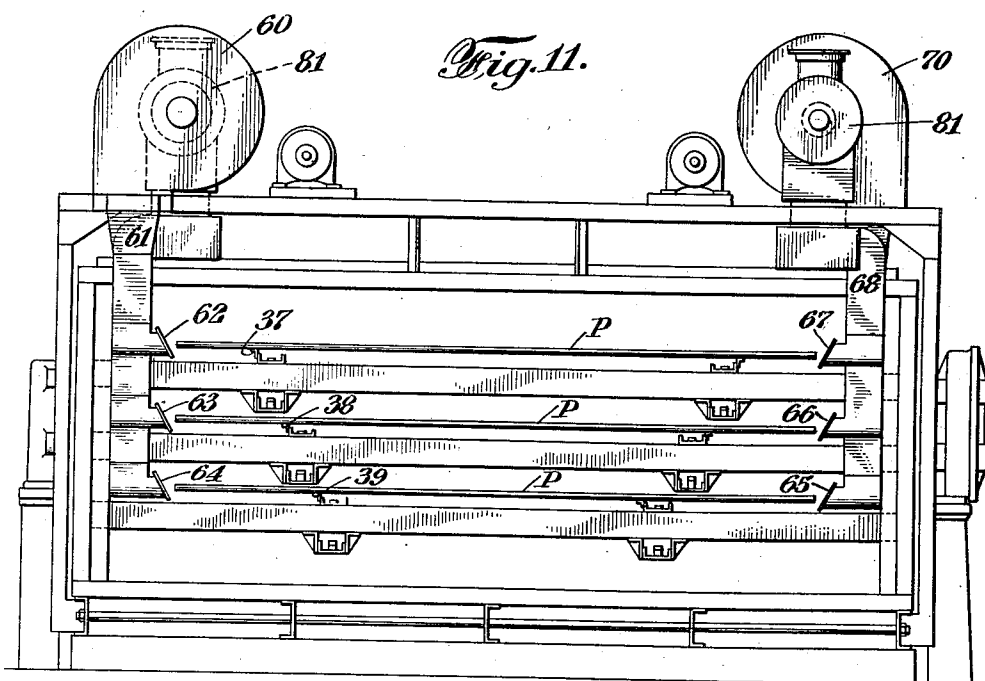
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APPARATUS FOR COATING PIPES

