Feb. 8, 1955 E. D. TOWNSEND 2,701,546

GALVANIZER

Filed March 31, 1951 4 Sheets-Sheet 1

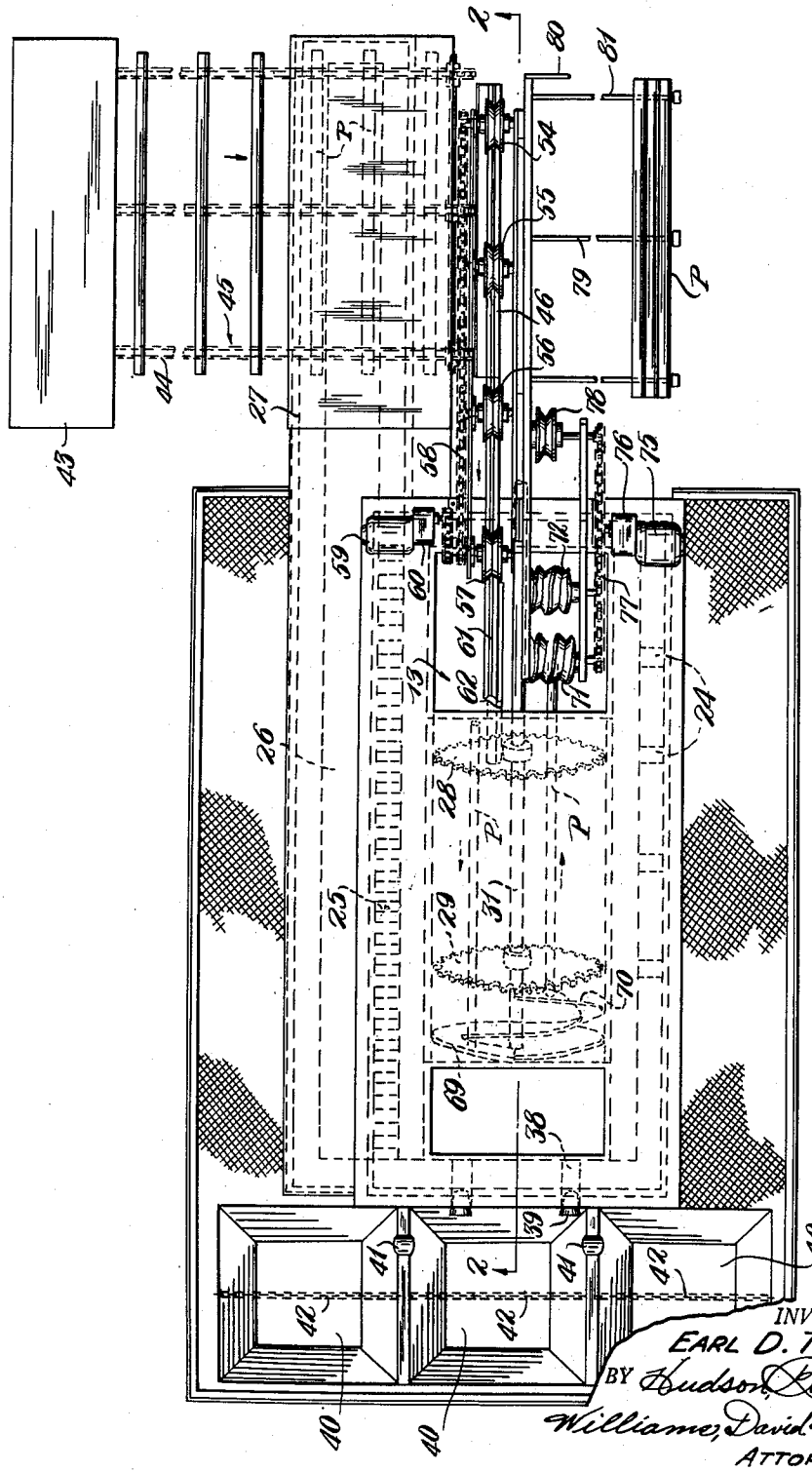


FIG. 1

INVENTOR.
EARL D. TOWNSEND
BY Hudson, Boughton, Williams, David & Hoffmann
ATTORNEYS

