Sept. 25, 1956 D. J. REED ET AL 2,764,124

GALVANIZING INTERIOR OF CONTAINER

Filed Feb. 9, 1952

3 Sheets-Sheet 1

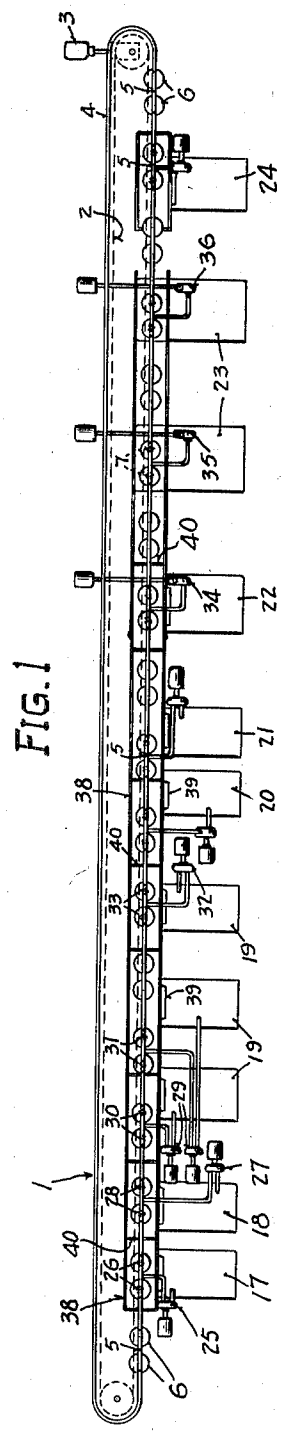


FIG. 1

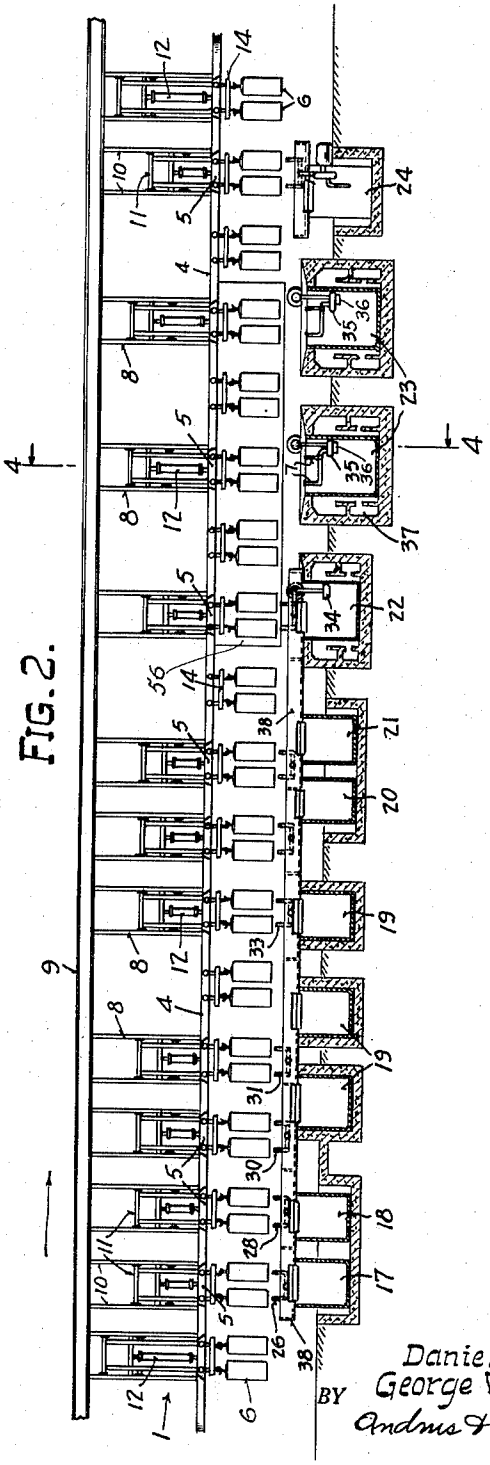


FIG. 2.

