Nov. 15, 1960 R. A. WHITBECK 2,960,061

APPARATUS FOR APPLYING A COATING OF CONTROLLED VARIABLE THICKNESS TO METAL STOCK

Filed Jan. 22, 1957 2 Sheets-Sheet 1

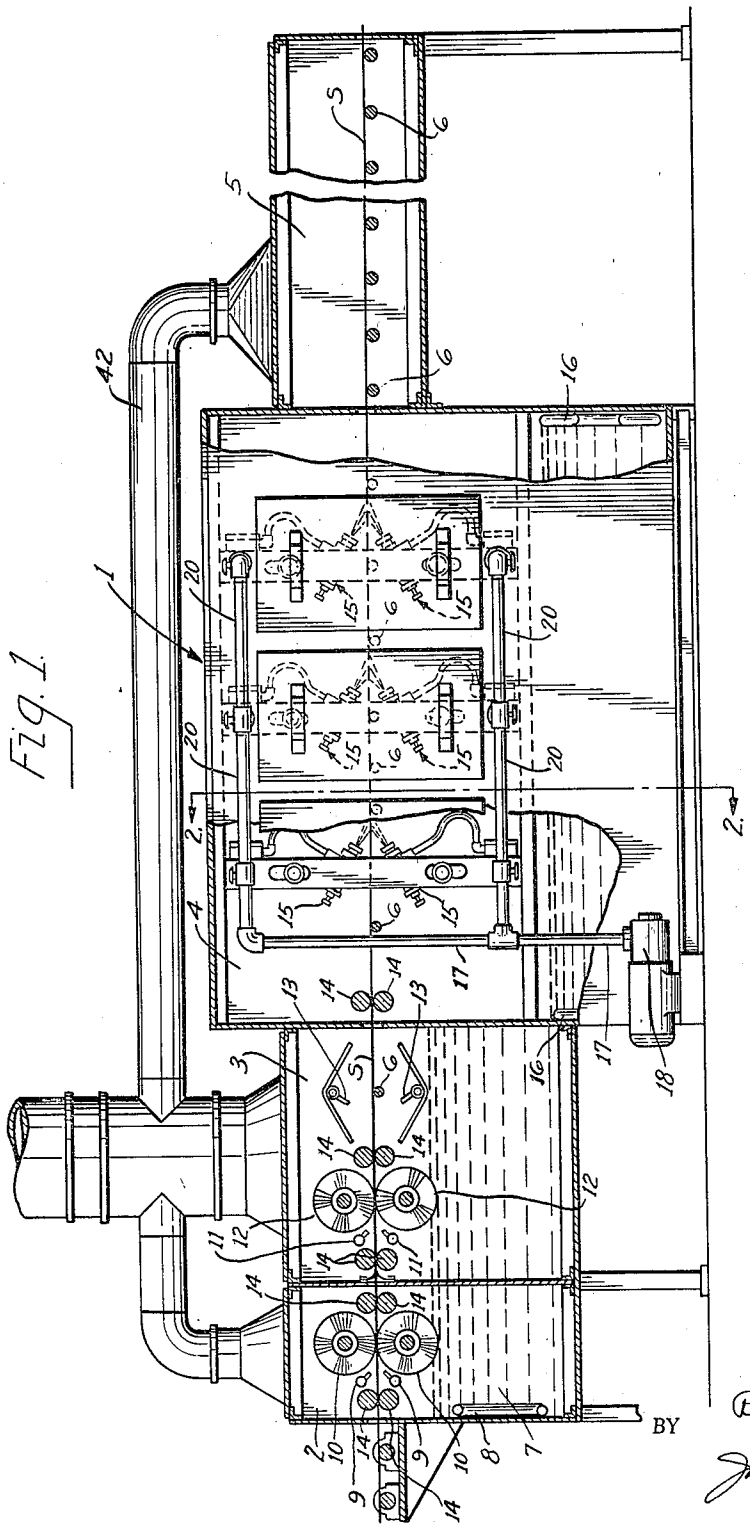


Fig. 1.