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4 Sheets-Sheet 3

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APPARATUS FOR COATING PIPES

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4 Sheets-Sheet 4

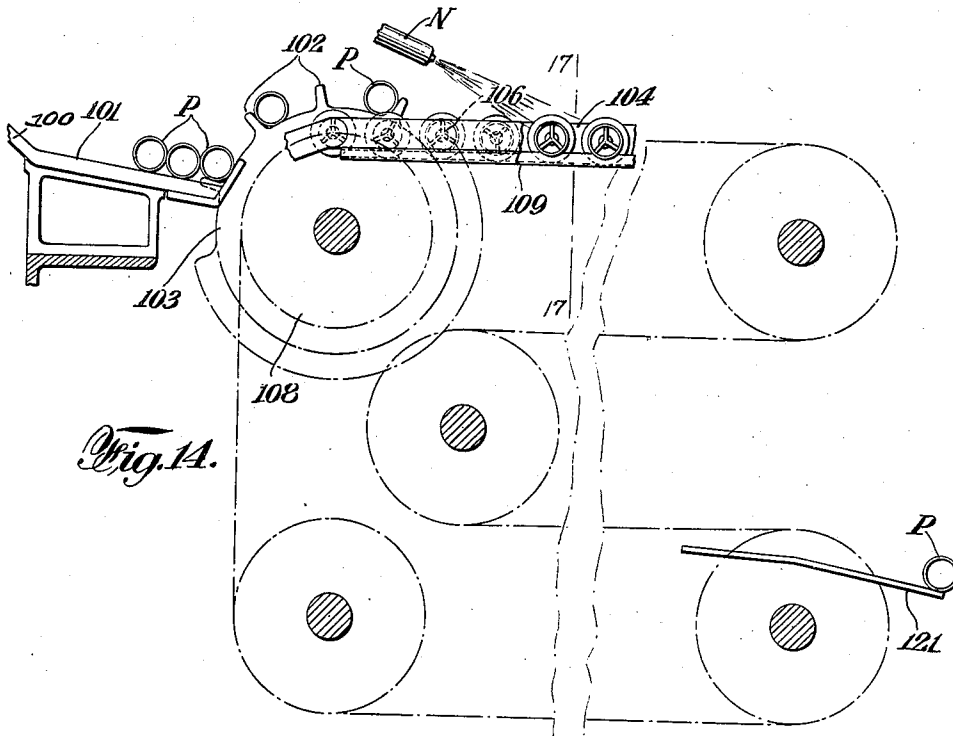


Fig. 14.

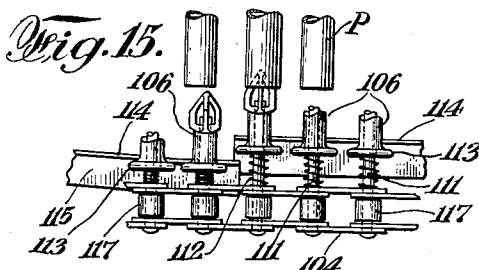


Fig. 15.

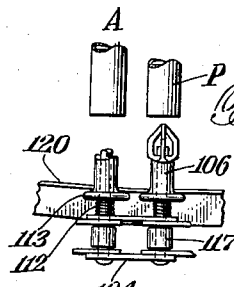


Fig. 16.

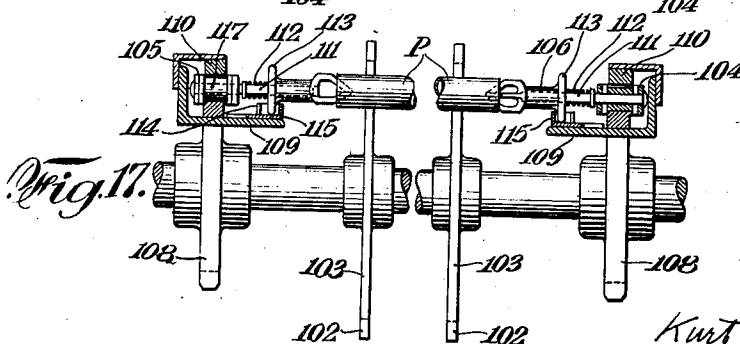


Fig. 17.

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APPARATUS FOR COATING PIPES

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Application November 18, 1930, Serial No. 496,427

5 Claims. (Cl. 91—45)

This invention relates to the coating of elongated tubes or pipes with enamel, lacquer or the like.

5 The object of the invention is to provide a process for coating tubes, pipes and the like that will be simple and effective to provide an even durable coating and adaptable to automatic operation.

10 A further object of the invention is to provide pipe coating apparatus for use in said process.

In the accompanying drawings illustrating the invention,

15 Fig. 1 is a diagrammatic view illustrating one step of the process,

Figs. 2 and 3 are similar views illustrating the coating of the pipe interior,

Fig. 4 is a sectional view of a spraying nozzle,

Fig. 5 is an end view thereof,

20 Figs. 6, 7 and 8 are diagrammatic end views of pipes illustrating successive steps in the process,

Fig. 9 is a plan view partly in section of drying and baking apparatus,

25 Fig. 10 is a vertical section of the drying and baking apparatus,

Fig. 11 is a vertical cross sectional view thereof,

Fig. 12 is a side view on enlarged scale of a portion of the conveying means,

30 Fig. 13 is a sectional view taken on the line 13—13 of Fig. 12,

Fig. 14 is a diagrammatic side elevation of apparatus for coating the exterior surfaces of the pipes,

35 Fig. 15 is a detailed plan view of a portion of the mechanism shown in Fig. 14,

Fig. 16 is a plan view of another detail of the mechanism shown in Fig. 14, and

Fig. 17 is a vertical sectional view taken on the line 17—17 of Fig. 14.

