

[54] **MACHINE FOR THE APPLICATION OF LIQUID COATINGS TO WORKPIECES**

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[51] **Int. Cl.**..... **B05c 5/00**

[58] **Field of Search**..... 118/313, 324, 323,
118/DIG. 4; 134/99, 101, 172; 117/105.3

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[57] **ABSTRACT**

A coating machine where liquid coatings of lacquer or glue are applied to continuous webs or to a succession of flat workpieces in a free-falling liquid curtain emanating from an applicator head positioned over the workpiece conveyor, the machine including a rotatable vertical column with two carrying arms at right angles and a complete independent liquid circulation system for each applicator head, the applicator heads and liquid circulation systems being rotatable together with the vertical column so that, when one arm and applicator head is in the operation position above the conveyor line, the other arm and applicator head is positioned alongside the conveyor line.

10 Claims, 10 Drawing Figures

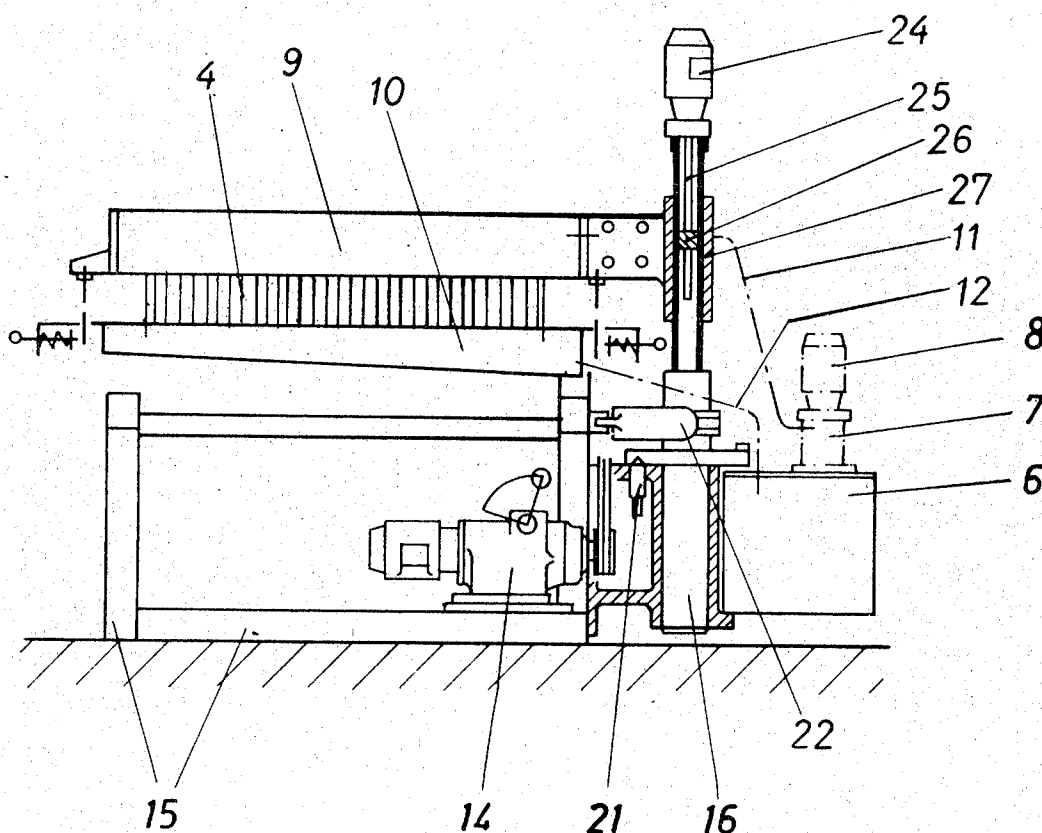
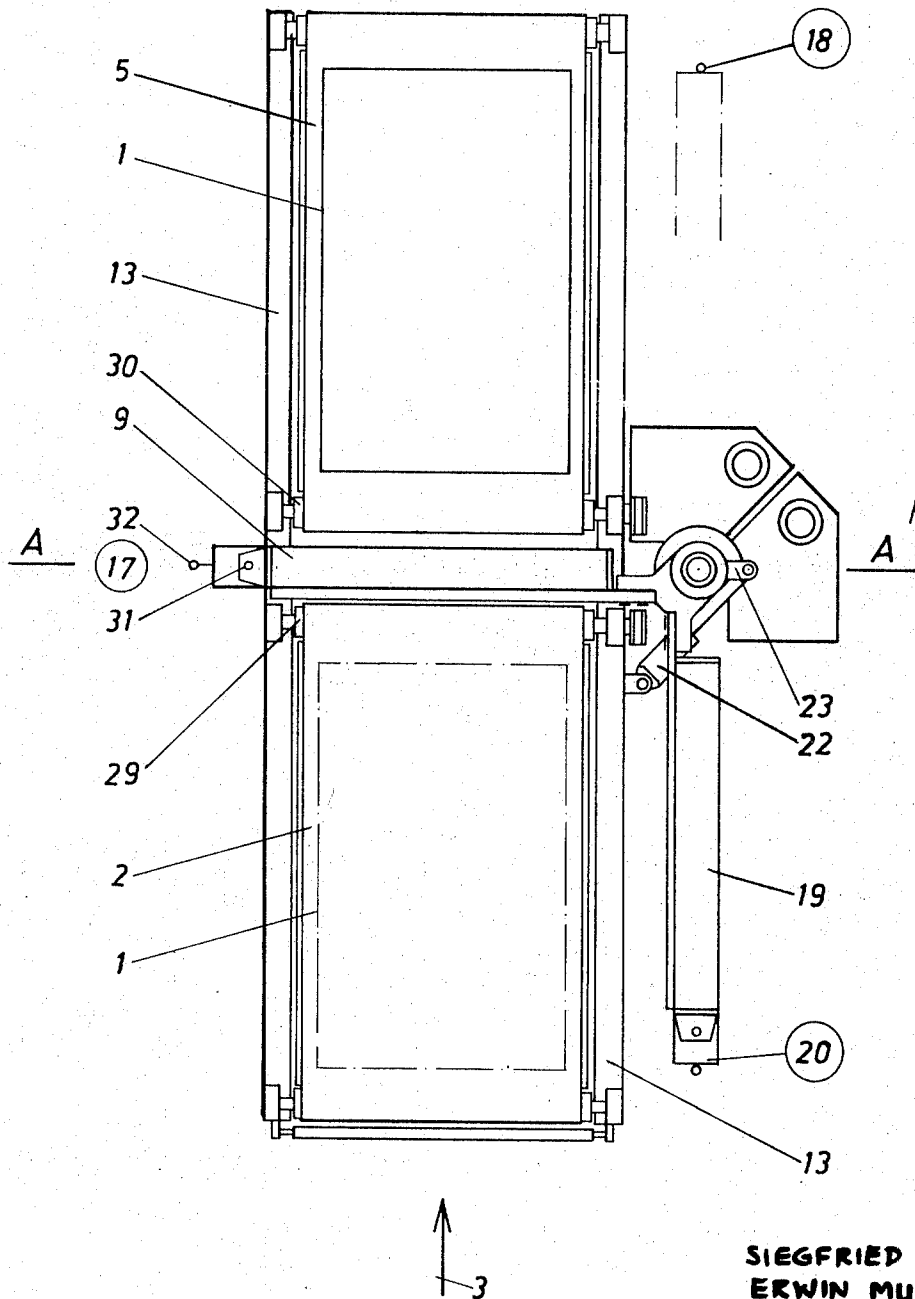