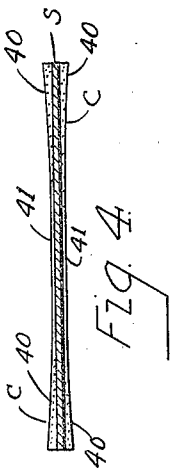


Fig. 4.

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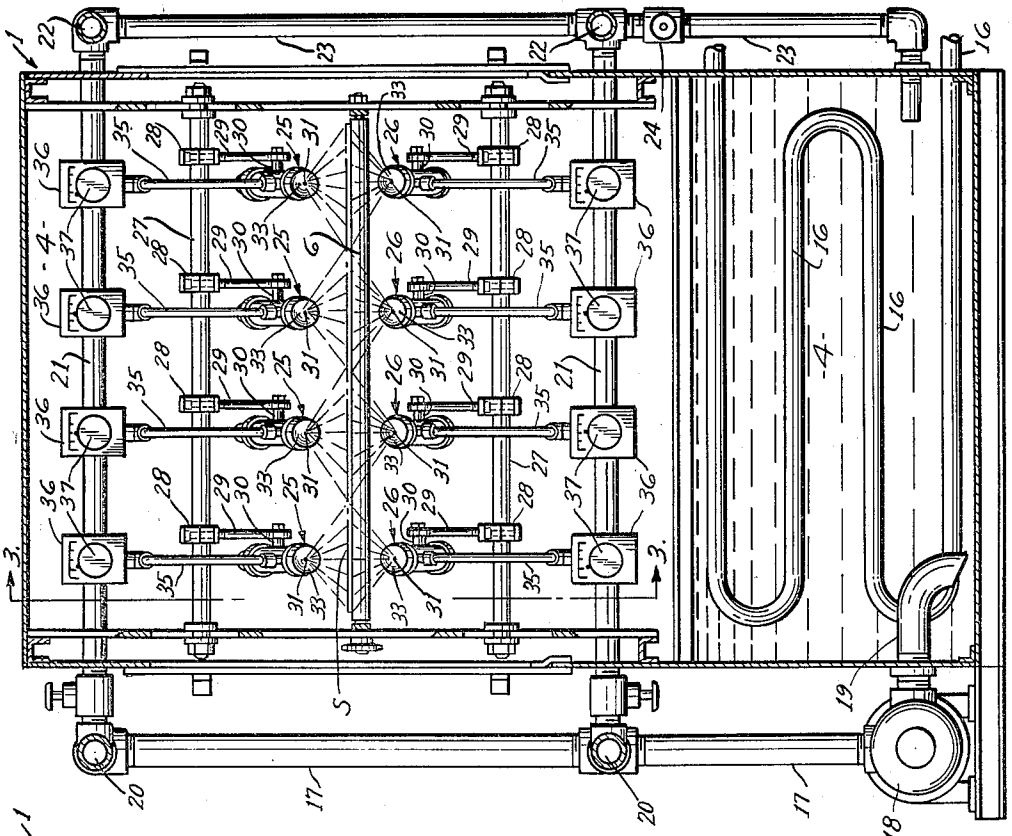


Fig. 2.

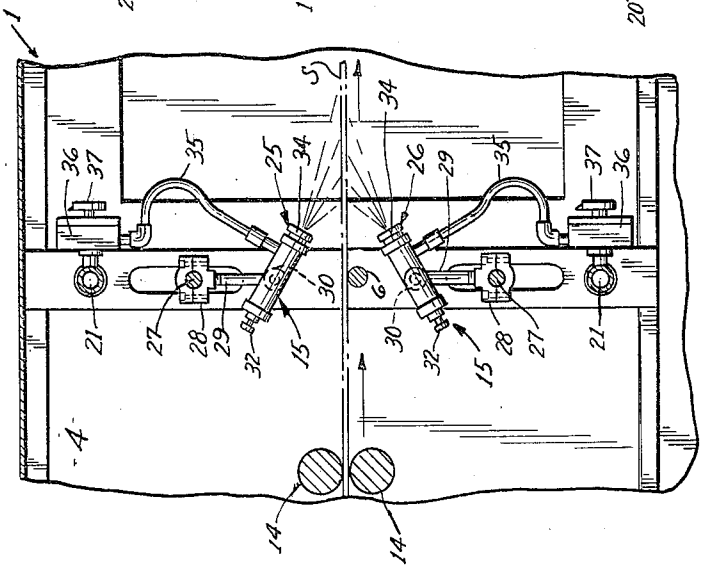


Fig. 3.