Feb. 8, 1955 E. D. TOWNSEND 2,701,546

GALVANIZER

Filed March 31, 1951 4 Sheets-Sheet 2

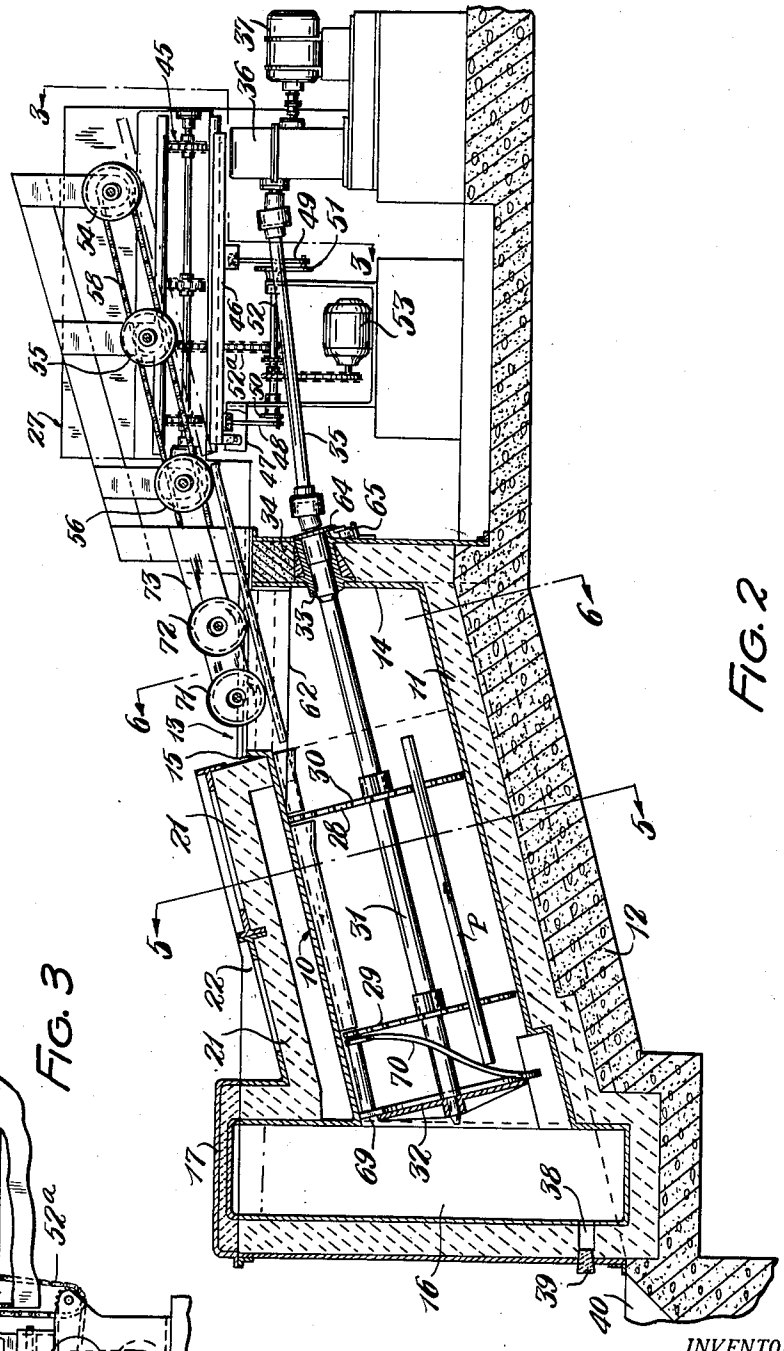


FIG. 2

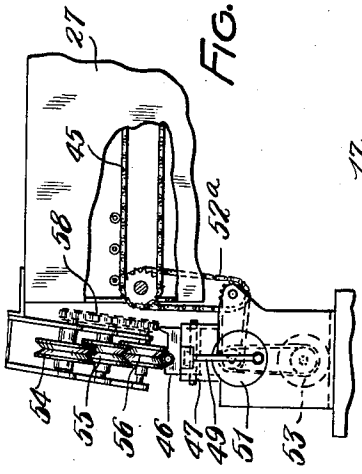


FIG. 3

INVENTOR.
EARL D. TOWNSEND
BY Hudson, Boughton, Williams, David & Hoffmann
ATTORNEYS

Feb. 8, 1955 E. D. TOWNSEND 2,701,546

GALVANIZER

Filed March 31, 1951 4 Sheets-Sheet 3

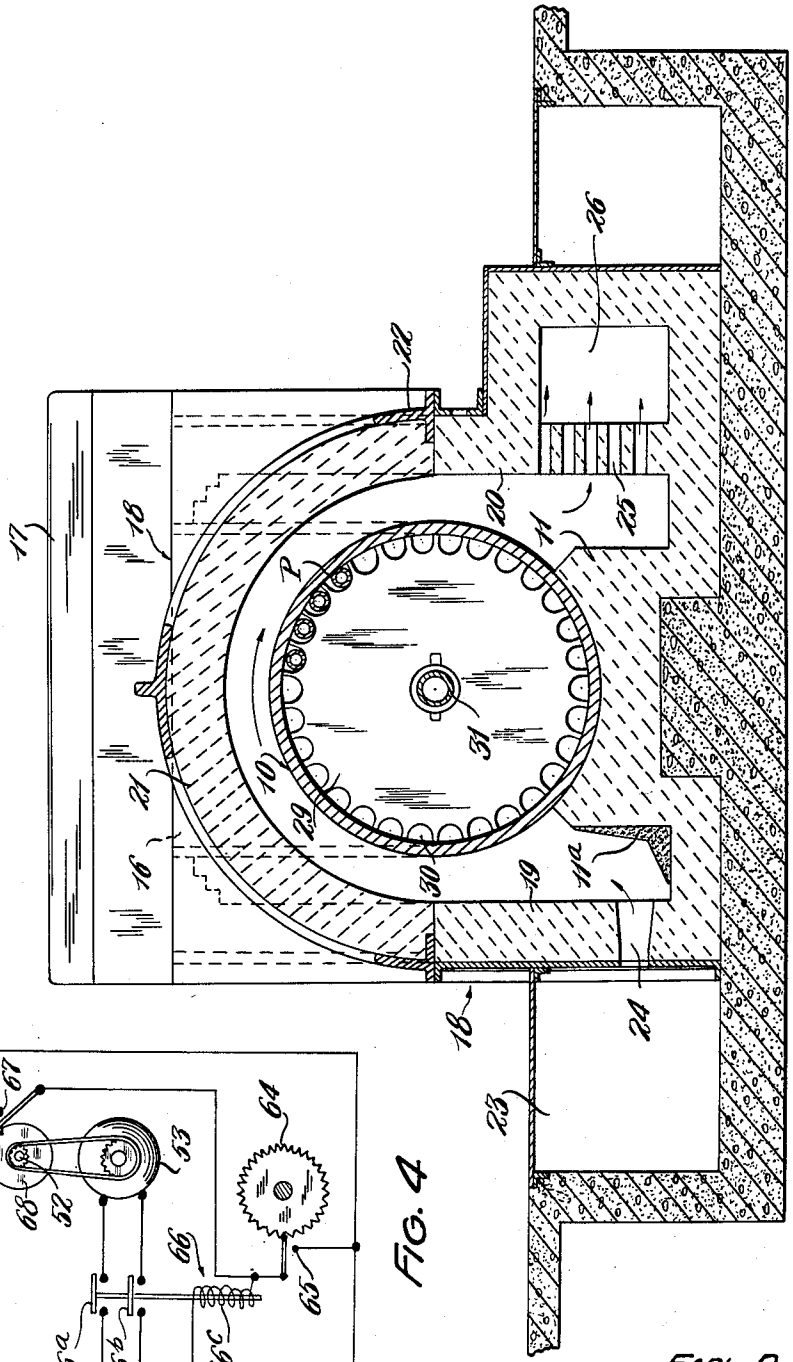


FIG. 5

FIG. 4

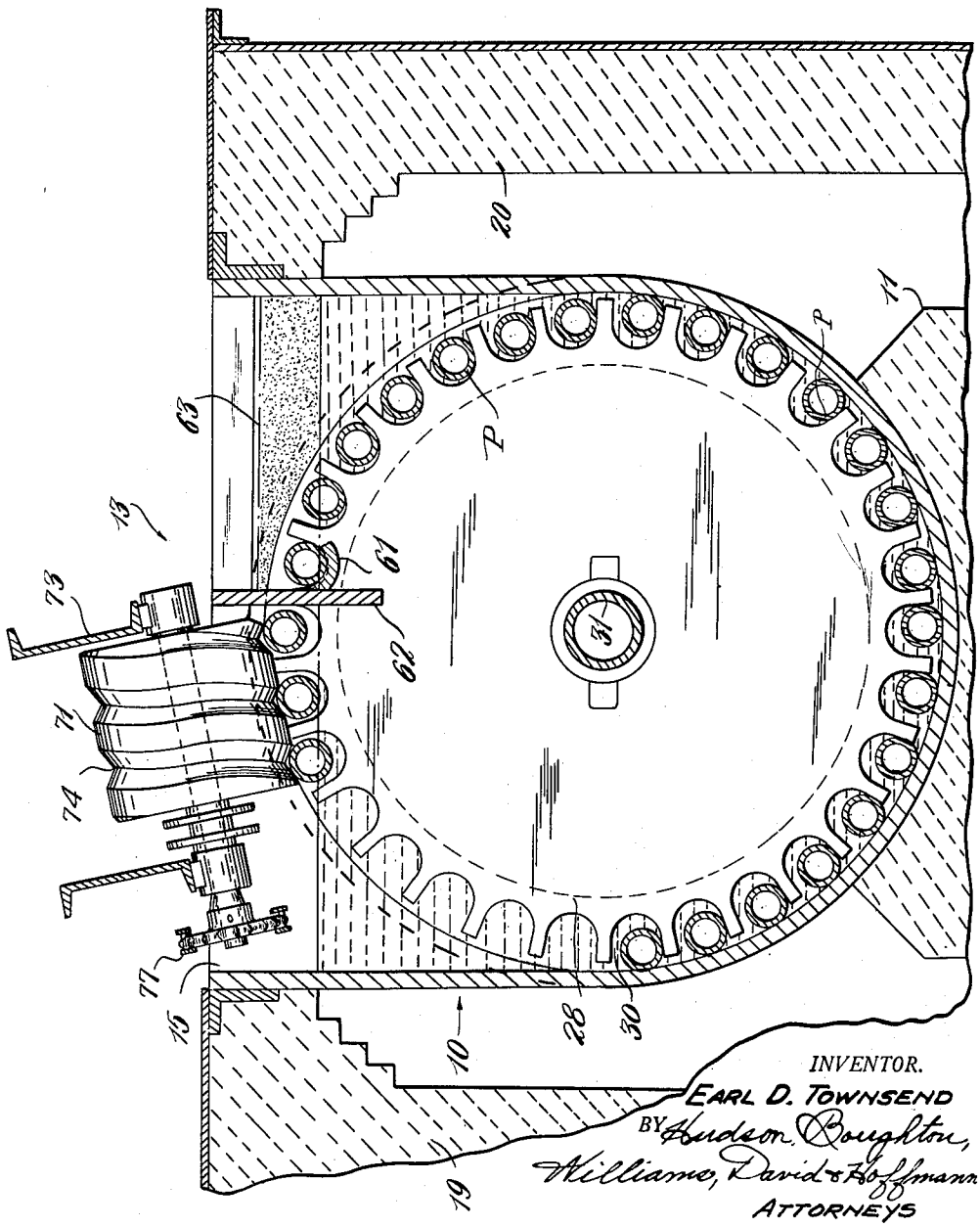
INVENTOR.
EARL D. TOWNSEND
BY Hudson, Boughton,
Williams, David & Hoffmann
ATTORNEYS