Fig. 1



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Fig. 2

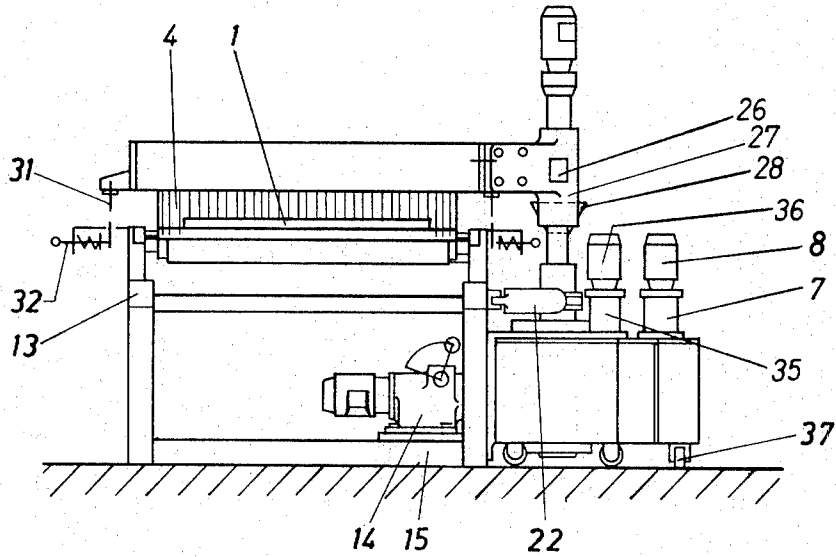
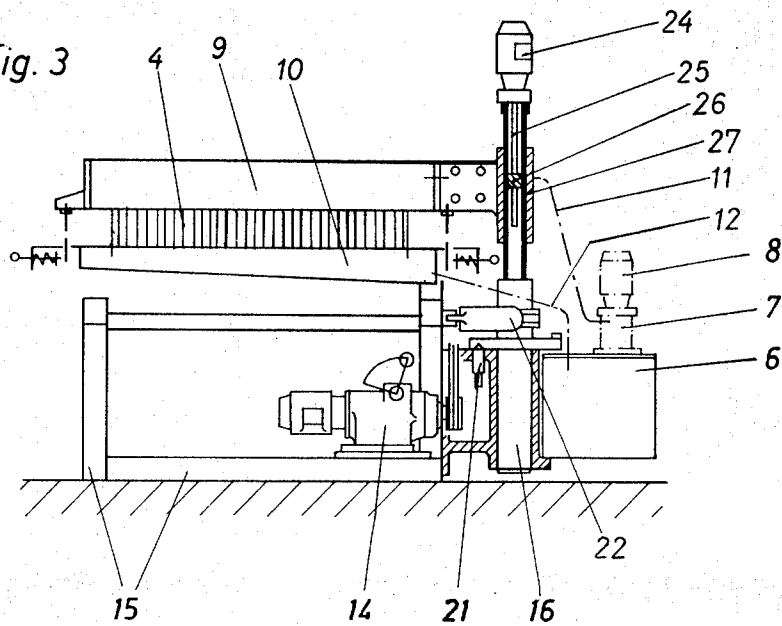


