Feb. 18, 1958 R. A. WHITBECK 2,823,640

APPARATUS FOR APPLYING LIQUID TO, AND DRYING, METAL STOCK

Filed June 22, 1955 2 Sheets-Sheet 1

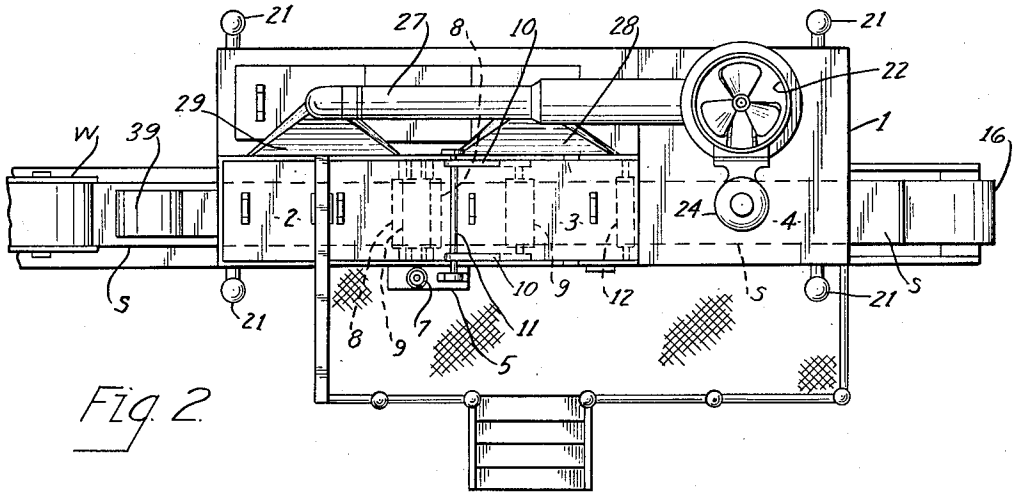


Fig. 2.

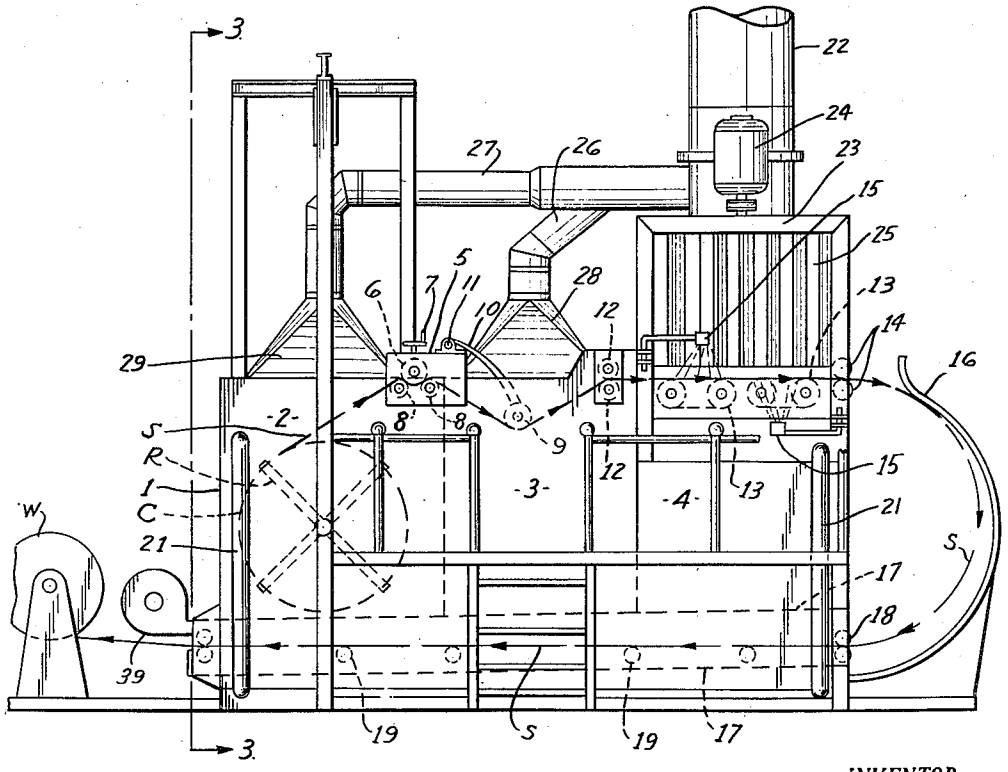


Fig. 1.