Feb. 8, 1955 E. D. TOWNSEND 2,701,546

GALVANIZER

Filed March 31, 1951 4 Sheets-Sheet 4

FIG. 6



INVENTOR.
EARL D. TOWNSEND
BY Hudson, Boughton, Williams, David & Hoffmann
ATTORNEYS

United States Patent Office 2,701,546
Patented Feb. 8, 1955

2,701,546

GALVANIZER

Earl D. Townsend, Beaver Falls, Pa., assignor to The Youngstown Welding & Engineering Company, Youngstown, Ohio, a corporation of Ohio

Application March 31, 1951, Serial No. 218,617

22 Claims. (Cl. 118—426)

The present invention relates to an apparatus for treating elongated articles, such as pipes or the like, with liquid material and, more particularly, to an apparatus of the so-called continuous type for applying molten material to pipes or tubes.

The principal object of the invention is the provision of an improved apparatus for applying liquid material to elongated articles, such as pipes, tubes and the like, wherein the articles to be treated are fed longitudinally in tandem relationship into a tank or pot of the material adjacent one end of the tank or pot and withdrawn from the latter in like manner from the same end in a substantially continuous operation.

Another object of the invention is the provision of a novel and improved tank or pot adapted to apply molten material to elongated articles, such as pipes, tubes or the like, which tank or pot is formed of relatively thin metal and has a major portion of its exterior in direct contact with the hot gases employed to maintain the material in the tank or pot in molten condition, a means being provided to move the articles being treated within the pot or tank adjacent the side walls thereof.

A further object of the invention is the provision of a novel and improved apparatus for applying molten material to elongated articles, such as pipes or the like, which apparatus includes a tank or pot for the molten material so constructed and arranged that dross can be removed from the tank without interfering with treatment of the articles therein, and the entire contents of the tank can be drained in the event it is necessary to terminate heating thereof, thereby preventing the solidification of the molten material in the tank.

An additional object of the invention is to provide an improved apparatus of the type defined above wherein means is provided within the tank or pot engaging the articles therein and projecting the ends thereof above the surface of the treating material adjacent the end of the travel of the articles through the tank to thereby facilitate longitudinal removal of the articles.

Another object of the invention is to provide an improved apparatus of the type defined in the preceding paragraph and further characterized by the provision of means adjacent the opening of the tank or pot for imparting both a longitudinal and lateral movement to the articles as they are removed through said opening thereby facilitating drainage of the articles without interfering with the movement of the articles within the tank or pot.

The invention further resides in certain novel constructions and combinations and arrangements of parts, and additional objects and advantages of the invention will be apparent to those skilled in the art to which it relates from the following description of the present preferred embodiment described with respect to the accompanying drawings, in which similar reference characters designate corresponding parts, and in which:

Fig. 1 is a plan view of a continuous pipe or tube galvanizing apparatus embodying the present invention with certain parts omitted for the sake of clarity;

Fig. 2 is a sectional view approximately on the line 2—2 of Fig. 1;

Fig. 3 is a fragmentary end view taken approximately on the line 3—3 of Fig. 2 and illustrating the pipe or tube elevating means of the apparatus;

Fig. 4 is a simplified schematic wiring diagram of a control circuit for the elevating means shown in Fig. 3;

Fig. 5 is a sectional view taken approximately on the line 5—5 of Fig. 2 with a few of the pipes being treated illustrated in section; and

Fig. 6 is a sectional view taken approximately on the line 6—6 of Fig. 2, the tank being indicated in this view as full of pipes or tubes and spelter to illustrate the manner in which the pipes or tubes are introduced into the tank, moved therein and withdrawn therefrom.

The apparatus of this invention is capable of employment in treating a variety of different types of elongated articles with liquid material, but for the sake of simplicity and clarity of disclosure the invention is here illustrated and described solely as embodied in a galvanizer for pipes or tubes. It is to be understood, however, that this restriction of the disclosure does not constitute a limitation upon the invention except as may be required by the subjoined claims.

In the illustrated embodiment, the galvanizing apparatus comprises a substantially cylindrical tank or pot **10** formed of relatively thin metal and supported in an inclined position at an acute angle by a supporting member **11** formed of suitable refractory material and which in turn is provided upon a base **12** of reinforced concrete or the like. The upper portion of the tank or pot **10**, adjacent the forward end thereof, is provided with a rectangular opening **13** through which the elongated articles, such as pipes P or the like, are adapted to be introduced and removed as hereinafter explained. The forward end of the tank **10** is closed by an end wall **14** which extends upwardly providing a part of a continuous upstanding flange **15** about the opening **13**. The rear portion of the tank or pot **10** is provided with a substantially rectangularly shaped well **16** having upwardly extending sides reaching to a level equal to or greater than that of the flange **15** around the forward opening, the top of the well **16** being normally closed by a cover **17**.

The tank or pot **10** is enclosed within a chamber or housing **18** formed of refractory material, the side walls of the chamber being spaced outwardly from the side walls of the tank or pot. As shown in Fig. 5, the lower portions **19** and **20** of the side walls of the chamber or housing **18** may be formed integral with or connected to the support member **11** for the tank or pot with a space therebetween, the tops of these side walls being united by an arched or grooved dome portion **21**. The chamber or housing **18** is preferably reinforced and/or protected by suitable metal plates such as **22**. The end wall **14** and the well **16** of the tank or pot are likewise enclosed in refractory material having a protective metal covering and the cover **17** is similarly constructed. While the refractory material forming the walls of the chamber or housing **18** has been shown in direct contact with the supporting or protective metal plates such as **22**, it will be evident that a loose insulating material such as sand, fireclay, or the like can be interposed between these parts to reduce heat conduction therethrough, if desired.