INVENTORS:
Daniel J. Reed
George W. Kennedy
BY Andms & Scales
ATTORNEYS.

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FIG. 3.

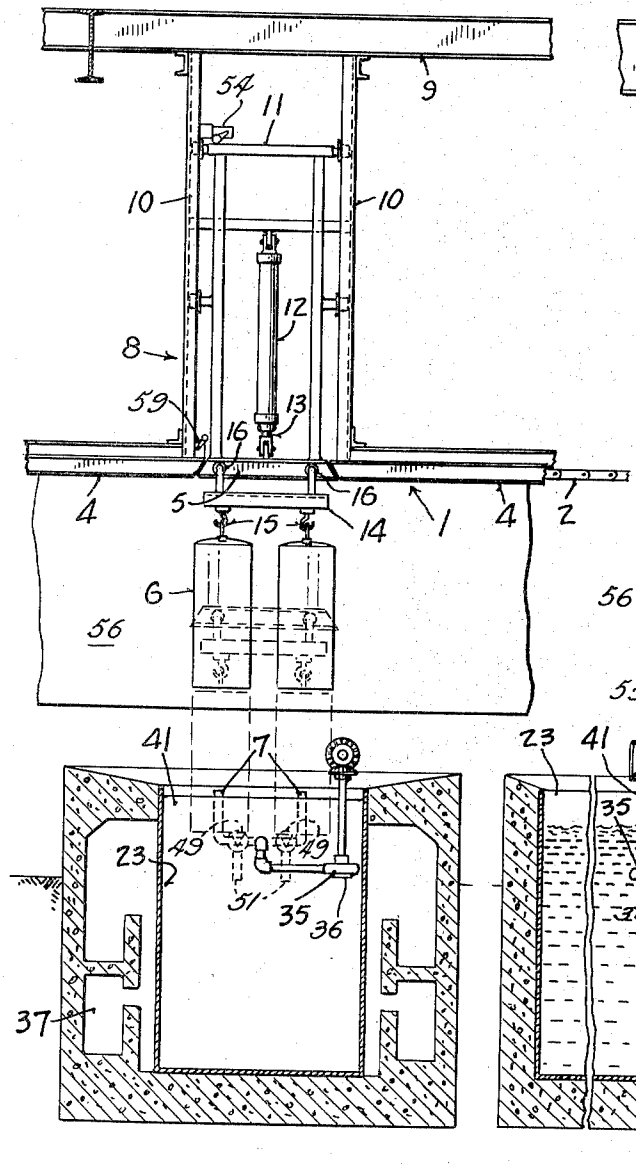
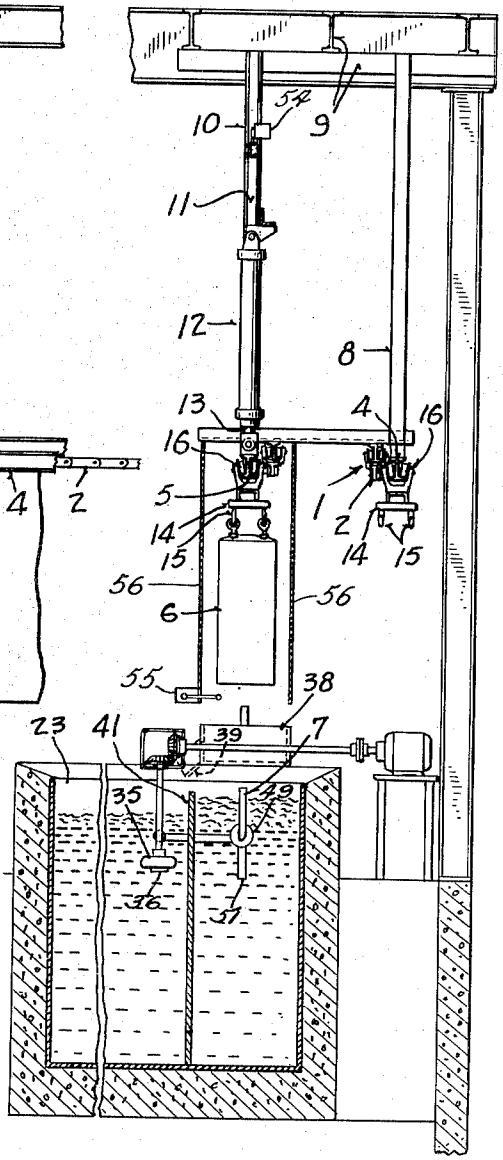


FIG. 4.