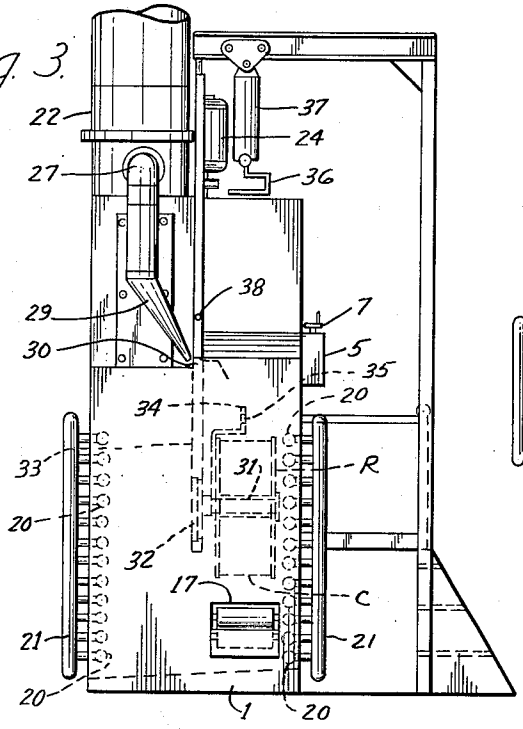
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Fig. 3.



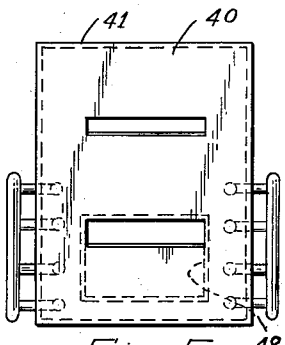
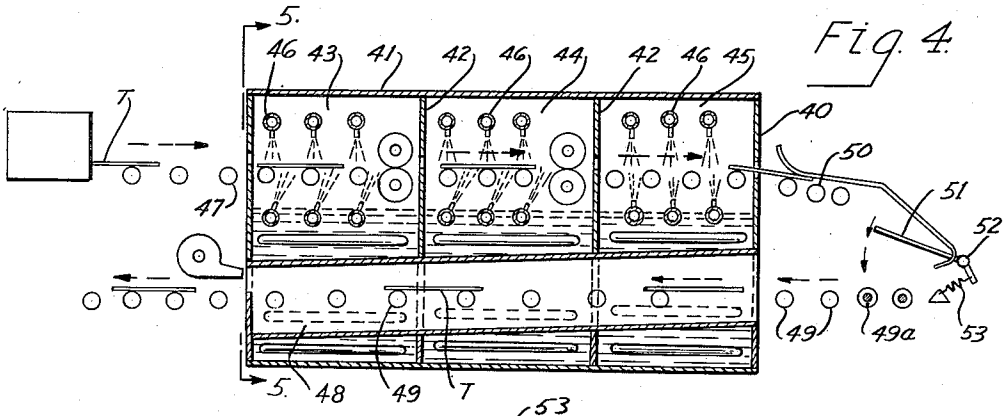


Fig. 5

Fig. 4.



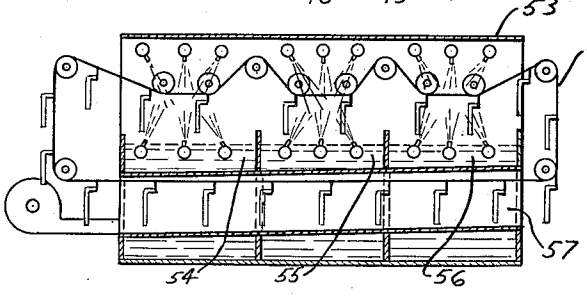


Fig. 6.