Fig. 3



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Fig. 4

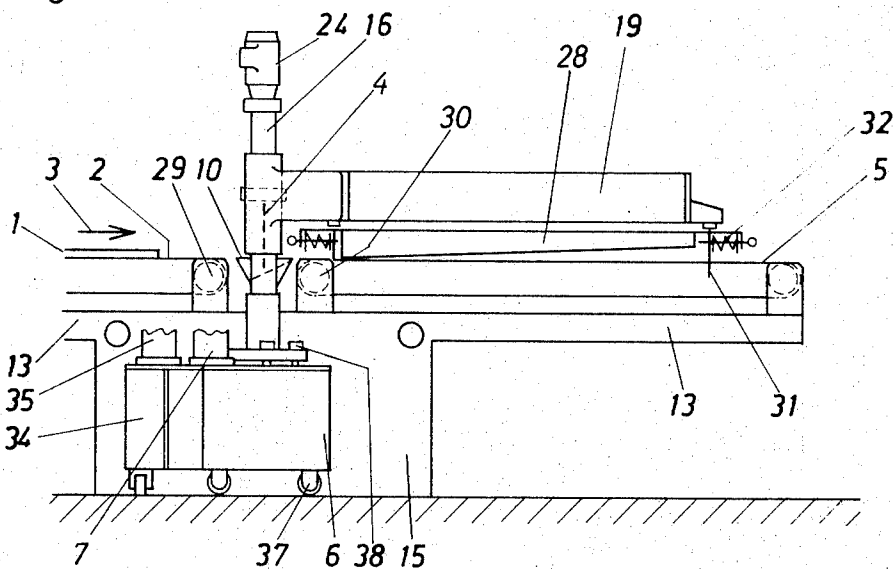
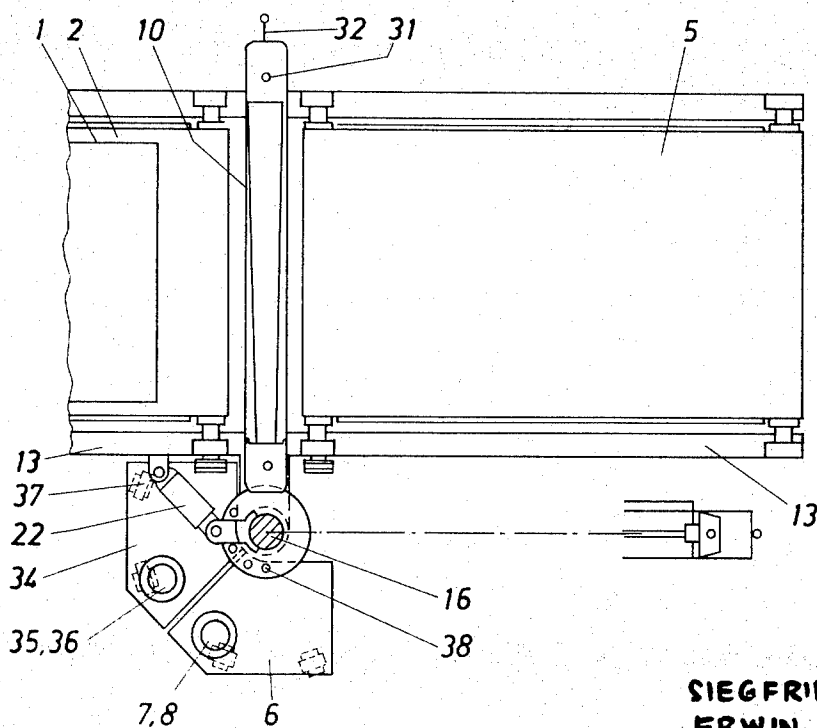


Fig. 5



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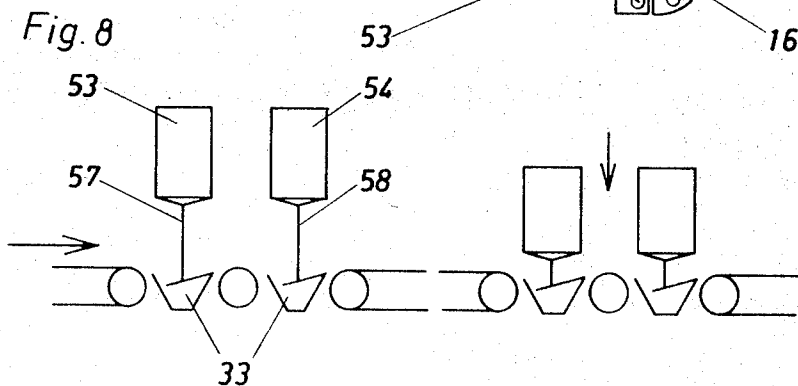
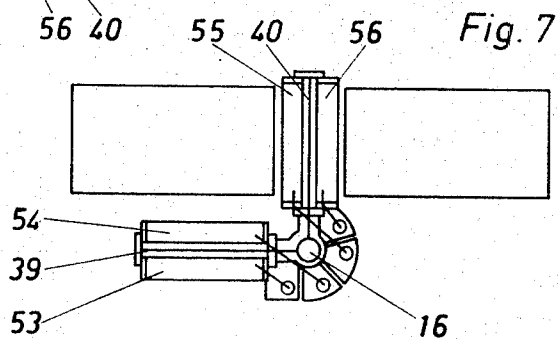
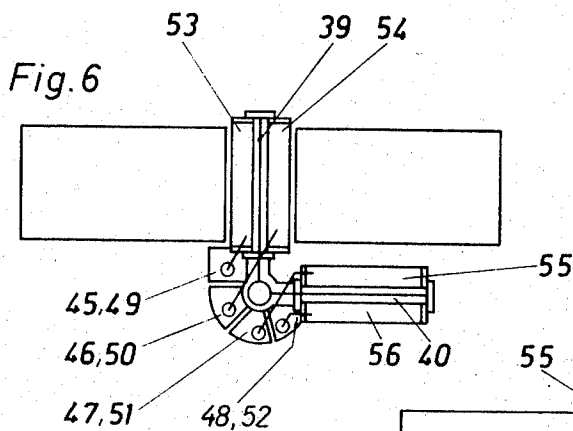
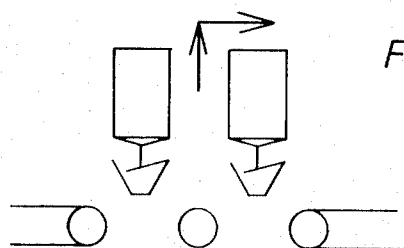