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2,960,061

# APPARATUS FOR APPLYING A COATING OF CONTROLLED VARIABLE THICKNESS TO METAL STOCK

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8 Claims. (Cl. 118—58)

This invention relates to an apparatus for applying to metal stock a thin surface coating or film of controlled variable thickness throughout the width and length of the stock and particularly to an apparatus for applying a thin, self-adherent, dry lubricating coating of controlled variable thickness to sheet metal stock preparatory to the forming of the stock in dies.

For purposes of illustration, the invention will be described primarily as embodied in an apparatus designed to clean, rinse, and heat the sheet metal stock preparatory to coating, then to apply on the surfaces thereof a layer of wet lubricating solution of controlled variable thickness, and finally to dry the applied solution thereon quickly, so as to form on the stock, a self-adherent dry lubricating film or coating of the desired variable thickness.

In the formation of sheet metal stock in dies, proper lubrication is essential and dry lubricating films and coatings are particularly desirable. Heretofore, it has been the custom, in forming such dry lubricating films on stock, to apply a film of wet lubricating solution uniformly over the entire surface of the sheet by means of roll-coaters or sprays and then to dry the solution to deposit the solute on the stock.

However, as draws become more complicated and different kinds of metal having different drawing characteristics are employed from time to time, it becomes necessary to have greater lubricity at some areas of the stock than at other areas. This is accomplished in the present invention, by controlling the lubricating film or coating so as to predispose more lubricant in the form of a thicker film at some portions of the stock than at others.

An excess film of dry lubricant tends to build up on the dies, and becomes objectionable, necessitating "down" time for die cleaning and the like. Consequently, the greater amount of lubricant needed at some areas cannot be provided by increasing the thickness of the entire coating. Insufficient lubricant causes scoring and breakage of the stock.

As the die shapes become more complicated, it is apparent that some portions of the metal must be drawn to a greater degree than others, and accordingly, during this drawing, greater slippage must be provided.

One of the objects of the present invention is to apply such coating material more effectively to the stock, so as to provide on different areas of the stock faces, different thicknesses of coating, depending upon the need indicated by the particular die forming operation.

Another object is to provide an apparatus by virtue of which the uniformity of a coating of different thicknesses at different portions throughout the width of the stock can be maintained along the entire length of the strip or sheet of stock and by means of which the quality of the coating can be maintained.

Other objects and advantages of the present invention 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, part thereof being shown in section for clearness in illustration.



Fig. 2 is an enlarged vertical cross-sectional view of the apparatus illustrated in Fig. 1 and is taken on line 2—2 thereof;

Fig. 3 is a fragmentary, vertical, longitudinal, sectional view taken on a line 3—3 in Fig. 2; and

Fig. 4 is an enlarged cross-sectional view of a strip of stock with the variable coating of the present invention applied thereon.

Usually, in order to determine the proper coating at different areas of the stock faces, it is only necessary to coat a few pieces of the stock with a coating of uniform thickness, and then form them in dies, noting where the tears, scoring, and roughness are caused by the drawing operation or improper slippage. This is readily determined from observation, and the coating then is varied accordingly, more coating being applied where inadequate slippage occurs, and less coating where excessive slippage or "build-up" on the die occurs.

Referring to the drawings, it is desirable in all cases that the stock be thoroughly clean preparatory to the application of the lubricating material, and that the solution be dried thoroughly, as near instantly as possible, after its application so as to prevent undue spreading and resultant uniform thickness of the coating produced.

The principles of the present invention have been embodied in a machine to provide these operations.