40 As indicated in Fig. 1 the pipes P may be first heated, after having been previously prepared to provide fresh surfaces for the coating layers. The heating shown in Fig. 1 may be the final drying step of previous cleaning treatment, or it may be a separate heating, and preferably the pipes will be delivered to the coating step (Figs. 2 and 3) at a temperature well above room temperature, for instance 100° F. These pipes P are elongated having bores which are small in comparison with the length of the pipes, i. e., the pipe length is forty or more times the diameter of the bore.

55 While only one pipe is shown in Fig. 1 the process is actually carried on in a continuous sequence of pipes, and preferably a plurality of

these, for instance five, are accumulated and held stationary and coated by five inserted spray nozzles 10. The nozzles 10, shut off, are inserted in through the pipes P to the position shown in Fig. 2, and then the sprays are started and continued as the nozzles move from one end of the pipes (Fig. 2) to the other (Fig. 3).

In each pipe the nozzle (Figs. 4 and 5) is formed to direct the coating material on to the interior of the pipe not only at an angle to an element of the cylindrical interior surface of the pipe, but also with a whirl component around the axis of the pipe. Therefore, each droplet of the spray as it strikes will spread not only longitudinally of the pipe, but also in a direction around the pipe interior. The result is a very uniform distribution of the enamel around the surface of the pipe, and since the nozzles are withdrawn lengthwise of the pipes at substantially constant velocity, this even distribution of the enamel is carried out throughout the entire length of the pipes. The projection of the enamel on to the interior surface of the pipes as an even spray thus deposits the enamel on the surfaces in exactly proper distribution.

The heat contained in the warm pipes tends immediately to warm the interior coating and cause the various droplets to flow evenly together and also initiates the evaporation of the solvent in enamel, the enamel containing preferably a solvent tending to set the material by evaporation.

60 Preferably the viscosity of the enamel as deposited and the rate of spraying and the rate of relative movement of the nozzle will be such as to give a thin film, substantially completely covering the surface but only to a thickness such that all of the particles of the film are held in place by adhesion to the pipe surfaces. I have found it advantageous to reduce excess of coating material over and above that necessary for the desired thickness, and not to depend entirely upon a surplus of enamel material to form an even film by flowing or draining along or over the other coating material in the pipe. By thus reducing this flowing action any tendency of the enamel to form into protruding drops and ridges is overcome, and greater smoothness and evenness of the coating is attained. At the same time the strength of the adherence of the enamel film is greatly increased and the liability of chipping or flaking off is also reduced.

When the nozzles 10 reach the end of the pipe completing the coating, the flow of enamel is 55

automatically stopped and the pipes are moved and deposited on an incline along which they roll making a number of complete revolutions (Fig. 6) so that all portions of the enamel film within the still warm pipes are subjected to a number of reversals of the action of gravity, first upward and then downward, and tending to spread and pull the enamel particles in opposite directions and avoid any tendency of the coating to adhere or accumulate unevenly on the pipe surfaces or on one side or the other of any irregularities.

The pipes are then temporarily stopped and picked up and conveyed to tracks along which they are rolled in substantially horizontal position while in a heated and preferably circulating air (Fig. 7). This heating tends to lower the viscosity of the enamel film and the continued rolling reversing the action of gravity on the successive portions of the adhering enamel film further smooths out any irregularities and is continued until the enamel film due to the action of the heated air has taken an initial set so that there is no substantial tendency for the particles of the film to move with relation to each other.