Fig. 9



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MACHINE FOR THE APPLICATION OF LIQUID COATINGS TO WORKPIECES

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to a machine for the application of liquid coatings to workpieces, and in particular to a machine for the continuous application of such coatings to the surface of workpieces, where, in a continuous liquid circulation system, the workpieces in the form of conveyed plates or continuous webs, or in the form of patterns of flexible material, are coated by using the principle of a flow curtain falling freely from an applicator head onto the workpieces.

2. Description of the Prior Art

A machine for the continuous application of liquid coatings to moving workpieces is disclosed in the German Pat. No. 1,138,345.

One of the problems encountered in connection with machines for the continuous application of liquid coatings to plates or web-shaped workpieces under a free-falling liquid curtain results from the repeated requirement of changing the kind of liquid to be applied to the workpieces. This is the case, for example, when a switch from one color to another is called for in the application of pigmented lacquers, where the lacquers contain either water or solvents, or when the lacquer is composed of two components which have to be mixed in the coating machine itself just prior to the application operation. For such a change-over operation, it was previously necessary to move the applicator head out of the workpiece conveyor area by pulling it laterally away from the conveyor line and by moving into its place another applicator head which contains the different-color liquid prepared in its liquid container. For each such change-over, it was necessary, however, to clean the lacquer collecting trough, the lacquer container, the pump and the piping before the new color could be introduced. Thus, the change-over from one color to another normally involved a considerable loss of time and required the use of costly cleaning fluid.

Another prior art proposal involves a machine arrangement where several successive lacquer application stations are arranged along the workpiece conveyor line. This arrangement permitted the simultaneous operation of more than one lacquer circulation system but, while only one liquid curtain would be applied to the workpieces, the latter would have to be shielded against the other liquid curtains by placing their collecting troughs between those liquid curtains and the workpieces to prevent any other lacquer, or even droplets thereof, from falling onto the workpieces. Thus, only the lacquer falling from the applicator head whose collector trough is below the conveying level would reach the workpieces. One shortcoming of such an installation is that the arrangement of several successive lacquer circulation systems requires an equal number of conveyor gaps in the workpiece conveying system for the accommodation of the collection troughs, with the resulting problem of an uneven conveying motion. As the workpieces must pass over each one of these conveyor gaps, the irregularity of motion can easily cause ripples, transverse patterns, or other coating irregularities, especially when the workpieces are short.