Referring to Fig. 1, the apparatus comprises a tunnel 1 or like structure which is divided interiorly into a cleaning compartment 2, a rinsing compartment 3, an applicating or coating compartment 4 with which the present invention is principally concerned, and a drying compartment 5. Stock is conveyed through the tunnel, being introduced into the cleaning compartment 2, passing successively therethrough, then through the rinsing compartment 3, the coating compartment 4, and the drying compartment 5, and thence being discharged from the tunnel. Any suitable conveyor means may be used. In the form illustrated, the conveyor means comprises conventional conveyor rolls 6.

In the bottom of the cleaning compartment is a tank portion 7 in which a cleaning bath, heated by a suitable steam coil 8, is contained. The cleaning solution is applied to the stock by sprays 9 at a temperature of about 210° F. and scrubbed thereon by suitable rotary scrubbing brushes 10.

The bottom portion of the rinsing compartment 3, is in the form of a tank and contains suitable rinsing liquid, such as hot water and rust proofer. The rinsing liquid is applied to the stock by suitable sprays 11 and scrubbed thereon by brushes 12. Also located within the compartment 3 is a steam blow-off in the form of suitable steam jet nozzles 13 which are arranged to discharge hot, live steam onto the stock in a direction opposite the direction of stock travel, thus blowing off any excess liquid and also heating the stock so that the coating solution will dry rapidly thereon. Leveling rolls 14 may be provided in the compartments 2 and 3, and at the entrance of the spray compartment 4.

Within the spray or coating compartment 4 are a plurality of banks of sprays 15. In the form illustrated three such banks are used, but since all banks are similar in form and function, only the leading one will be described in detail.

The bottom of the compartment 4 is in the form of a tank in which the liquid coating material or solution is contained and maintained at the proper temperature of about 210° F. by suitable steam coils 16. For supplying the various groups of nozzles, a riser 17, connected to the discharge side of a pump 18 of which the inlet 19 is

connected with the interior of the compartment 4 near the bottom thereof, is provided. Each riser 17 is connected to upper and lower manifold lines 20 which, in turn, are connected to upper and lower lateral feed lines 21. Each line 21 extends entirely through the compartment 4 transversely of the tunnel. The lines 21 also are connected to manifolds 22 which, in turn, are connected to a discharge riser 23. The riser 23 leads back into the tank at the bottom of the compartment 4.

A control valve 24 is provided at the lower or outlet end of the discharge riser 23. The valve 24 is settable so as to maintain the desired pressure in the lines 21 while continuously bleeding at least a substantial portion of the coating solution from the lines 21 and manifolds 20 and 22 back into the tank, thus eliminating the accumulation of any sediment, sludge, or coating solution of undue viscosity in the lines 21. This is particularly important when the coating being applied is one containing soaps.

Each bank 15 of nozzles comprises a plurality of upper nozzles 25 and a plurality of lower nozzles 26, the upper nozzles 25 being arranged to discharge onto the upper surface of the sheets passing through the compartment 4 and the lower nozzles 26 being arranged to discharge onto the under surface of the sheets.

Both the nozzles 25 and 26 have a large number of adjustments so that the solution discharged by them can be applied to substantially any selected part of the sheets. Furthermore, each is adjustable as to the rate of discharge of coating solution, the fineness of the spray, anud the like. For example, referring to Fig. 2, the nozzles are supported from suitable transverse rods 27. The upper nozzles 25 are supported from the rods 27 by means of suitable collars 28, which snuggly embrace the rods 27, and depending supporting arms 29, respective to the collars 28. Each supporting arm 29 is connected to its associated nozzle device by means of a pivot 30, so arranged that the nozzle can be rocked in a vertical plane about the axis of the pivot and will remain held frictionally in its rocked position.

The collar 28 of each nozzle engages the rod 27 so that it can be rotated thereabout to different positions yet remain held frictionally in the position to which rotated. Furthermore, each of the collars 28 is adjustable endwise of its rod 27. Thus each of the nozzles 25 can be positioned transversely of the sheet passing through the apparatus, at the location desired, independently of the others, each can be rocked to discharge at whatever angle desired to plane of the sheet independently of the others, whether in the direction of travel or against the direction of travel, and each can be moved bodily to different locations vertically above the level of the sheet, independently of the others so that the spread or width of the pattern for a given discharge can be modified.