Thereafter (Fig. 8) the pipes are conveyed in a heating and circulating atmosphere without rotation, and are subjected to this heating and ventilation until the enamel is finally set and baked to a rigid hard film within the interior of the pipe.

From the entrance to the delivery end the pipes are preferably automatically conveyed, coated and baked without any intervening hand manipulation, the pipes being conveyed and rolled and treated in substantially horizontal position throughout the entire process.

The enamel spray nozzle 10 is of special construction to bring together an annular rotating vortex of air around an enamel feed orifice at the center. As shown in Fig. 4 the enamel feed tube 11 has its end orifice 15 controlled by the plunger or rod 13 having a conical portion 14 forming a shut off valve with the engaging inner surfaces of the tube 11, the extending end 14' of the rod leaving an annular orifice passage around which the enamel flows to the rod 15. The supply of enamel is adjusted by movement of the rod 13 and is shut off when the rod is moved to close the valve seat at 14. An air passage 16 is provided between the outer tube 17 and the inner enamel tube 11, and the air jet is formed by a series of inclined and slanting orifices 19 at the end of the bushing 18 surrounding the enamel tube 11. In the construction shown in Figs. 4 and 5 there are six of these orifices formed as slots in the end of the bushing 19 and having bottom surfaces 20, and top surfaces 21 formed by the inner conical surface of the end or cap bushing 17. These surfaces 20, 21 extend at an angle of approximately 45° to the axis of the nozzle. The side walls 22 of the orifice 19 are at a slant with relation to radial planes so that the orifices and the resulting jets are directed tangentially with relation to the enamel orifice 15, this tangential direction of the orifices forming the series of jets into a hollow vortex sweeping around the end of the conical nozzle containing orifice 15, reducing the pressure in the annular enamel opening so as to draw the enamel therefrom, and divide it up into droplets, and projected as a whirling spray against the interior wall of the pipe so that the particles of enamel are thrown or spattered along the pipe in a direction for a component parallel to the surface

thereof. The end 23 of the air nozzle ring 18 is beveled inward on a conical surface at an angle of approximately 60° to the axis of the nozzle. Air pressure of thirty to seventy pounds may be varied in accordance with the coating film desired, and the pressure on the enamel at the nozzle is substantially constant, the metering of the enamel being mainly accomplished by the annular orifice between the extension 14' of the rod 13 and surrounding cylindrical opening of the nozzle 15, these surfaces being separated by a small clearance imposing a constant resistance on the flow of the nozzle so as to maintain a substantially constant spray deposit of the thickness desired.

As shown in Figs. 9, 10 and 11 the baking oven comprises a chamber of generally rectangular shape having walls 30 of heat insulating material. A series of endless chain conveyors 31, 32 and 33 having pockets 34 are driven in synchronism by gearing 35 and sprocket chain 36 and convey the pipes first in one direction along the uppermost trackway 37 and then in the opposite direction along the intermediate trackway 38, and then in the reverse or first direction again along the trackway 39 to the delivery conveyor 40 which carries the pipes up and rolls them out on the inspection table 41. The rear sprockets 42, 43 and 44 of the chains 31, 32 and 33, respectively, are yieldingly drawn to exert a tension on these chains irrespective of their expansion or contraction with heat or cold, the tension means comprising the standards 45 of sprockets 42 and 43 drawn to the right by the rod 46 under the expansive forces of the springs 47, and similarly the springs 48 of rod 49 draws the sprocket 44 toward the right, the delivery conveyor 40 being mounted to automatically adjust itself to follow the movements of the sprocket 44.

The pipes P picked up by the pockets 50 of the conveyor chain 31 are carried inward and rolled along the tracks 51 of the oven for substantially half the length of the upper trackway. Then these tracks 51 end in an incline 52 and the pipes are supported and carried by the chain pockets without any rotation. At the end of the first trackway the pipes are carried down with the chain and rolled along the arcuate guards 53 into position to be picked up by the pockets 50 of chain 43 which carries them back the whole length of the oven and down along the guides 54 to the pockets 50 of the lower conveyor chain 33 carrying them again through the whole length of the oven to the delivery conveyor 40.