The material for treating the elongated articles, in this case spelter for coating pipes or tubes P, is introduced into the tank or pot **10** through the well **16** by removing the cover **17**, the spelter then being maintained in molten condition by heated gases circulated about the tank or pot **10** in the spaces provided between the latter and the chamber or housing **18**. In the illustrated construction, heated gases flow from a source, not shown, through a manifold **23**, see Figs. 1 and 5, extending parallel with the side wall **19** of the chamber or housing and entering the latter through a plurality of longitudinally spaced openings **24**. While the manifold **23** has been shown simply as a rectangular opening or duct, it will be evident that the heated gases may be conducted through bustle pipes provided with suitable insulation or, in some instances, gas may be burned within the manifold **23** or at the openings **24** by provision of suitable pipes and burner jets.

The heated gases, however produced and conducted to the openings **24**, pass through the latter into the space between the inner walls of the chamber or housing **18** and the outer walls of the tank or pot **10** as indicated by the arrows in Fig. 5 being directed in this path by suitably shaped refractory material **11***a* on the side of the

tank support member **11** opposite the openings **24**. The gases pass from the region adjacent the tank or pot **10** through checker work openings **25** in the wall **20** of the chamber into a longitudinally extending manifold **26** on the opposite side of the apparatus from the inlet manifold **23**. From the manifold **26** the gases pass to a muffle type furnace, generally designated **27**, see Fig. 1, in which the pipes P or other articles to be treated are preheated before introduction into the tank or pot **10**.

It will be observed that the dome portion **21** of the chamber or housing **18** engages the walls of the tank or pot **10** at or adjacent the upstanding flange portions of the latter about the openings at the opposite ends of the tank, so that the heated gases circulate about a major portion of the tank or pot **10** in contact with the walls thereof, but such gases are prevented from contacting the molten material within the tank or pot, thus preventing undesired oxidation or other contamination of the material. It will be further noted that, since the well **16** is normally closed by a cap or cover **17**, the molten material within the pot **10** has only a very small part of its total surface exposed to the atmosphere since the opening **13** is of relatively small dimensions with respect to the total surface of the spelter or other molten material in the tank or pot. Moreover, it will be evident that the heated gases directly contact the principal or major part of the side walls of the tank or pot as well as the adiacent surface of the well **16** so that there is a highly efficient heat transfer to the material in the pot, it being remembered that the walls of the tank or pot are of only sufficient thickness to give the requisite strength. Furthermore, the efficiency of the apparatus is additionally improved by utilizing the heated gases exhausted from the chamber or housing **18** to preheat the pipes or tubes before their entrance into the galvanizing tank or pot.

Means are provided within the tank or pot **10** to move the tubes or pipes P laterally therethrough closely adjacent the side walls thereof, thus insuring that the pipes or tubes are uniformly at the proper temperature for the galvanizing operation and that the spelter in contact with the tubes is also at the correct temperature, which might not be the case if the tubes or pipes were at different radial distances from the side walls of the container. This means for moving the pipes or tubes P preferably comprise a plurality of sprocket or spider-like members **28** and **29** having recesses or pockets **30** opening radially inwardly from their peripheries in which the tubes or pipes are received and carried thereby in a circular path adjacent the inner side walls of the tank or pot **10**. The members **28**, **29** are rotated by mechanism comprising a shaft or tube **31** extending axially through the tank or pot **10** with its inner end supported in a bearing plate **32** adjacent the inner end of the pot and its outer end passing through a suitable sleeve bearing **33** provided in the outer end wall of the tank or pot **10** and the cooperating refractory material adjacent thereto, the shaft **31** being keyed or otherwise connected with the members **28**, **29** to effect rotation thereof. Preferably the region adjacent the sleeve bearing **33** is provided with finely divided dry fireclay **34** as indicated in Fig. 2.

The shaft **31** is connected, externally of the chamber **18** and tank **10**, to a tubular drive shaft **35** which in turn is connected with a speed reduction unit **36** driven by an electric motor **37**. It will be evident that when the motor **37** is energized, it will effect rotation of the shaft **31** and hence of the members **28** and **29** so that the tubes or pipes P received within the pockets or recesses **30** are carried about in a circular path within the tank or pot **10** and hence through the molten spelter therein. This rotation of the pipes or other members being treated not only provides an effective means of thoroughly coating the latter with the spelter but also stirs the spelter so that any dross within the pot or tank **10** tends to collect at the bottom of the tank and move towards the bottom of the well **16** from which it may be readily removed from time to time by removing the cover **17** and employing a clamshell bucket or other suitable expedient. Consequently, dross may be removed without interfering with the galvanizing of pipes or the like in the tank or pot **10**.

Adjacent the bottom of the well **16** are outlet openings **38** which are normally closed by suitable valve or plug members **39**, the latter being here illustrated, and below the openings **38** are suitable pits or receptacles **40**. These pits or receptacles are lined with refractory material with communicating openings such as **41** in the top edges to permit overflow from one pit or receptacle to the other. Extending over and dipping into the tops of the pits **40** is a chain or chains **42**. The construction is such that, in the event it is necessary to terminate the supply of heated gases to the pot **10**, the entire molten contents can be drained into the pits or receptacles **40** so that there is no danger of the molten material hardening within the tank or pot and producing a crust or other formation which cannot readily be liquified by simply resuming heating. When the molten material is thus drained into the pits or receptacles, portions of the chain or chains **42** will become embedded in the material as the latter hardens thus providing a handle by which the solidified material may be removed from the pits or receptacles.

As mentioned heretofore, the apparatus of this invention is intended for operation in a continuous manner as contrasted with batch type operations. Consequently, means are provided for automatically supplying the articles, such as the pipes P, to the tank or pot **10** in timed relation with the rotation of the members **28**, **29** and for removing the treated pipes or other articles therefrom without interfering with that rotation. As is readily understood, the pipes or other articles to be treated are first subjected to descaling operations, if necessary, and are then pickled by means not shown after which the pipes or other articles may be immersed in a suitable flux bath such as zinc ammonium chloride provided in the container indicated **43** in Fig. 1. From this flux bath the pipes are removed and placed upon skids such as **44** from which they are then transferred, one pipe at a time, to a chain conveyor generally designated **45**, which conducts the pipes in spaced relationship to and through the aforementioned muffle furnace **27** where the pipes are preheated by the gases exhausting from the chamber or housing **18** of the galvanizing pot.