Each of the bottom nozzles 26 is arranged and supported in like manner, and need not be described in detail.

Each of the nozzles 25 and 26 has a central orifice 31, the discharge through which is controlled by a suitable needle valve 32. The central orifice of each nozzle is formed in an orifice plate 33 secured in place by a cap 34. Interchangeable orifice plates with various sizes of orifices may be provided and selected ones used on the nozzles, depending on the pattern of spray desired. Each nozzle is connected by a flexible hose 35, with its own individual flow control device 36.

The flow control devices are readily available on the market and are arranged to control the volume of the liquid discharged therethrough, maintaining it constant regardless of changes in pressure. Each of the flow control devices 36 for the nozzles 25 and 26 is connected to one of the transverse feed lines 21. These flow controls are identical with each other, and the volume of flow is controlled by means of a suitable external settable dial 37.

With these arrangements, each of the nozzles can be adjusted individually to the position desired, the adjustment being almost universal bodily adjustment. Further, each can be arranged to discharge a very accurately controlled and constant amount of the solution to be applied. The pattern applied on the sheet by each nozzle is determined for each nozzle by the setting of its flow control device, the adjustment of its needle valve, the selection of the size of its orifice, and its position.

Due to the valve 24, the consistency of the fluid passing through the lines 21 maintained substantially uniform throughout the entire extent of the lines so that the nozzles nearer to the inlet ends of the lines 21 do not receive a different consistency of solution than those near the discharge ends of the lines 21.

After it has been determined what pattern is required on the stock transversely and the adjustments described have been made, thereafter the selected variable pattern is maintained constant throughout the width of the stock.

As an example, a width of stock S is shown in Fig. 4, in which the coating or film C of lubricant has been applied and dried. In this instance it is assumed that greater lubrication is required near the lateral margins of the stock than at the center. Accordingly, the adjustments are made so as to apply a thicker coating at the lateral margins as indicated at 40, than at the central portion, as indicated at 41.

In order to assure that the solution applied to the stock will remain in situ and not flow and level and become uniform in thickness over the stock surface after application, the solution is applied to stock which has been preheated and is, itself, preheated to the proper temperature.

For example, it is desired that the cleaning liquid and rinsing liquid be maintained at a temperature of about 210° F., so that the stock, in being subjected to these liquids, will absorb a considerable amount of heat. Next the stock is subjected to the steam jet which blows off any excess liquid, leaves the stock nearly dry, and additionally heats the stock. Finally, the coating solution to be applied is maintained at a temperature of about 210° F. in the tank of the compartment 4, and reaches the stock at substantially that temperature. The stock passes immediately from the compartment 4 into the drying chamber 5 which may be heated by any suitable means, preferably by gas burners and the like.

Accordingly, due to residual heat in the stock from cleaning, rinsing, and blow off, and from the sprayed lubricating solution itself, to its reception of the solution on a relatively hot and dry surface, and to the prompt application of heat in the compartment 5, the solution dries substantially in situ sufficiently to prevent flow and spread and levelling.

It is to be noted that a conduit 42 leads from the drying compartment 5 to the exhaust fan so that any moisture is carried away rapidly, thus permitting the sheet to dry very thoroughly before issuing from the compartment.

It is apparent from the foregoing description that the present apparatus is adapted to provide on the stock coatings of controlled variable thickness. If desired, external controls for various parts of the equipment may be provided by flexible cables and the like so that the needle valve 32 and the dials 37 may be operated by hand from the exterior of the tunnel, but, generally, this is unnecessary as it is seldom that such apparatus is used unless a substantial number of pieces are to be coated. Therefore, one setting is satisfactory for a considerable length of time, and for a large number of sheets.

By using all three sets of banks of nozzles, adjusting each nozzle individually, substantially any controlled variable thickness and even type of coating desirable for forming operations can be obtained.