During the travel of the pipes a ventilating system is provided supplying air to one end of the pipes and exhausting it from the other end so as to create a draft of air through the pipes as they are rolled or carried through the oven. A centrifugal blower 60 forces air outward into the conduit 61 having branches leading to the distributing manifolds 62, 63 and 64 provided with slot openings directly adjacent to the left ends of the traveling pipes and supplying air to said pipes while the manifolds 65, 66 and 67 are maintained at a lower pressure to draw away from the right ends of said pipes, said manifolds being connected by pipes 68 leading to the suction side of the blower 70. Similarly the delivery side of the blower 70 is connected to the piping 71 leading to the manifolds 72, 73 and 74 supplying air to the right ends of the traveling pipes while the manifolds 75, 76 and 77 connected to the piping 78 lie to the suction side of the blower 60. Therefore, as the pipes are carried through the oven they are supplied with circu-

lating air first from left to right and then from right to left and then from left to right again, and then finally again from right to left.

Preferably the circulating air supplied to the blowers 60, 70 is heated as by heaters 80, 81, so that the circulating gases are constantly supplied with heat to heat the pipes and keep them heated throughout the entire length of their travel to the delivery end, and at the same time to remove the vapors from the interior pipe coating and permit this coating to gradually harden and rigidify.

During the first heating by the air supplied through manifold 62, the pipes are rolled along the tracks 51 (Figs. 12 and 13), the conveyor chain 31 having its link pins provided with rollers 84 running upon the tracks 85 while the tracks 51 for the pipes are supported by the angle iron 86 so that the surfaces of the tracks 51 raise the pipes a small distance from the bottoms of the pockets 50. Then at the end of the tracks 51 the pipes pass down the incline 52 and are received and carried by the bottoms of the pockets 50 as shown.

I have found it also desirable to coat the outside of the pipe, and this outer coating may be the same as the inner coating, for instance where it is to be enameled inside and outside; but where the pipe is plated on the outside, the outer coating may be of lacquer if desired. Where such outer coating is to be applied it is done during the rolling of the pipes after the application of the interior coating so that both the coatings are dried together.

When the pipes are to be double coated they are first coated on the interior as previously described and then specially supported during the outer coating operation and during the drying and baking, as shown in Figs. 14 to 17 inclusive. The position of the interior coater is indicated at 100 in Fig. 14, five pipes being coated at one time and delivered to the incline table 101 down which they roll to be picked up by the projections 102 of the disks 103 driven in synchronism with the side chains 104, 105 carrying the spring pressed plugs or frames 106, 107, and as the disks 103 rotate to carry the pipes over top position, each pipe in turn rolls down against the back of the preceding pin 102, and is then carried to a position A opposite the center line of the frames 106, 107 in position for the ends of these frames to enter the ends of the pipe. The chains 104, 105 after leaving their sprockets 108 concentric with disks 103 are guided horizontally between the lower guide tracks 109 and upper guide tracks 110, the pins 111 of these chains being extended to slidably carry the clamps or plugs 106, 107 with springs 112 between the links of the chains and the collars 113 of the clamps. During the first operation of the progress of the chains from the sprockets 108 the clamps are held in back or retracted position by the flanges 114 of the auxiliary guides or tracks 115, and at position A, where the pipes P are located opposite the ends of the clamps, the flange 114 is discontinued to permit the springs 112 to force the clamps inward into the ends of the pipes, opposite clamps gripping a pipe between them and lifting it from the supporting pins 102 and carrying it horizontally by the movement of the chains 104, 105. Preferably the collars 113 of the clamps will run on the auxiliary tracks 116 so that the clamps and pipes will be rotated, the clamps being rotatably mounted on the pins 111

for this purpose, and the chains 104, 105 having their rollers 117 held between the guides 109, 110. As long thereafter as tracks 116 are sufficiently high to bear against the collars 113 the pipes will be rotated, and in this respect these tracks correspond to the tracks 51 of the oven, and then when these tracks 116 are discontinued or depressed, there will be no peripheral frictional force exerted on the collars 113, and the pipes will be carried without rotation through the remainder of the drying and baking operation.