INVENTORS:
Daniel J. Reed
George W. Kennedy
BY Andrus & Sceales
ATTORNEYS.

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FIG. 5.

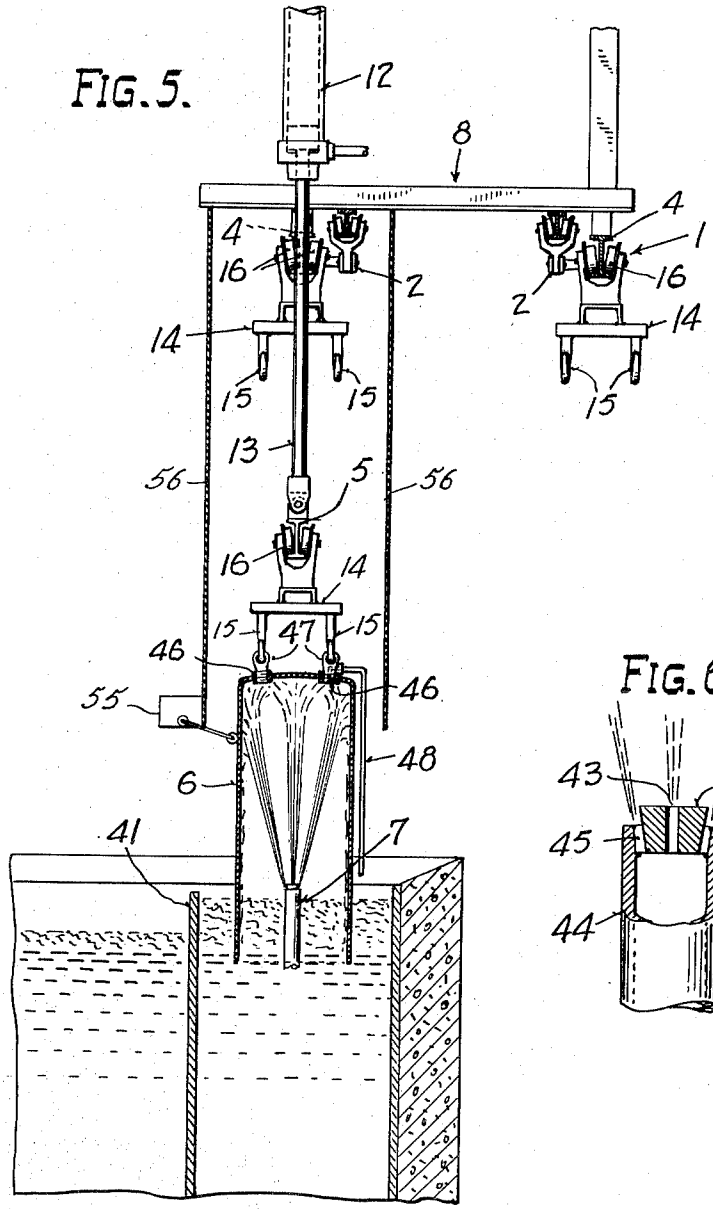
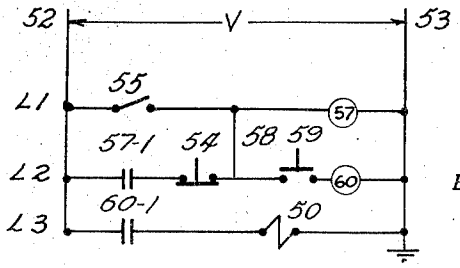


FIG. 6.

FIG. 7.



INVENTORS:
Daniel J. Reed
George W. Kennedy
BY Andrus & Sceales
ATTORNEYS.