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APPARATUS FOR APPLYING LIQUID TO, AND DRYING, METAL STOCK

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8 Claims. (Cl. 118—64)

This invention relates to broadly a liquid applying and drying apparatus for treating articles such as stock material to be formed or fully or partially formed pieces or articles, and more specifically to coating them with a thin, self-adherent dry film, such as a lubricating film of a temporary nature which is operative in subsequent forming, fabricating, or treating steps, or a film of a permanent nature, such as a decorative coating.

For the purposes of illustration, the invention will be described primarily as embodied in an apparatus which is designed to clean and rinse such articles as sheet metal stock, then to apply a wet lubricating solution of the desired coating material thereon, and finally, to dry the applied solution thereon so as to form on the stock a self-adherent, dry, lubricating and protecting film or coat.

Specifically the invention is described hereinafter as an apparatus in which the stock is passed through a tank having successive compartments in the first of which the stock is cleaned with a suitable hot cleaning bath, in the second of which it is rinsed in a hot bath, and in the third of which it is coated with a hot coating solution, after which the stock is passed immediately through a drying tunnel extending through the compartments and heated by heat applied to the tunnel walls by one or more of the baths, whereby the solvent of the coating solution is evaporated by the residual heat of the stock and the heat within the tunnel, and the solute is deposited on the stock as a dry film.

The apparatus comprises a tank having a series of compartments arranged end to end and containing, in turn, a cleaning bat, a rinsing bath, and a bath of coating material with which the stock is to be coated. Each of the baths is heated to a predetermined temperature, preferably near to 212° F. Means are provided for feeding lengths of stock or articles continuously from one end of the tank to the other end through the compartments so that they are first cleaned, then rinsed, and then coated just before they emerge.

The principal novelty of the apparatus resides in a tunnel which extends through the tank from the discharge end of the last compartment to the feeding or inlet end of the first compartment and which is so arranged within the tank that it is in direct contact with the heated liquids of the baths therein and derives sufficient heat therefrom so that, when the lengths of stock or articles emerge from the tunnel the coating is dried properly thereon due to the residual heat in the stock or articles and the heat transmitted to the interior of the tunnel from one or more of the baths.

The principal object of the present invention is to provide a simple apparatus for this purpose which eliminates the necessity for the large drying unit heretofore provided and which greatly reduces the floor space required as compared to apparatus of comparable capacity in which the cleaning, rinsing, coating equipment is arranged in end to end relation to the drying apparatus.

Other objects and advantages will become apparent

from the following description wherein reference is made to the drawings, in which:

Fig. 1 is a side elevation of a preferred form of apparatus embodying the principles of the present invention;

Fig. 2 is a top plan view, partly in section, of the apparatus illustrated in Fig. 1;

Fig. 3 is a left end elevation of the apparatus illustrated in Figs. 1 and 2;

Fig. 4 is a diagrammatic, longitudinal, vertical, sectional view of an apparatus similar to that illustrated in Figs. 1 through 3, but modified for coating successive individual sheets of material;

Fig. 5 is a diagrammatic end view of the transfer device illustrated in Fig. 4, viewed as indicated by line 5—5 in Fig. 4; and,

Fig. 6 is a diagrammatic, longitudinal, vertical, sectional view of an apparatus similar to Fig. 4, but employing a chain conveyor.

Referring to Figs. 1 through 3, the apparatus comprises an elongated tank **1** which, beginning at the left end in Fig. 1, is divided successively into a plurality of compartments for the solutions to be used in cleaning and coating the stock or articles to be processed therein.

In the form illustrated, three compartments are provided, these comprising a cleaning compartment **2** in which a chemical cleaning bath is contained, a rinsing compartment **3** in which a hot water rinsing bath is contained, and a coating compartment **4** in which a bath of coating solution to be applied is contained.

The form illustrated in Fig. 1 is arranged for processing coiled stock S in which case the coil C is mounted on a suitable reel R and supported in the compartment **2** so as to be submerged in the bath therein.

The stock S is driven continuously and passes through a suitable straightening device **5** having rolls which are arranged so that the stock passes therethrough as it is leaving the compartment **2** and passing itno the compartment **3**. The main or upper straightening roll **6** of the device is adjustable by means of the usual hand operated shaft and gear **7** for imposing the desired straightening strain on the stock. The straightening rolls **8** of the device preferably are power driven so as to assist in effecting travel of the stock.