The conveyor **45** causes the pipes to drop one-at-a-time into a charging trough or member **46**, see Figs. 2 and 3, which is provided adjacent its left-hand end as viewed in Fig. 2 with a pivotal connection to a bracket or supporting member **47**. The charging trough **46** is adapted to be periodically rocked about its pivot in timed relation with the rotation of the members **28**, **29** in the tank or pot **10** and for this purpose the illustrated embodiment of the apparatus includes links **48** and **49** pivotally connected at spaced points to the underside of the trough **46**. The lower ends of these links **48** and **49** are connected with eccentrics **50** and **51** provided on shaft **52** and rotated by a motor **53**, the construction being such that each revolution of the shaft **52** rocks the charging trough **46** from its lower position as shown in full lines in Fig. 2 to its upper position as shown in broken lines in that figure and then back to its initial position. The chain conveyor **45** is driven in timed relationship with respect to the movement of the trough **46** by any suitable means which, for example, may comprise a sprocket and chain drive **52***a* interconnecting the shaft **52** and a shaft of the chain conveyor **45**, the timed relationship being such that one of the pockets on the chain conveyor **45** carrying a pipe or tube P comes adjacent the trough **46** each time that the latter is at its lowermost position shown in full lines in Fig. 2.

In the upper position of the trough **46** it is disposed adjacent to the peripheries of magnetic rollers or pulleys **54**, **55**, **56** and **57** which are of conventional construction and are adapted to attract a pipe or tube P into engagement therewith and move the latter longitudinally as the said pulleys or rollers are rotated. The rotation of the pulleys or rollers such as **54**—**57** can be effected by individual electric motors, but in the illustrated embodiment these pulleys or rollers are driven by a chain **58** driven by a motor **59** through a speed reduction unit **60**, the direction of rotation of the pulleys being clockwise as viewed in the drawings so that a pipe or tube is moved thereby towards the tank **10**.

The pipes or tubes P in engagement with the magnetic rollers or pulleys **54**—**57**, as just explained, move forwardly into the opening **13** of the tank or pot **10** where they are guided into one of the notches or recesses **30** of the members **28**, **29** by a trough **61** supported upon a vertically extending partition plate **62** mounted in the opening **13** of the tank substantially centrally thereof and dividing the latter into two parts as will be apparent from Fig. 6. The quantity of spelter contained within the pot

10 is such as to rise into the opening 13 with the upper level thereof preferably at a point above the lower end of the plate 62. A suitable fluxing material 63, see Fig. 6, may then be floated upon the upper surface of the spelter in that portion of the opening 13 through which the tubes or pipes P enter and this flux is prevented from moving into the discharge portion of the opening 13 just to the left of the plate 62, as viewed in Fig. 6. It will be evident, therefore, that the pipes or tubes P are subjected to a flux material 63 as they enter the galvanizing tank or pot and prior to their introduction into the spelter contained in that tank or pot.

In order that the recesses or openings 30 in the members 28 and 29 may be properly positioned for receiving a tube or pipe P, the rotation of these members is synchronized with respect to the operation of the charging trough 46. For this purpose the shaft 31 is preferably provided with a toothed wheel 64 similar to a sprocket wheel adjacent which is mounted an electrical switch 65 for actuation by the teeth or projections of the wheel 64, the switch 65 controlling the circuit for the motor 53. The sprocket wheel or member 64 has the same number of teeth or projections as there are pockets or recesses in the members 28, 29 so that the switch 65 is actuated each time a recess 30 is positioned for receiving a tube or pipe.

One way in which the member 64 may control the motor 53 is indicated in Fig. 4 from which it will be seen that the power supply leads L1 and L2 are connectible with the terminals of the motor 53 under control of the contacts 66*a*, 66*b* of a contactor 66. The coil 66*c* of the contactor 66 has one terminal thereof connected with the power supply line L1 and the other terminal thereof connected to the power supply line L2 through the switch 65 when the movable contact of the latter is closed in response to actuation by a tooth or projection of the sprocket wheel 64. In parallel with the switch 65 is a second switch 67, the movable contact of which is normally open and provided with a roller 67*a* riding upon the periphery of a disk 68 carried by the shaft 52. This disk 68 is provided with a notch into which the roller 67*a* is adapted to drop when the charging trough 46 is in its lowermost position.

It will be apparent from the construction just described that each time a tooth or projection on the member 64 actuates the switch 65, the motor 53 will be energized to elevate the charging trough 46 thus moving a pipe thereon into engagement with the magnetic rolls or pulleys 54—57 which rapidly longitudinally move the pipe or tube into the aligned openings 30 of the members 28 and 29, this movement of the tube or pipe P being guided by the member 61. The switch 67 is actuated as soon as the motor 53 begins to rotate and insures that the motor will be maintained energized for one complete movement of the charging trough 46 even though the sprocket wheel 64 will have moved its tooth or projection beyond the point releasing the switch 65.

The pipe or tube P which is fed into the tank or pot 10 has its forward or lower end moved by the projecting action into engagement with a stop member 69 adjacent the lower portion of the tubular part of the tank or pot 10, see Fig. 2. This stop member 69 is preferably formed as a part of an annular member extending adjacent the inner periphery of the tank or pot 10 and having approximately a 180° portion thereof disposed in a plane extending substantially at right angles to the shaft 31. The remaining 180° portion of the member 69 is preferably disposed forwardly within the pot 10 as an inclined cam portion or surface 70. Consequently, as the tubes or pipes P are moved in a circular path within the tank 10, the inclined surface or cam portion moves the said pipes or tubes P longitudinally forwardly within the tank during the latter part of their rotation until when the pipes or tubes P have come adjacent the opening 13 the forward ends thereof will be projecting above the level of the spelter for removal therefrom.

Preferably the pipes or tubes P are removed from the galvanizing tank or pot in an inclined position and at a slower rate than the said tubes or pipes are introduced into the tank or pot so as to provide for complete drainage of excess molten spelter therefrom. In order that this relatively slow rate of withdrawal may

not, however, interfere with rotation of the spiders or members 28, 29 and the pipes or tubes carried thereby, the withdrawing or drag-out means for the pipes or tubes is so arranged as to impart a longitudinal movement to the pipes or tubes while permitting a lateral movement thereof. For this purpose the illustrated embodiment employs one or more drag-out rolls or pulleys adjacent the discharge opening 13, which pulleys or rolls not only exert a longitudinal force on the pipes but are also provided with helical cam surfaces thereon for receiving and guiding the tubes laterally during their withdrawal. As shown, two such drag-out rolls or pulleys 71, 72 are provided which are identical in construction.

Each of the drag-out rolls or pulleys 71, 72 is of the magnetic type such that it attracts and holds magnetically susceptible materials thereto as is well known in the art, this magnetism being either of a permanent nature or electromagnetically provided as will be readily understood. The rolls 71, 72 are rotatably supported by suitable frame members 73 adjacent that part of the opening 13 of the tank or pot on the opposite side of the plate 62 from that in which the flux is maintained. The periphery or circumference of each of the rolls or pulleys 71, 72 is provided with a helical cam groove 74, the pitch of which is substantially the same as the distance between centers of the openings 30 in the rotatable members or spiders 28, 29, the cam groove 74 preferably having a plurality of convolutions, in this instance, two. The rolls or pulleys 71, 72 are rotated together by suitable means which may comprise separate electrical motors, but which in the illustrated embodiment is shown as including a single motor 75 operating through a speed reduction unit 76 to drive a chain 77 which passes about sprocket wheels connected with the axles for the rollers. While magnetic drag-out rolls have been illustrated, it will be apparent that suitable non-magnetic material removing means may be utilized when the pipes or tubes treated are not formed of iron, steel or other magnetically susceptible material.