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GALVANIZING INTERIOR OF CONTAINER

Daniel J. Reed, Milwaukee, Wis., and George W. Kennedy, Sylvania, Ohio, assignors to A. O. Smith Corporation, Milwaukee, Wis., a corporation of New York

Application February 9, 1952, Serial No. 270,792

5 Claims. (Cl. 118—302)

This invention relates generally to apparatus for, and the method of galvanizing the interior of containers such as for example hot water storage tanks.

It has been the general practice to galvanize such articles as hot water storage tanks by either dipping the entire tank into a molten bath of zinc or by introducing a predetermined quantity of molten zinc into a horizontally disposed tank, rotating the tank to spread the molten zinc across the interior surface of the tank and subsequently tilting the tank to drain the excess molten zinc from within the tank. Both of these procedures are relatively expensive to follow because in the first instance, a considerable time element is necessary in carrying out either procedure, fairly complicated apparatus may be required and there is little if any flexibility of operability available to control the thickness of zinc coating applied to the interior of the article being coated. In other words, if the article is coated by immersion of the same in a molten bath of the coating material, the thickness of coating is only generally determined by the time the excess coating material is permitted to drip from the article. In most instances this results in a coating of such heavy thickness as to effect flaking in service due to differences in thermal expansion and contraction between the coating and the base metal where the product is subjected to heating.

A principal object of this invention is to provide a method and apparatus for applying a thin coating of zinc to the interior surface of a substantially closed container such as for instance a hot water tank.

Another object is to provide a method and apparatus for automatically cleaning, flushing, fluxing and zinc coating the inside of a hollow member.

A further object is to provide apparatus for applying a coating of zinc to the interior surfaces of containers in which the time of exposure of the uncoated containers to the coating metal may be controlled.

Still another object is to provide apparatus for applying a coating of zinc to the interior surface of containers whereby the surfaces are deluged with streams of only molten zinc thereby preventing the undesirable results generally attained by atomization when air is utilized.

A further object is to provide the combination of an automatic conveyor system for containers and apparatus for applying streams of molten zinc to the interior surface of the articles to coat the same.

Another object is to provide apparatus of the above type in which the time for applying a desired thickness of zinc coating to the interior surface of containers is greatly reduced thereby effecting a saving in manufacturing costs.

Another object is to provide apparatus of the above type in which the interior of the article being coated may be effectively sealed from the atmosphere during application of the coating thereto.

Another object is to provide apparatus for applying a coating of zinc to the interior surface of containers and in which the containers and zinc applying means are

moved relative to one another prior to application of the coating.

These and other objects will appear from the following description when taken in conjunction with the drawings in which:

Figure 1 is a schematic plan view of a conveyor system and the various tanks of the combination apparatus of the invention:

Fig. 2 is an elevational schematic view of the conveyor system in combination with a sectional elevational view of the tanks;

Fig. 3 is an elevational view of a pair of containers disposed in position above one of the galvanizing tanks which is shown in section;

Fig. 4 is a view taken on line 4—4 of Fig. 2;

Fig. 5 is an enlarged section similar to Fig. 4 with the tank in lowered position and showing the spraying operation;

Fig. 6 is an elevational sectional view of the nozzle employed in the invention; and

Fig. 7 is a schematic circuit diagram of the electrical circuit which controls the spraying operation.

The invention will be described in connection with applying a coating of molten metal, for instance zinc, to the interior surfaces only, of hot water storage tanks of the general type used domestically.

Briefly, tanks to be coated on the inside with zinc are carried by an endless conveyor system above a battery or series of treating vats which successively provide for cleaning, pickling, fluxing, and coating the interior of the tanks. The conveyor system shown is timed to progressively move pairs of tanks, whose bottom ends are open, to stations immediately above the treating and coating vats, and to automatically lower the pairs of tanks over nozzles which are adapted to supply galvanizing material to the inner surfaces of each tank for a predetermined length of time.

The conveyor system **1** comprises an endless driving member **2**, such as a chain or the like, which may be driven by an electric motor **3** located preferably at one end of the system. An I-beam rail **4** is disposed around the driving chain **2** and is provided at spaced intervals with cut-out or free segments **5**. When in normal position the free segments **5** complete the continuity of the rail **4**, but the segments are adapted to be forced downwardly from the rail **4** to lower a plurality of open-end containers **6** such as hot water tanks, into position over nozzles **7**.