The stock passes from the rolls **6** and **8** into the compartment **3** where it is maintained submerged in the rinsing bath therein by means of a heavy roller **9** which is mounted on a supporting arm **10** which is arranged to swing about a horizontal pivotal axis, as indicated at **11**. Thus the roll **9** can maintain the stock S submerged as it passes through the compartment **3** without imposing any undue stresses on the stock.

Near the opposite or outlet end of the compartment **3** are feed rolls **12** between which the stock passes and which are arranged to drive it, as near as may be, at the same speed as the bank of rolls **5**. The rolls **12** are arranged near the inlet of the coating compartment **4**.

The stock passes from the compartment **3** into the compartment **4** wherein it is supported on additional power driven feed rolls **13** which drive it through the compartment **4** wherein it is sprayed with the coating solution. Sprays **15** are arranged within the compartment **4** so as to spray the coating solution onto both the upper and lower faces of the stock as it passes through the compartment. These sprays **15** are of a conventional type for the liquid to be applied and are connected to the conventional feed line and pump which latter withdraws the liquid to be sprayed from near the bottom of the compartment **4**. The excess of the sprayed material drips from the stock back into the compartment **4**.

Near the outlet end of the compartment **4** are power driven feed rolls **14**. As the stock issues from the compartment **4**, it passes against the inside of a curved guard

or guide 16 which engages its lateral margins and directs it downwardly and back in the direction opposite from that at which it emerged from the compartment 4.

Compartment means are provided which have walls with portions extending into the tank 1 and arranged to provide a drying compartment therein which is uncommunicated with the interior of the tank and open at at least one of its ends exteriorly of the tank. The major portion, and preferably all, of the exterior surface of these wall portions lies below the level of the bath and is exposed in direct contact with the bath.

In the preferred form, particularly where continuous travel of the articles is desired, the compartment means is in the form of a tunnel which extends through the tank 1 from its left hand or inlet end to its right hand or outlet end. This tunnel is open at both ends and the stock S, when redirected by the guard 16, passes into the tunnel at the right hand end in Fig. 1 and travels entirely through the tunnel, emerging at the left hand end of the tunnel where it is rewound on a rewinding reel W.

Suitable sets of drive rolls 18 and power driven supporting conveying rolls 19 are provided for propelling the stock through the tunnel 17.

The tunnel, throughout its length, is immersed in the baths in the tank 1. Preferably it is spaced from the bottom and side walls of the tank 1 so that its top, bottom and side walls are in direct contact with the liquid baths in the compartments 2, 3 and 4.

The walls of the tunnel preferably are made of metal having high heat conducting and radiating properties and, if desired, they may be provided with the usual heat radiating fins and other extended heat exchange surfaces on either their inside or their outside surfaces, or both.

Arranged in the tank 1 and preferably extending from one end thereof entirely through each of the compartments, in turn, are steam pipes 20 by which the liquid baths in the compartments are heated. Preferably the steam pipes are arranged in banks at each side of the tank 1 and are connected to the usual in-put and discharge manifolds 21. The banks of pipes extend from near the bottom of the tank 1 a substantial distance thereabove, and preferably considerably above the level of the top wall of the tunnel 17. The conventional motor driven recirculating pumps or propellers (not shown) may be provided in the compartments for keeping the baths stirred and uniform.

A suitable exhaust duct system, including a main duct 22 which opens into a hood 23 above the compartment 4, is provided. An exhaust fan is provided and is driven by a suitable motor 24. Louvres 25 are arranged in the hood 23 between the fan and the inlet of the duct 22. Suitable supplementary ducts 26 and 27 lead from the duct 22 to suitable inlet housings 28 and 29, respectively, which communicate with a suitable collecting channel 30 arranged near the tops of the compartments 2 and 3 along one side. This exhaust system is arranged for convenience in removing from the work-site any gases and steam and the like which might interfere with the operator.