It has also been suggested to combine all the elements constituting the lacquer circulation system, such

as the lacquer container, the pump and motor, and the lacquer applicator head, the lacquer collecting trough and the supply and return piping into a single unit which can be rolled away from the conveyor area in a direction perpendicular to the conveying direction by using rollers and tracks. Into the place of the removed unit would immediately be moved another unit which is similarly constructed and ready for operation with a different liquid. Thus, the second unit would permit an immediate continuation of the coating operation with the new color. However, the major shortcoming of this machine resides in the fact that it requires a considerable amount of floor space during the change-over from one color to another, at which time both sides of the conveyor are alternately occupied by a complete lacquer circulation system.

SUMMARY OF THE INVENTION

It is an objective of the invention to provide a coating machine of the above described type which, together with a low investment in its manufacture, requires a minimum of floor space for its operation, and where the changeover from one kind of coating to another requires only a minimum of time and does not unduly obstruct the working areas alongside the conveyor line. A further objective of the invention is to permit the change-over between four different kinds of liquid with essentially the same machine structure.

The invention proposes to attain this objective by suggesting that the interchangeable liquid applicator units be arranged on two horizontal carrying arms extending from a common rotatable vertical column mounted alongside the conveyor line, the two horizontal arms being rotatable in unison around the axis of this vertical column so that, while one arm extends over the conveyor line for operation, the other arm is positioned alongside the conveyor line for servicing. The vertical column includes a common lifting mechanism for the two arms, and the rotatable structure on the vertical column carries with it the liquid containers for the separate applicator heads.

This concept also offers the possibility of providing a liquid collecting trough which also serves as a liquid container and includes a built-in or attached pump. In this case, the rotatable applicator unit would consist essentially of two parts, a liquid applicator head and a liquid container. In the preferred embodiment of the invention, the two rotating arms with their applicator heads are arranged at an angle of 90° to one another. A further development of the invention suggests the arrangement of two applicator heads on each of the two carrying arms, each applicator head being part of a separate liquid circulation system. This arrangement brings with it the possibility to apply the particular advantages of the invention to coating operations where two liquids are used simultaneously. Coatings where this type of operation is necessary include, for example, DD-lacquers, polyester coatings, and two-component glues which, if they would be combined in the applicator head, would harden too quickly. Thus, when two applicator heads are combined on a single carrying arm, the machine can be used for the simultaneous application of two components, and it can also be changed over to two different components with a minimum of change-over time required.

One important aspect of the change-over from one liquid to another is the speed with which the liquid col-

lecting trough can be removed from under the work-piece conveying level. To accomplish such a quick removal of the liquid collecting trough, the invention further suggests a releasable catch device arranged between the applicator head and the collecting trough. Such a catch device permits the automatic catching and holding of the collecting trough, when the carrying arm with its applicator head is lowered toward the collecting trough. When the carrying arm is raised again, it carries with it the collecting trough, thus permitting rotation of the combined applicator head and collecting trough away from the conveyor line.

Another preferred feature of the invention suggests that the liquid container is not mounted on the carrying arm directly but, in order to give it a larger liquid capacity, is arranged directly on the vertical column in such a manner that it follows the rotation of the carrying arm. Such large-capacity liquid containers are preferably provided with casters running on the machine floor or with rollers engaging a circular track. At their inner side, the liquid containers are connected to the rotating portion of the vertical column without following the vertical motion of the carrying arms.

In a preferred embodiment, the liquid containers are interchangeably attached to the column hub by means of screws, or arranged to be hooked onto the latter, whereby the liquid containers envelop the vertical column on an angle of approximately 225° . This arrangement affords the additional advantage that, for the cleaning operation, the container with coating liquid can be quickly unhooked, and another container holding cleaning fluid can be attached in its place.

The general arrangement of the machine thus permits the performance of the change-over and cleaning operations in the area immediately alongside the conveyor line, with a minimum of floor space requirement.