The endless chain **2** and I-beam rail **4** are carried by the lower ends of skeleton frames **8** which in turn are secured at their upper ends to an overhead support beam **9** secured into the ends of the building. The frames **8** are each provided with a pair of spaced side rails **10** upon which upper carriages **11** are adapted to slide. The lower ends of the carriages are secured to the upper edges of the free segments **5**.

Air cylinders **12** are disposed intermediate the side rails of the upper carriages and have their pistons **13** secured likewise to the upper edges of segments **5** so that upon actuation of the piston downwardly the segments **5** are driven downwardly. The size of the air cylinder with its piston may be selected in accordance with the distance it is desired that the work pieces shall move.

Undercarriages **14** are provided with suitable means **15** such as hooks or the like upon which are hung the containers **6** with their open ends facing downwardly. The undercarriages are provided with rollers **16** which permit the undercarriages to travel longitudinally along the rail **4**. The undercarriages are connected to the chain **2** by any suitable means such as fingers, which serve as a connection between the driven chain and the undercarriages.

The undercarriages **14** are spaced along the conveyor

and are indexed in their movement so that they will come to rest under the segments 5 of the I-beam 4. The indexing means is not shown or described as it is not, per se, the subject matter of the present invention. When an undercarriage and the tanks supported therefrom have been indexed into position with respect to a segment 5 the piston of the air cylinder will then force the segment 5 of the track 4 downwardly a predetermined amount so that the open ends of the tanks will be disposed over the nozzles 7. After the spraying operation the undercarriages are raised to a position where the segment 5 again becomes a part of track 4 at which time a driving connection is simultaneously made between the undercarriage and the endless chain 2 and the containers are indexed longitudinally to the next station.

As best seen in Fig. 2 a plurality of vats are disposed below the conveyor system 1 and are arranged in series so that the workpieces being processed may pass from one to another in proper sequence. The bottoms of the vats are disposed in pits extending below the floor line of the building and provide for cleaning, pickling, rinsing, fluxing, and galvanizing of the containers as the same are indexed to the respective vats. The particular vats herein described are arranged from left to right as follows: a cleaning vat 17, cold rinse vat 18, three acid pickling vats 19, a cold rinse vat 20, a hot rinse vat 21, a flux vat 22, two galvanizing vats 23, and finally a cold rinse vat 24.

The respective vats may be made from any appropriate material that will withstand corrosion and the effects of heat. Thus the cleaner and rinse vats may be of suitable steel, the pickling vats lead lined, and the galvanizing vats preferably fabricated from firebox steel. Likewise the respective vats are provided with a pump and motive power therefor to deliver fluid from the tank through a nozzle to the interior of the articles to be coated. The cleaning vat is provided with a motor driven pump 25 for supplying cleaning fluid to nozzles 26, vat 18 is provided with pump 27 to supply a cold rinse fluid to nozzles 28. Two of the three acid vats 19 are provided with acid pumps 29 for supplying pickling fluid to nozzles 30 and 31 respectively, while the third of the acid vats is provided with motor driven pump 32 to supply pickling fluid to nozzles 33. The remaining cold rinse vats and the hot rinse vat are supplied with individual motor driven pumps similar to pump 25 and all of the pumps heretofore mentioned are mounted adjacent the respective vats mentioned with dip tubes leading from the pump into the fluid in the vat.

Flux vat 22 is provided with an independently driven pump 34 for delivering the flux material to its corresponding nozzles for spraying into the containers 6. The galvanizing vats 23 are each provided with independently driven pumps 35 having their intakes 36 submerged in the molten galvanizing material. In accordance with the lowering of containers 6 over the nozzles 7 corresponding to the vats 23, pumps 35 deliver the galvanizing material to the nozzles for spraying into the containers.

The flux in vat 22 is generally maintained at a temperature ranging from 800 degrees to about 820 degrees while the molten zinc in vats 23 is generally maintained at temperature ranging from about 845 degrees to about 870 degrees. To provide the required temperatures each vat is surrounded and heated by suitable gas fired furnaces 37. In order that these temperatures may be maintained at these particular stations it is generally preferable to enclose and heat the space above the vats. This may be accomplished by electric heaters or by the use of a non-oxidizing heated gas in this area. The particular structure for accomplishing this end is not shown it being merely necessary to utilize a suitable source of heat to maintain the desired temperatures.