For supporting the reel or coil C and permitting its ready installation and removal, the reel R is mounted on a spindle 31 which, in turn, is carried in a carriage 32. The carriage 32 is guided by, and slidable along, an upright trackway 33. A hook 34 is provided on the spindle and in its upper end has a hole 35 which can receive a hook 36 of a power operated travelling hoist 37. Thus the coil or reel R can be raised or lowered into the tank. A suitable hole 38 is provided in the trackway 33 so that, when the coil is hoisted above the level of the top of the compartment 2, a pin can be inserted in the hole 38 to support the slide 32 in the raised position while the coil or reel is being changed.

The liquid baths in the compartments preferably are maintained at a temperature of about 212° F. so that the tunnel is heated at least close to this temperature.

The rate of travel of the stock is such as to afford it ample time to become dried to the proper extent for recoil by the time it emerges from the discharge end of the tunnel.

It is to be noted that since the stock is subjected to the hot liquid baths when passing through the compartments 2, 3 and 4, it contains a substantial amount of residual heat which, with the additional heat maintained in the tunnel by the baths, is ample to dry the stock.

Generally there is ample flow of air into and out of the tunnel by convection. However, if greater flow is desired the tunnel may be sloped upwardly from one end to the other, preferably from its discharge end to its inlet end, as illustrated in Fig. 1, so that the stock is subjected to progressively drier air as it approaches the outlet. If desired, a conventional blower 39 may be provided to blow air into the discharge end of the tunnel to facilitate the air flow therein and drive the moist air out of the inlet end of the tunnel.

Referring next to Fig. 4 there is shown diagrammatically an apparatus which may be similar in all respect to that in Figs. 1 through 3 except that, since the stock is in the form of individual sheets T and must be conveyed differently through the compartments and differently handled therein, the means of transporting the stock are modified.

The tank 40 is provided at the top with a continuous hood 41, and partition walls 42 which extend from the bottom to the top of the tank on up to the top of the hood and divide the tank and hood into compartments 43, 44, and 45, respectively. Suitable spray nozzles 46 are arranged in the various compartments and the nozzles of each compartment are connected with the conventional pipe lines and pumps so as to receive liquid from near the bottom of their associated compartments and spray it onto the stock being conveyed therethrough. The stock is conveyed by driven conveyor rolls 47.

A tunnel 48 is provided near the base of the tank 40 and extends entirely therethrough from end to end, suitable conveyor rolls 49 being provided in the tunnel for effecting travel of the stock therethrough. The compartments are provided with heating coils or pipes in the same manner as the compartments in the form illustrated in Figs. 1 through 3.

At the outlet end of the compartment 45, a suitable number of conveyor rolls 50 are provided, these conveyor rolls conducting the sheets a short distance from the end of the tank at which location the sheets tip and fall from the rolls 50 onto a pair of transfer arms 51 which are spaced apart from each other across the path of travel. The arms are mounted on a pivot 52 and are held in a normally raised position, illustrated in Fig. 4, by suitable means, such as a counterbalance spring 53. The arms 51 are so arranged relative to the spring 53 that when a sheet of the stock T is disposed on the arms 51, its weight causes them to swing down about the pivotal axis so that that end of the sheet nearest the tank 41 strikes some of the feed rolls 49 and the sheet is thereby moved off of the arms 51 onto the remaining rolls 49 which carry it through the tunnel. When a sheet is removed from the arms 51, they return to the position illustrated in Fig. 4 and receive the next successive sheet of stock. If desired, some of the rolls 49 which are nearest the pivot, may be provided with peripheral grooves 49a into which the arms 51 can swing so as to pass beneath the level of the upper surface of the rolls and thus apply the weight of the sheet to the rolls 49 so as to facilitate its removal by the rolls 49.

Thus the sheets can be fed from the stack at the left in Fig. 4, sheet by sheet, into the left end of the tank 41, or cleaning compartment 43, after which they pass successively through the compartments thence to the transfer arms 51, and thence into the tunnel from which they emerge at the feeding end of the tank 41, cleaned, coated,

and dried, and so ready for any subsequent coating or handling.