The operation of the drag-out or removing means just described will be readily understood from an inspection of Figs. 1 and 6 from which it will be seen that as the pipes or tubes P move in the circular path within the tank or pot 10 the lower ends of the pipes engage the cam surface or portion 70 and, as a result, the tubes or pipes P are moved longitudinally during the latter part of their movement in the tank so that the ends thereof are sequentially projected above the level of the spelter at the opening 13 and adjacent the outer convolution of the cam groove 74 in the drag-out roll or pulley 71. As a result, the tube or pipe P is attracted into engagement with the drag-out roll or pulley 71 which imparts a longitudinal movement to the latter due to its rotation by the motor 75. Simultaneously with the longitudinal movement, the helical nature of the groove 74 permits the tubes or pipes P to continue their lateral travel until the inner end of the pipe or tube P has moved longitudinally forward of the rotatable member or spider 28.

Preferably the speed of withdrawal of the tubes or pipes P is related to the speed of rotation of the rotatable spider or sprocket-type members 28, 29 such that the tubes or pipes P being withdrawn are moved transversely a distance equal to the circumferential space occupied by two of the recesses or pockets 30 during the withdrawal period, it being understood that several of the tubes or pipes will be in the process of withdrawal in different stages thereof at any given time. This relatively slow withdrawal of the tubes or pipes facilitates complete drainage of the excess molten spelter therefrom, thus preventing unevenness in the finish upon the pipes or tubes and reducing wastage of the spelter. As the pipes or tubes are withdrawn from the tank, they may be subjected to the action of an air wiper, if desired, which wiper is not however here illustrated since it is of conventional construction.

The pipes P may be further conveyed longitudinally, after passing from the rolls or pulleys 71, 72, by magnetic rolls or pulleys such as 78 which are identical in nature to those designated 54—57 and act to impart longitudinal movement to the pipes or tubes. While only one such roll or pulley 78 is shown, it will be appreciated that any desired number may be utilized, which pulleys or rolls may be driven by any suitable means,

the drive here being shown as effected by the same chain **77** as is utilized to rotate the drag-out pulleys **71, 72**. The roll or pulley **78** projects the pipes or tubes P forwardly to a point above skids such as **79**, the longitudinal travel of the pipes or tubes P being terminated by engagement thereof with a stop member **80**, the pipes or tubes being allowed to drop by gravity onto the skids **79** assisted, if necessary, by the aid of a deflection cam or the like, to overcome the attraction of the pulleys **78**. As the pipes or tubes P run down the skids **79**, they may be subjected to a blow-out cycle utilizing superheated steam for removing loose particles from the interior of the pipes, which blow-out cycle is not however herein illustrated since it does not form a part of the present invention. The pipes or tubes may also be subjected to any other suitable treatment during their rolling upon skids or tracks such as **79**, after which they may come to rest upon a cooling rack **81** from which they may be removed by any suitable means, not shown.

It is believed that the operation of the galvanizing apparatus as a whole will now be readily apparent from the above detailed description of the parts thereof. However, for convenience the operation is here briefly summarized.

The elongated articles, such as pipes or tubes, which are to be treated with molten metal, for example, galvanized by immersion in spelter, are preferably first subjected to suitable cleaning actions including pickling or the like and are then immersed in a flux bath indicated at **43** in Fig. 1. From this bath the pipes are placed on a chain conveyor **45** in spaced relationship and moved thereby laterally through a muffle furnace **27** utilizing exhaust heat from the galvanizing pot or tank **10**, the rate of travel of the pipes being such that they are thoroughly heated to the proper temperature for the galvanizing operation. As the pipes emerge one at a time from the muffle furnace, they are received upon the vertically reciprocating trough **46** which is actuated in timed relationship with the movement of the chain conveyor **45** and the rotation of the spider members **28, 29** within the tank. This trough **46** therefore elevates each pipe sequentially into contact with the magnetic feeding rollers **54—57** which longitudinally move the tubes or pipes into the tank **10** and into aligned recesses such as **30** in the rotatable members or spiders **28, 29**, the insertion of the pipes or tubes being facilitated by longitudinal sliding movement on the fixed guide **61**. During the insertion of the tubes or pipes into the tank or pot **10**, they pass through the flux **63** maintained upon the top level of the spelter and then into the spelter itself.

The members **28** and **29** are rotated by the motor **37** and hence the pipes are moved thereby in a circular path closely adjacent the side wall of the tank or pot **10** which is subjected to the action of the heating gases so that there is excellent heat transfer to the pipes or tubes and the spelter in contact therewith, thus facilitating the galvanizing action in much shorter time than has been heretofore possible. As the pipes continue their movement through the tank, the inner ends thereof engage the inclined or cam surface **70**, thus projecting the tubes or pipes P forwardly until, as they near the opening **13**, they sequentially extend beyond the upper level of the spelter and adjacent the drag-out roll or pulley **71** to which the pipes are sequentially attracted by magnetic action. As the members or spiders **28, 29** continue to rotate the drag-out roll or pulley **71** exerts a longitudinal force upon the tubes or pipes and at the same time the helical nature of the groove **74** permits lateral movement of the pipes or tubes so that they are longitudinally moved from the spelter at a rate of removal slower than the rate of their introduction thus facilitating proper draining of the excess spelter therefrom. The removing action of roll **71** is further assisted by the similar drag-out roll or pulley **72** and the withdrawn tubes or pipes are then longitudinally moved by one or more magnetic pulleys or rolls **78** to a discharge position above the skids **79** upon which the pipes or tubes fall by gravity and may be subjected to various cleaning or drying operations, if desired, the pipes or tubes collecting upon the cooling racks **81** for removal therefrom as necessary or desired.

It will therefore be apparent that, in accordance with this invention, an improved apparatus has been provided for treating elongated articles such as pipes or the like with molten metal, the treating operation being performed in a continuous manner with a minimum of attention or effort on the part of the operator or operators. Moreover, by virtue of the novel construction of the tank or pot, the articles are inserted and removed through a single relatively small opening in the tank, thus materially reducing the surface area of the molten material exposed to the atmosphere so that oxidation and introduction of impurities is materially lessened. Furthermore, the invention affords material improvement with respect to conservation of heat due to the manner in which the heated gases are circulated about the tank or pot **10** and this circulation of the heated gases coupled with the manner in which the articles are moved within the tank or pot insures that the said articles are at a proper temperature throughout the treating operation, thereby materially reducing the time required therefor, which reduction of time for galvanizing is in the order of 40%. In addition, the means employed for introducing the elongated articles into the tank and for effecting removal therefrom facilitates the automatic operation by reducing the man-hours necessary, while the relatively slow drag-out permits the proper drainage of excess molten material from the articles without, however, correspondingly slowing the rate of treatment of the articles, since the withdrawal rate can be slower than the rate of introduction.