An elongated drip pan 38 of generally rectangular shape and having a plurality of spouts 39 leading from the pan to the above-mentioned vats is disposed along the tops of the vats to catch the excess fluid which drips from the treated containers and returns the same to the respective vats. The pan 38 is provided with a plurality of transverse partitions 40 suitably positioned so as to insure that the various fluids employed in the process will not become intermixed and will return to the proper vats.

Each galvanizing vat 23 is provided with a dam 41 adjacent the front of the vat (as seen in Fig. 4) which extends across the vat from one side to the other. The molten zinc in the vat is provided with a blanket or covering of flux. It is preferable that the thickness of the flux blanket be greater in that portion of the vat into which the open end containers are disposed, and the dam 41 functions to permit this. The flux not only prevents oxidation of the molten zinc but also serves as a semi-seal for the open ends of the containers which are permitted to extend down into the blanket for a substantial depth during application of the zinc to the inner surfaces of the containers.

Nozzles 7 which are located in each galvanizing vat 23 comprise a tip 42 of generally conical shape having passageway 43 extending centrally through the tip from the base to the apex. The tip is disposed so that the base faces upwardly as viewed in Fig. 6 with the apex facing oppositely. The tip 42 is secured in spaced relation to the body 44 of the nozzle by metal spacing fins 45. Nozzle body 44, which is in effect the conduit for the molten zinc, may be made to any suitable configuration so that when it is secured to the outlet side of the submerged pump it will supply molten zinc to the tanks disposed over the nozzles. The tip and body of the nozzle is designed so that the streams of molten zinc issuing therefrom reach the entire closed end of the container being coated as well as the junction between the closed ends and the shell of the container. This feature of the nozzle is of great importance in the event that the container is provided with a joint between the end of the tank and the shell such as when either a concave or convex head is secured to the shell of the tank as by welding. The nozzle may be designed so that the side streams of molten zinc issuing from the tip 42 will be directed against the joint to insure a supply of the particular coating material at the joint area. The nozzle of the invention permits deluging of the upper end of the container by the coating with the excess running down the side of the shell to coat that portion of the tank which is not directly covered by the sprayed molten zinc.

In the event that an end of the container is provided with openings 46 for the usual connections to be applied thereto, the openings may be closed with suitable plugs, or screw eyes 47 for supporting the tank, may serve as a plug. A vent 48 may be inserted into an apertured screw eye to discharge air from the inside of the container.

It is generally unnecessary to employ the vent unless the container being coated is of a particular shape which requires venting.

The air cylinder (see Fig. 2) at the extreme left, or loading station, of the conveyor system, and the air cylinder at the extreme right, or unloading station, of the conveyor system are of substantially greater length than the remainder of the air cylinders. This is necessary because of the fact that the containers are loaded and unloaded from ground or floor level whereas the remaining air cylinders need only operate to position the containers which are to be coated over the respective nozzles. However, the air cylinders disposed above the flux vat and galvanizing vats are of substantial length for the reason that it is necessary to lower the open ends of the containers being treated over nozzles which are disposed within the respective vats near the top of the vats. This is preferable because it is desirable to prevent as much air as possible from coming into contact with the interior of the containers at the fluxing and galvanizing stations.

The conveyor system is provided with suitable electric controls including relays, limit switches, timer and transformer, some of the controls for automatic operation of the system being shown in Fig. 7 and hereinafter described, the only manual operations being those of loading and unloading the containers from the undercarriages.

To insure that the respective spraying operations will be timed with the lowering of containers 6, a controlled valve 49 is disposed between each nozzle and the pump associated therewith. The valve 49 is operated by a solenoid 50, shown in Fig. 7. Normally the valve 49 is set to close the conduit to nozzle 7 so that the pumped liquid is returned to the vat via the submerged outlet 51. When the solenoid 50 is energized valve 49 is operated to close outlet 51 so that the pumped liquid issues from the nozzle 7.