As the pipes are carried along the auxiliary track 116 and before they reach the baking oven they are sprayed over their entire outer surfaces by means of the spraying apparatus N giving a uniform coating of lacquer or enamel after which the pipes are carried into the baking oven wherein both the inner and outer coatings are set and hardened.

The plugs or clamps 106, 107 are formed as generally triangular frames open to pass the circulating air currents into and out of the ends of the pipes so that air will be circulated through and around the pipes as previously explained in connection with Figs. 9, 10 and 11.

At the unloading end of the machine before the pipes are picked up by the delivery conveyor 40 the clamps 106, 107 are retracted from the ends of the pipes by flanges 120 engaging against the faces of the collars 113, these flanges being inclined away from the ends of the pipes to draw the clamps back and deposit the pipes on the incline delivery table 121 down which they roll to be picked up by the delivery conveyor 40.

Where the pipe holding plugs are used the chain in the oven will carry the pipes through the entire extent of the travel without transfer from one chain to another, a single endless chain being used instead of a plurality of chains.

The final thickness of the outer or inner coating, or both, may be varied as desired, and the pipes or tubes instead of being round in section may have different shapes, for instance square, in which case the tubes will be preferably carried by holding plugs modified to fit the corresponding section. While the coatings have been described as preferably heat treated and baked in place, these coatings, inner, outer, or both, may be air dried if the proper material is used for air drying.

I claim:

1. Apparatus for coating tubes or pipes having a bore small in comparison with their length comprising means for applying a coating within the interior of the pipe, means for automatically rolling said pipe and means for simultaneously circulating air therethrough from one end to the other comprising air jet means positioned at the ends of the pipes and directing a blast of air therethrough.
2. In apparatus for coating the surface of a pipe or tube having its bore small in comparison with its length, the combination with means for spraying a deposit of coating material on the interior surface of the pipe, of interior supporting means adapted to engage the end of the pipe and carry it horizontally while exposing the entire exterior surface of the pipe, means for spraying the outside surface of the pipe while so supported and carried, and means for then setting and hardening both the interior and exterior coatings at the same time while continuing to carry the pipe horizontally.
3. In apparatus for coating the surface of a pipe or tube having its bore small in comparison

son with its length, the combination with means for spraying a deposit of coating material on the interior surface of the pipe, of interior supporting means adapted to engage the end of the
5 pipe and carry it horizontally while exposing the entire exterior surface of the pipe, means for spraying the outside surface of the pipe while so supported, and means for then setting and hardening both the interior and exterior coatings
10 at the same time, said supporting means being adapted to simultaneously convey and roll the pipe to distribute said coatings on the surfaces thereof.

4. Apparatus for coating the exterior surface
15 of a pipe comprising end carriers adapted to enter the pipe ends and roll said pipe around its axis while carrying it horizontally, means for spraying the exterior surface of the pipe to form an even deposit of coating material thereon, and

means for then rotatably supporting said end carriers for rotation of said pipe in substantially horizontal position, and means for heating said pipe to set and harden said coating.

5. Apparatus for coating tubes or pipes having a bore small in comparison with their length comprising means for applying a coating within the interior of the pipe, means for automatically rolling said pipe and means for simultaneously circulating air therethrough from one
10 end to the other comprising air jet means positioned at the ends of the pipes and directing a blast of air therethrough, and an inclined guide strip adjacent the ends of the pipes as they are moved and adapted to aline said pipes with their
15 ends moving along a linear element of said guide and openings through said guide for said air jet means.

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