The invention has been here illustrated and described as embodied in an apparatus for galvanizing metal tubes or pipes. It will, however, be appreciated that the invention is also susceptible of use for treating other elongated articles with molten material. Moreover, it will be evident that changes may be made in details of the construction specifically disclosed. For example, rotation of the members or spiders **28, 29** may be intermittent, such as step-by-step in nature, rather than continuous and means other than those specifically disclosed may be employed for charging the pipes, tubes or other articles into the tank. Moreover, as mentioned above, removing or withdrawing means other than the drag-out rolls **71, 72** may be employed. Thus, if desired, the rate of withdrawal may be the same as the rate of introduction of articles into the pot in which event the drag-out rolls may be magnetic pulleys similar to **78**. When the articles are not formed of magnetically susceptible material, other types of withdrawing or removing means may be employed. Furthermore, in some instances the tank or pot need not be cylindrical, in which event a suitable arcuate member or members will be provided in the pot to retain the pipes or other articles in the spider members as the latter are rotated. These and other changes which may be effected by those skilled in the art, after having had the advantages of this disclosure, are considered as comprehended within the ambit of this invention and therefore the latter is deemed not to be limited by the specific constructions herein illustrated and described except as may be required by the spirit and scope of the subjoined claims.

Having thus described the invention, I claim:

1. An apparatus for treating elongated articles such as pipes or the like comprising an elongated substantially cylindrical pot adapted to contain article treating material and having an opening adjacent one end, means supporting said pot with its axis inclined at an acute angle and with the said opening adjacent the upper end of said pot, means adjacent said opening for longitudinally introducing into the pot through said opening the articles to be treated, means within said pot for moving the articles therein in a substantially circular path adjacent the side wall of said pot with the entire length of each article substantially equidistant from the said side wall of the pot while moving in said path therein, and means adjacent the said opening for longitudinally removing the treated articles from said pot through said opening.

2. An apparatus for treating elongated articles such as pipes or the like comprising an elongated substantially cylindrical pot adapted to contain article treating material and having an opening adjacent one end, means supporting said pot with its axis inclined at an acute angle and with the said opening adjacent the upper end of said pot, means adjacent said opening for longitudinally introducing into the pot through said opening the articles to be treated, rotatable means in said pot having article engaging portions for receiving the articles to be treated and moving them in a substantially circular path within said pot adjacent the side wall thereof with the entire length of each article substantially equidistant from the said side wall of the pot while moving in said path therein,

and means adjacent the said opening for longitudinally removing the treated articles from said pot through said opening.

3. An apparatus for treating elongated articles such as pipes or the like comprising an elongated substantially cylindrical pot adapted to contain the treating material and having an opening adjacent one end, means for longitudinally moving the articles to be treated through said opening and into said pot, means within said pot for moving the articles therein in a circular path adjacent the side wall of said pot with the entire length of each article substantially equidistant from the side wall of the pot while moving in said path therein, means in said pot at a location remote from said opening engaging the treated articles during their said movement in the pot and acting upon the moving articles to sequentially elevate the ends of the latter above the surface of the material in said pot during the latter part of that movement, and means adjacent the said opening engaging the elevated ends of the articles and applying a longitudinally directed force thereon for removing the articles from the pot.

4. An apparatus as defined in claim 3 wherein the said means in the pot for elevating the ends of the articles above the material in the pot is a member having an inclined surface engaging the inner ends of the articles to project the latter longitudinally towards said opening as the articles are moved in the pot.

5. An apparatus for applying a molten material to elongated articles such as pipes or the like comprising an elongated pot adapted to contain the molten material, the said pot being normally closed except for an article introducing and removing opening adjacent one end, means for conducting heated gases about a major portion of the sides of said pot and out of contact with said opening, means adjacent said opening for longitudinally introducing the articles to be treated into said pot through said opening, means within said pot for moving the articles therein laterally through the molten material in a substantially closed path with the entire length of each article substantially equidistant from the side wall of the pot while moving in said path therein, and means adjacent the said opening for longitudinally removing the treated articles from said pot through the said opening.

6. An apparatus for applying a molten material to elongated articles comprising an elongated substantially cylindrical pot adapted to contain the molten material and having an opening adjacent one end, means for conducting heated gases about a major portion of said pot to maintain said material in molten condition, means for longitudinally moving the articles to be treated through said opening and into said pot, means within said pot for moving the articles therein through the molten material in a circular path adjacent the inner side wall of said pot with the entire length of each article substantially equidistant from the side wall of the pot while moving in said path therein, and means adjacent the said opening for longitudinally removing the treated articles from said pot through the said opening.

7. An apparatus for applying a molten material to elongated articles such as pipes or the like comprising an elongated pot adapted to contain the molten material, the said pot being normally closed except for an article introducing and removing opening adjacent one end, means for conducting heated gases about a major portion of the sides of said pot and out of contact with said opening to maintain said material in molten condition, means adjacent said opening for longitudinally moving the articles to be treated through said opening and into said pot, means within said pot for moving the articles therein laterally through the molten material in a substantially closed path with the entire length of each article substantially equidistant from the side wall of the pot while moving in said path therein, means in said pot engaging said articles during their movement in said pot and acting during the latter part of that movement to sequentially elevate the ends of said articles above the surface of the molten material at said opening, and means adjacent the said opening engaging the said elevated ends of the articles and applying a longitudinally directed force thereto for removing the articles from the pot.

8. An apparatus as defined in claim 7 wherein the said means in the pot for elevating the ends of the articles above the molten material is a member remote from said opening and having a surface inclined towards said opening upon which the inner ends of the treated articles ride as they are moved through said pot.

9. An apparatus for applying a molten material to elongated articles such as pipes or the like comprising an elongated substantially cylindrical pot adapted to contain the molten material and having openings adjacent either end, means supporting said pot with its axis inclined at an acute angle and with one of the openings adjacent the upper end of said pot and the other opening adjacent the lower end of the pot, the said pot including an upwardly extending portion surrounding the said other opening providing an extension for the introduction of material into said pot, the height of said extension being sufficient to maintain the molten material in said pot at a predetermined level, means for conducting heated gases about a major portion of said pot and out of contact with said openings to maintain the material in molten condition, means adjacent said one opening for longitudinally moving into said pot through said opening the articles to be treated, means within said pot for moving the articles therein through the molten material in a circular path adjacent the side wall of said pot with the entire length of each articles substantially equidistant from the side wall of the pot while moving in said path therein, and means adjacent the said one opening for longitudinally removing the treated articles from said pot through the said one opening.

10. An apparatus for applying a molten material to elongated articles such as pipes or the like comprising an elongated substantially cylindrical pot adapted to contain the molten material and having an opening adjacent one end, means supporting said pot with its axis inclined at an acute angle and with the said opening adjacent the upper end of said pot, means for heating said pot to maintain the molten material therein in liquid condition, means adjacent the said opening for longitudinally moving the articles to be treated through said opening and into said pot, means within said pot for moving the articles therein in a circular path adjacent the side wall of said pot with the entire length of each article substantially equidistant from the side wall of the pot while moving in said path therein, means adjacent the said opening for engaging and longitudinally removing the treated pipes from said pot through said opening, the said pot having a normally closed drain opening adjacent the lower end for removing material in a liquid state, and means adjacent the said drainage opening for receiving liquid material therefrom, whereby the molten material may be readily drained from said pot when heating of the pot and treating of articles are terminated.