Referring next to Fig. 6, there is shown a form of the apparatus for coating formed articles. This form of the invention is the same as those heretofore described, employing a tank **53**, with compartments **54**, **55**, and **56**, respectively, which contain baths for cleaning, rinsing and coating. The articles are carried through the baths on hooks on an endless conveyor **58** in the form of a chain, which, beginning at the left in Fig. 6, conveys the articles through the compartments **54**, **55**, and **56**, in turn, and then back through a tunnel **57** to the inlet end of the tank. The tunnel **57** is heated by the heated baths in the compartments **54**, **55**, and **56**. In the form illustrated in Fig. 6, the compartments are shown as provided with sprays for spraying on the various baths. However, if desired, the chain may be loosened so that it sags downwardly in each compartment so as to dip the articles in each bath in turn.

The apparatus may be used, when desired, for cleaning, or rinsing, and drying, without coating.

Having thus described my invention, I claim:

1. In a liquid applying and drying apparatus, a tank adapted to contain at least one liquid to be applied to articles, means for supplying heat into the tank for heating the liquid therein, means having walls with portions thereof within the tank and providing in the tank a drying compartment for articles to which the liquid has been applied, said compartment being arranged to exclude entry of the liquid into the compartment from the tank and being open at at least one of its ends exteriorly of the tank, at least the major portion of the exterior of the surface of said wall portions being positioned below a predetermined normal liquid level of the tank and exposed in the tank for direct contact with liquid therein when the tank is filled to said level, means for causing articles to travel along a predetermined path, means for applying the liquid from the tank onto the articles when they pass along a portion of said path, and means for causing the articles to pass through said drying compartment after they have traveled along said portion of said path.

2. Apparatus according to claim 1 characterized in that means are provided to circulate air through said drying compartment.

3. Apparatus according to claim 1 characterized in that at least the top wall of said compartment slopes endwise of the compartment upwardly towards said one of the ends of the compartment.

4. Apparatus according to claim 3 further characterized in that the compartment is in the form of a tunnel open at both ends and the slope of said top wall is upwardly from one end of the tunnel to the other end of the tunnel.

5. In a liquid applying and drying apparatus, a tank adapted to contain heated liquid to be applied to articles, means for supplying heat into the tank for heating the liquid therein, a tunnel extending through the tank and open at its ends for admitting and discharging articles to which the liquid has been applied, said tunnel being arranged to exclude the entry of the liquid into the compartment from the tank, disposed with the major portion of its exterior surface below the normal liquid level of the tank, and exposed for direct contact with liquid in the tank, and means to convey articles through said tunnel.

6. In a liquid applying and drying apparatus, an elongated tank adapted to contain heated liquid to be applied to articles, a tunnel extending through the tank from one end of the tank to the other end of the tank, said tunnel being open at its ends for admitting and discharging articles, being arranged to exclude the entry of liquid into the tunnel from the interior of the tank, and having its peripheral wall within the limits of the tank disposed with the major portion of the exterior surface below the normal liquid level of the tank and exposed for direct contact with liquid in the tank, means to convey articles lengthwise of the tank from one end to and beyond the other end along one portion of the path of travel of the articles and thence back in the opposite direction through the tunnel along another portion of said path, means to apply liquid from the tank on the articles along said one portion of the path, and means to supply heat to the liquid in the tank.

7. In a liquid applying and drying apparatus, means providing a row of compartments for liquids, heating means within the compartments for heating the liquids therein, respectively, an elongated tunnel which is peripherally sealed and open at its ends for admitting and discharging articles at its ends, respectively, said tunnel extending through said compartments successively from one end of the row to the other, means respective to the compartments for applying liquid therefrom to the articles as the articles pass through said compartments, means for conveying the articles through said compartments in succession and then through the tunnel.

8. In a liquid applying and drying apparatus, a tank adapted to contain at least one liquid to be applied to articles, means for supplying heat into the tank for heating the liquid therein, means having heat conducting wall portions in heat exchange relationship to the liquid in the tank and including a tunnel arranged to exclude the entry of liquid from the tank and open at its ends to admit and discharge articles, means for applying liquid from the tank to articles along a predetermined initial path of travel of the articles, means to convey the articles along said initial path of travel and along a subsequent path of travel which extends entirely through the tunnel.

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