A circuit for operating the solenoid valve 49 for each nozzle is shown in Fig. 7. The power lines 52 and 53 are connected to a source of power and supply the circuits through lines L1, L2, and L3. The normally closed switch 54 disposed in line L2 is located on frame 8 as shown in Fig. 3 and is opened by carriage 11 when it reaches its uppermost position. After the undercarriage 14 comes to rest on the disengageable segment 5 of rail 4 and the air cylinder 12 is energized to lower the carriage 11, switch 54 returns to its normally closed position after the carriage starts downwardly. As the containers 6 on carriage 11 move downwardly to their position over the respective nozzles, the containers at least momentarily engage the switch arm of safety switch 55 disposed in line L1 and shown in Figs. 3 and 4 as being secured to the barrier guard 56. Closure of switch 55 energizes contact relay 57 to close contacts 57—1 in line L2 to lock in the circuit through relay 57, branch line 58, normally closed switch 54 and contacts 57—1. When the containers 6 reach their lowermost position over the nozzles 7, the carriage 11 closes the switch 59 located on the frame 8 as seen in Fig. 3. Closure of switch 59 closes the circuit through line L2 to energize contact relay 60 to close contacts 60—1 in line L3. Closure of contacts 60—1 energizes the solenoid 50 in line L3 to set valve 49 to supply the pumped fluid to the nozzle.

After a predetermined period of time the air cylinders 12 are energized to return the disengageable segments 5 to their initial position to form the continuous track 4. As the carriage 11 starts upwardly it will disengage switch 59 in line L2 deenergizing relay 60. Deenergization of relay 60 will open the contacts 60—1 in line L3 and break the circuit through line L3 to deenergize solenoid 50 and set valve 49 to close the conduit to nozzle 7 so that the pumped fluid is returned to the vat via outlet 51. When the carriage 11 reaches its uppermost position it will engage and open normally closed switch 54 to break the locked in circuit through relay 57 to set the respective circuits for the next cycle of operation.

The described system provides that the liquids in the respective vats are constantly being pumped with valves 49 normally being set so that the liquid bypasses the nozzle 7 and merely recirculates in the vat. The system further provides that valve 49 will not be operated to deliver fluid to the nozzle unless a container 6 actually trips switch 55 to set the solenoid circuit. Thus, if for any reason a container 6 is missing from hooks 15 solenoid 50 will remain deenergized so that the pumped liquids will merely continue to recirculate within the vat.

In operation, the open end containers are loaded at one end of the system and the undercarriages are moved longitudinally progressively until they are stopped when in subjacent alignment with the free segments 5 of the conveyor rail 4. The air cylinders then operate to lower the free segments, undercarriages and containers to positions over the nozzles which then deliver the particular fluid medium to the inner surfaces. The time of exposure of the interior of the containers to the several fluid media is controlled, and this is of particular importance in that the thickness of zinc coating applied to the interior surfaces of the container may be regulated to assure a zinc or galvanizing coating of sufficient thickness without waste of zinc as is likely to occur in the well known and practiced dipping art.

The terminology "open end containers" as used herein refers to a container which does not have the lower head secured in place as shown in Fig. 5, and also to a container where the lower head has been secured within the shell but has an opening for insertion of the nozzle and run out of zinc.

This invention may also be used in galvanizing one surface of objects such as pipe, wherein a plurality of lengths of pipe may be disposed in an adapter and molten zinc pumped into the interior of the pipe by suitably designed nozzles.

The invention provides apparatus and a method whereby only one surface of a container may be deluged or flooded with a zinc coating and in which the time of exposure of the uncoated surface to the coating material may be controlled, thereby assuring a coating of a specified thickness with consequent saving of operating time.

Various embodiments of the invention may be employed within the scope of the accompanying claims.

We claim:

1. Apparatus for the automatic galvanizing of the inside of metal tanks and cylindrical articles without galvanizing the outside thereof, comprising a plurality of open top vats disposed in a series and respectively adapted to contain cleaning, flushing, fluxing and molten zinc compositions, a pump associated with each vat and having its intake disposed below the liquid level in the vat, a vertically disposed discharge nozzle above the liquid level in each vat and adapted to discharge liquid from the corresponding pump in a plurality of upwardly directed streams, conveyor means adapted to transfer successive articles to be galvanized to successive positions over the respective discharge nozzles and to disposed each article with its open end downward and closed by the liquid in the corresponding vat, and means to control the discharge of liquid from said discharge nozzles into the interior of said articles in synchronism with the operation of said conveyor.