11. An apparatus for applying a molten material to elongated articles such as pipes or the like comprising an elongated substantially cylindrical pot adapted to contain the molten material and normally closed except for an opening adjacent one end, means for conducting heated gases about a major portion of said pot and out of contact with said opening to maintain the material in molten condition, means adjacent said opening for longitudinally moving the articles to be treated into the pot through said opening, a plurality of rotatable members within said pot having openings adjacent their peripheries for supporting and moving the said articles in a circular path adjacent the side wall of said pot with the entire length of each article substantially equidistant from the side wall of the pot while moving in said path therein, driving means exteriorly of said pot connected with said rotatable members for rotating the latter with respect to said pot, and means adjacent the said opening for longitudinally removing the treated articles from said pot through said opening without interfering with the rotation of said members.

12. An apparatus as defined in claim 11 and further comprising means operated in timed relationship with the rotation of said members for controlling the delivery of articles to be treated to the said means for longitudinally moving the articles into said pot.

13. An apparatus for applying a molten material to elongated articles such as pipes or the like comprising an elongated substantially cylindrical pot adapted to contain the molten material and normally closed except for an opening adjacent one end, means for conducting heated gases about a major portion of said pot and out of contact with said opening to maintain the material in molten condition, means adjacent said opening for longitudinally moving the articles to be treated through said opening and into said pot, means within said pot for moving the

articles therein in a circular path adjacent the side wall of said pot with the entire length of each article substantially equidistant from the side wall of the pot while moving in said path therein, and means adjacent the said opening for longitudinally removing the treated articles from said pot, the last-mentioned means including a rotatable member having a helically arranged surface on the periphery thereof positioned for receiving the forward end of an article as it is returned to said opening by the means for moving the articles in said pot, and means rotating the said member whereby the said articles are longitudinally withdrawn from said pot while being circumferentially moved relative thereto.

14. An apparatus for applying molten material to elongated iron or steel articles such as pipes or the like, comprising an elongated substantially cylindrical pot adapted to contain the molten material and normally closed except for an opening adjacent one end, means for conducting heated gases about a major portion of said pot and out of contact with said opening to maintain the material in molten condition, means adjacent said opening for longitudinally moving the articles to be treated through said opening and into said pot, means within said pot for moving the articles therein in a circular path adjacent the inner wall of said pot, a member in said pot at a location remote from said opening, the said member having a surface inclined towards said opening on which the inner ends of the treated articles ride during their movement in said pot thereby causing sequential projection of the other ends of the articles above the surface of the molten material at said opening, and means longitudinally withdrawing the treated articles from said pot through said opening including a rotatable magnetic member having a helical surface on the circumference thereof positioned for sequential attraction thereto of the projected ends of the treated articles, and means for rotating said magnetic member whereby the articles are longitudinally withdrawn from said pot while being circumferentially moved relative thereto.

15. An apparatus for applying molten material to elongated articles such as pipes or the like comprising a chamber having heat insulating walls, a substantially cylindrical metal pot adapted to contain the molten material and supported within said chamber in spaced relationship with respect to the sides and top thereof, means for conducting heated gases through said chamber in contact with a major portion of said pot, the upper walls of said chamber and pot being normally closed except for openings adjacent one end thereof through which articles to be treated in said pot may be longitudinally introduced therein, means within said pot for moving the articles therein in a circular path adjacent the side wall of the pot with the entire length of each article substantially equidistant from the side wall of the pot while moving in said path therein, and means adjacent said openings for longitudinally withdrawing the treated articles from said pot.

16. An apparatus for applying molten material to elongated articles such as pipes or the like comprising a chamber having heat insulating walls, a substantially cylindrical metal pot adapted to contain the molten material and supported within said chamber in spaced relationship with respect to the sides and top thereof with the axis of said pot inclined at an acute angle, means for conducting heated gases through said chamber in contact with a major portion of said pot, the upper walls of said chamber and pot being normally closed except for communicating openings adjacent one end thereof through which articles to be treated in said pot may be longitudinally introduced therein, means intermediate the walls of said chamber and pot adjacent said openings preventing the heated gases from contacting the molten metal or escaping through the opening in the chamber wall, means within said pot for moving said articles in a circular path adjacent the side wall of the pot with the entire length of each article substantially equidistant from the side wall of the pot while moving in said path therein, and means adjacent said openings for longitudinally withdrawing the treated articles from said pot.

17. An apparatus for applying molten material to elongated articles such as pipes or the like comprising a chamber having heat insulating walls, a substantially cylindrical metal pot adapted to contain the molten material and supported within said chamber in spaced relationship with respect to the sides and top thereof with the axis of said pot inclined at an acute angle, means for conducting heated gases through said chamber in contact with a major portion of said pot, the upper walls of said chamber and pot being closed except for openings adjacent either end for respectively permitting longitudinal introduction of articles to be treated into said pot and for adding material to or removing dross from the pot, means adjacent said openings extending between the walls of the chamber and pot preventing the heated gases from contacting the molten material or escaping from the chamber through the said openings, means within said pot for moving said articles in a circular path adjacent the side wall of the pot with the entire length of each article substantially equidistant from the side wall of the pot while moving in said path therein, and means adjacent the article-introduction opening for removing the treated articles from said pot.

18. An apparatus as defined in claim 17 wherein the said pot has a normally closed drain opening adjacent the lower end of the pot for permitting removal of material in a liquid state, and means adjacent said drain opening for receiving liquid material therefrom, whereby the molten material may be readily drained from the pot when heating of the pot and treating of articles are terminated.

19. An apparatus for applying molten material to elongated articles such as pipes or the like comprising a chamber having heat insulating walls, a substantially cylindrical metal pot adapted to contain the molten material and supported within said chamber in spaced relationship with respect to the sides and top thereof with the axis of said pot inclined at an acute angle, means for conducting heated gases through said chamber in contact with a major portion of said pot, the upper walls of said chamber and pot being normally closed except for communicating openings adjacent one end thereof through which articles to be treated may be longitudinally introduced into said pot, means adjacent said openings extending between said pot and chamber walls preventing the heated gases from contacting the molten material or escaping from the chamber through the said opening in the chamber wall, rotatable members within said pot having openings adjacent their peripheries for supporting and moving the said articles in a circular path adjacent the side wall of the pot with the entire length of each article substantially equidistant from the side wall of the pot while moving in said path therein, driving means exteriorly of said pot connected with said rotatable members for rotating the latter with respect to said pot, and means adjacent the said openings for longitudinally removing the treated articles from said pot without interfering with the rotation of said members.

20. An apparatus as defined in claim 19 and further comprising means operated in timed relationship with the rotation of said members in the pot for controlling the delivery of articles to be treated to said pot.

21. An apparatus as defined in claim 19 and further comprising a member in said pot at a location remote from the opening therein having a surface inclined towards said opening and which engages the inner ends of the treated articles during their movement in said pot to sequentially project the other ends of the articles above the surface of the molten material at said opening for engagement with said removing means.

22. An apparatus as defined in claim 19 wherein the said removing means includes a rotatable member having a helical groove about the circumference thereof in which the ends of the treated articles are sequentially received, and means for rotating the last-mentioned member whereby the articles are moved both laterally and longitudinally as they are being removed from said pot.

References Cited in the file of this patent

UNITED STATES PATENTS

545,429	Lewis	Aug. 27, 1895
1,707,711	Conti	Apr. 2, 1929
2,184,610	Church	Dec. 26, 1939
2,326,843	Ely	Aug. 17, 1943