The lubricating coating composition used in practicing

the method of this invention is the type commonly referred to as "dry lubricant" which is applied as an aqueous solution to metal stock by dipping, spraying, or similar operation, and caused, or permitted, to dry thereon so as to form on the stock a dry, homogeneous, self-adherent, and tenacious protective and lubricating film as a result of which the dry coated stock can be subjected to pressure die forming operations and the like without the addition of other lubricating and cooling agents. Examples of said lubricating composition are shown in United States Letters Patents No. 2,753,305 of Whitbeck, dated July 3, 1956, and No. 2,753,304 of Orozco, dated July 3, 1956. A typical lubricant has the composition:

| | Parts by wt. |
|---|---|
| Tallow soap | 15 |
| Borax | 83 |
| Sulfonated castor oil | 2 |

For use in practicing the present invention, a liquid solution of the composition is formed by dissolving in water from one ounce to two pounds of the dry mix per gallon of water. The concentration of the solution will depend upon the thickness of deposit desired on different areas of the stock.

Having thus described my invention, I claim:

1. An apparatus for the purposes described and comprising means adapted to support stock for receiving a spray coating of liquid solution, a plurality of spray nozzles arranged for individual adjustment to different positions and to spray the liquid solution onto the stock while the stock is so supported, means for adjusting the spray pattern of each nozzle for a given rate of supply of solution to the particular nozzle, and flow control devices for the nozzles arranged to meter predetermined constant volumes of the solution per unit of time to the associated nozzles, independently of any fluctuation in the pressure at which the solution is supplied to the nozzles, whereby different metered amounts of the solution can be applied concurrently to different preselected areas of the stock, respectively.

2. An apparatus according to claim 1 characterized in that means are provided for heating the stock and the solution, preparatory to the application of the solution on the stock, so that the temperatures of the stock and solution, when the solution is sprayed onto the stock, are those at which the sprayed solution will dry onto the stock sufficiently rapidly to remain substantially in situ where applied.

3. An apparatus according to claim 2 characterized in that means are provided for additionally drying the solution on the stock.

4. An apparatus according to claim 2 characterized in that means are provided for rendering the stock substantially dry immediately before the original application of the sprayed solution thereonto.

5. An apparatus according to claim 1 characterized in that said control devices are arranged one to each nozzle.

6. In an apparatus for the purposes described, a feed line having an inlet and an outlet, a supply tank for liquid solution, a pump having an outlet connected to the inlet of the line and an inlet connected to the tank, a settable control valve connected to the outlet of the line, a plurality of concurrently operable spray nozzles connected to the line between the pump and valve, said valve being continuously open sufficiently to permit discharge of an amount of the solution supplied by the pump sufficient to keep the line filled with fresh solution while the volume and pressure are maintained sufficient for predetermined operation of the nozzles and flow control devices for the nozzles arranged to meter predetermined constant volumes of the solution per unit of time to the associated nozzles, independently of any fluctuation in the pressure at which the solution is supplied to the nozzles, whereby different metered amounts of the solution can be applied concurrently to different preselected areas of the stock, respectively.

7. An apparatus for the purposes described and comprising conveyor means adapted to convey stock along a predetermined path, a plurality of individual spray nozzles, means supporting the nozzles for individual adjustment upwardly and downwardly toward and away from the path of the stock, individual and independent adjustment laterally and longitudinally of the path, individual adjustment of the angle of their axes relative to the path, means for adjusting the spray pattern of each nozzle individually, flow control devices respective to the nozzles, and each of the flow control devices being adjustable to meter the solution to its associated nozzle at a pre-determined rate independently of fluctuations in the pressure at which the solution is supplied to the nozzles, whereby a metered amount of the solution is applied to the stock at different preselected areas.

8. An apparatus for the purposes described and comprising conveyor means adapted to convey stock along a predetermined path, a plurality of individually adjustable spray nozzles arranged to spray a liquid onto the stock while it is moving along said path, means for adjusting the spray pattern applied by each nozzle for a given volume input, per unit time, to the particular nozzle, and flow control devices for the nozzles arranged for adjustment to meter pre-determined volumes of the solution per said unit of time to their associated nozzles, independently of any fluctuations in the pressure at which the solution is supplied to the nozzles, whereby a metered amount of the solution is applied to the stock at different pre-selected areas concurrently.

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