2. Apparatus for the automatic galvanizing of the inside of metal tanks and cylindrical articles without galvanizing the outside thereof, comprising a plurality of open top vats disposed in a series and respectively adapted to contain cleaning, flushing, fluxing and molten zinc compositions, a pump associated with each vat and having its intake disposed below the liquid level in the vat, a vertically disposed discharge nozzle above the liquid level in each vat and adapted to discharge liquid from the corresponding pump in a plurality of upwardly directed streams, conveyor means adapted to transfer successive articles to be galvanized to successive positions over the respective discharge nozzles and to disposed each article with its open end downward and closed by the liquid in the corresponding vat, and means to by-pass liquid from said nozzles at all time, except when an article is positioned thereover.

3. In combination with a power-driven conveyor system provided with a conveying track having a plurality of spaced periodically disengageable and retractable segments therein and adapted when disengaged to expose to upwardly directed streams of molten metal, the inner surface of hollow articles of manufacture dependingly supported from movable carriages disposed beneath the segments, a plurality of vats disposed in series beneath said track with at least one of the vats adapted to contain a supply of molten metal, a pump having its intake submerged within said last recited vat beneath the top level of said molten metal, a nozzle connected with said pump and having its discharge outlet disposed upwardly and above the metal level, said nozzle comprising a hollow body member, a conically shaped tip member having a centrally disposed passageway extending longitudinally thereof, said tip being invertedly secured in spaced relationship to one end of said body to provide upwardly and outwardly extending passageways between the tip and the body, the combination of passageways being adapted to supply streams of molten metal to the inner surface of

hollow articles disposed above said nozzle, and motive means disposed adjacent the pump to operate the same.

4. In combination with a power-driven conveyor system provided with a conveying track having a plurality of spaced periodically disengageable and retractable segments therein and adapted when disengaged to expose to upwardly directed streams of molten metal, the inner surface of hollow articles of manufacture dependingly supported from movable carriages disposed beneath the segments, a plurality of vats disposed in series beneath said track with at least one of the vats adapted to contain a supply of molten metal and a blanket of flux disposed across the upper level of the metal, a dam disposed adjacent the top of said vat and extending between the opposite sides thereof and downwardly from the top level thereof for a substantial distance, and so arranged that a flux blanket on one side of the dam will be of greater depth than on the opposite side thereof to provide a seal to the entrance of air at one end of the hollow articles disposed therein, a pump having its intake side disposed within said last recited vat and beneath the top level of said molten metal, a nozzle connected with said pump and having its discharge outlet disposed upwardly and above the metal level, said nozzle having a plurality of angularly upwardly disposed openings therein to supply molten metal from the vat to the inner surface of hollow articles of manufacture disposed above said nozzle, and motive means to operate the pump.

5. In combination with a power-driven conveyor system, a conveying track having a plurality of spaced periodically disengageable and retractable segments, a plurality of carriages disposed for movement on said track and supporting hollow articles of manufacture having an

open end disposed downwardly, means to disengage said segments after a carriage comes to rest thereon and move the same downwardly, a plurality of vats disposed in series beneath the track with at least one of the vats adapted to contain a supply of molten metal, a pump having its inlet submerged below the level of the molten metal, a nozzle connected to the outlet of said pump and being disposed above the level of the molten metal and aligned beneath a disengageable segment of the track, said nozzle comprising a hollow body member, a conically shaped tip member at the upper end of the nozzle having a centrally disposed passageway extending longitudinally thereof, and said tip being invertedly secured in spaced relation to one end of said body to provide upwardly and outwardly extending passageways between the tip and the body, the combination of passageways being adapted to supply streams of molten metal to the inner surface of the hollow articles after the supporting carriage from which they depend have moved downwardly with the disengageable segment, and means to operate the pump.

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