DESCRIPTION OF THE DRAWINGS

Further special features and advantages of the invention will become apparent from the description following below, when taken together with the accompanying drawings which illustrate, by way of examples, several embodiments of the invention, represented in the various Figures as follows:

FIG. 1 shows a schematic plan view of a coating machine embodying the invention, where one applicator head is shown in operational position while the other applicator head is shown in its non-operating position;

FIG. 2 shows the machine of FIG. 1 in an elevational view along arrow 3 of FIG. 1, the two applicator heads having been rotated by 90° ;

FIG. 3 is similar to FIG. 2, showing a cross-section of the machine of FIG. 1 taken along the line A—A thereof;

FIG. 4 shows a partial elevational side view of the machine of FIG. 1;

FIG. 5 shows a plan view corresponding to FIG. 4, the applicator heads being removed to show the arrangement of the collecting trough between two sections of the conveying line;

FIGS. 6 and 7 show, in a further simplified plan view, another embodiment of the invention, the machine being equipped with two applicator heads on each carrying arm, both rotational positions being shown;

FIG. 8 shows, in a schematic elevational view, the coating applicator portions of the machine of FIGS. 6 and 7 in their operational position;

FIG. 9 is similar to FIG. 8, showing the two applicator heads in a lowered position in which the collecting troughs are attached to the applicator heads by means of a catch device; and

FIG. 10 is again similar to FIGS. 8 and 9, the collecting troughs being raised together with the applicator heads for removal from the conveying line by rotation around the vertical column.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Work pieces 1, representing, for example, furniture panels or veneers, are conveyed on a conveyor belt 2 in the conveying direction represented by arrow 3, thereby passing through the zone of a free-falling liquid curtain 4. Here, a liquid coating is applied to the upper surface of the workpieces. In further continuous motion along the conveyor line, the workpieces pass over a second conveyor belt 5 and from there into an evaporation or curing zone which is not shown in the drawings.

A liquid circulation system including a liquid container 6 with a pump 7 and a motor 8, an applicator head 9, a collecting trough 10, a feed pipe 11, and a return pipe 12, is arranged to create the free-falling liquid curtain 4. The liquid contained in this circulation system is kept in continuous circulation by the pump 7 and the motor 8. Only that amount of liquid is spent which is carried away on the workpieces 1, the excess liquid falling from the applicator head 9 being collected in the collecting trough 10 and returned via the return pipe 12 to the liquid container 6.

The conveyor belts 2 and 5 are supported on a machine frame 13 which includes a conveyor drive 14 mounted on the base 15 of the machine frame.

The applicator head 9 is mounted on a vertical column 16 which is rotatable around its vertical axis, so that the applicator head can be rotated in a horizontal plane in a manner known as such, in order to remove it from the area of the conveyor belts 2 and 5. A second applicator head 19 is also arranged on the vertical column 16 at a 90° -angle from the first applicator head 9. Thus, the applicator head 9 can move between the positions 17 and 18, while the applicator head 19 can move between the positions 20 and 17. The applicator heads 9 and 19 have a common hub 27 supporting them on the vertical column 16, a stationary index pin 21 securing the two rotational positions on the vertical column. The rotation of the vertical column 16 can be operated by hand or performed mechanically by an electric motor, pneumatic controls, or hydraulic controls. The embodiment illustrated in FIGS. 1 - 3 uses a pneumatic ram 22 for this purpose, one end of the ram being fastened to the machine frame 13 and the other end being linked to the vertical column by a lever 23.

For the vertical movement of the applicator heads 9 and 19, the machine includes a lifting device which includes, for example, an electric gear motor 24, a lifting spindle 25, and a spindle nut 26. The latter engages the hub 27 to which are attached the applicator heads 9 and 19. Operation of the lifting device thus permits the lowering of the applicator heads 9 and 19 toward their respective collecting troughs 10 and 28, allowing attachment of the latter to the applicator heads by means of a catch device so that when the applicator heads 9 and 19 are raised again, they carry with them the col-

lecting troughs 10 and 28. This permits convenient removal of the collecting troughs 10 and 28 from their operational position in the gap between the conveyor end rollers 29 and 30. The raised collecting troughs can now be rotated horizontally out of or into the conveyor area while they are attached to the respective applicator heads. The earlier-mentioned catch device preferably consists of a pair of vertical catch rods 31 which cooperate with spring loaded pins 32 (FIG. 4) which automatically snap into the catch rod 31, when the latter are lowered into the catch device mounted on the collecting trough. For redepositing the collecting trough, it is merely necessary to release the index pins 32 from the catch rod 31, after the trough has been lowered into position by the operation of the lifting device. In its non-operating position alongside the conveyor line, the collecting trough 28 can be conveniently cleaned.

Each of the two separate liquid circulation systems includes a liquid container 6 or 34, respectively, which is connected to a pump 7 or 35, and a motor 8 or 36. The pumps and motors supply a liquid to their respective applicator heads 9 and 19 through the supply pipes 11. Return pipes 12 allow the excess liquid to flow back to the liquid containers. The two liquid containers 6 and 34 make the same horizontal pivoting motion as the vertical column 16, and for this purpose, they are arranged in close proximity thereto. To carry their weight, the liquid containers 6 and 34 include casters 37 on their base, the casters rolling on the surface of the machine floor. Instead of these casters, the containers may be equipped with guide rollers rolling on a circular track. On their inner side the liquid containers 6 and 34 are attached to the vertical column 16 by means of screws or by means of quickly releasable pins 38.

In a different embodiment, illustrated in FIGS. 6 and 7, the two rotating arms 39 and 40 carry each two applicator heads 41 and 42, or 43 and 44. In this case, each applicator head is part of a separate, independent circulation system. Each of these systems includes a corresponding liquid container 45 and 46, or 47 and 48, with corresponding pumps 49 and 50, or 51 and 52, all of them pivoting horizontally in unison with the carrying arms 39 and 40.

A particular advantage of this arrangement resides in the fact that the associated pairs of applicator heads which alternately are moved into the operating position above the gap between the conveyor belts 2 and 5 are always returning into exactly the same operating position above the conveyor line. This leads to a simplified and above all compact construction in the area of the collecting troughs, or pairs of collecting troughs, as the case may be, while permitting operation with two or four liquid circulation systems, either alternately or collectively.

In FIGS. 8 through 10 is illustrated schematically the operative procedure for the removal of the two collecting troughs 33 by lowering the pair of applicator heads 53 and 54. While the free-falling liquid curtains 57 and 58 remain in operation, the applicator heads 53 and 54 are lowered until the catch rods 31 engage their respective index pins in the collecting troughs, thereby coupling the troughs to the applicator heads. The collecting troughs follow the subsequent lifting and horizontal pivoting motions of the carrying arms and applicator heads as shown in FIG. 10.

We claim:

1. A machine for the continuous application of liquid coatings to a succession of conveyed workpieces or to a moving web under a free-falling curtain of such liquid coating comprising in combination:

a generally flat conveyor line and drive, including at least two successive, synchronized conveyor belts with a transverse conveyor gap between the adjacent ends of the two conveyor belts;

an elongated machine frame carrying the conveyor line and its drive, including a column base mounted on one side thereof adjacent to the machine frame and facing the conveyor gap;

a vertical column movably mounted in the column base for rotation around its vertical axis, including means for rotating the column between at least two predetermined angular positions;

a hub enclosing the vertical column in its upper portion, the hub being rotatably fixed with respect to the column, but vertically movable relative thereto, including means for vertically moving the hub by raising or lowering it along the vertical column;

at least two rigid carrying arms extending generally horizontally from the hub at a level above the conveyor line and mounted at an angular distance from one another which corresponds to the rotational positions of the vertical column so that rotation of the vertical column between its predetermined positions brings a different carrying arm into alignment with the conveyor gap in each column position;

at least one complete liquid circulation system associated with each carrying arm, each liquid circulation system including: an elongated applicator head arranged on the carrying arm for the creation of the free-falling liquid curtain in a manner known as such, a liquid collecting trough below the applicator head, a liquid container, and means for circulating the liquid through the applicator head and back into the liquid container via the collecting trough.

2. A coating machine as defined in claim 1, wherein the components of each liquid circulation system are attached to the vertical column and the corresponding carrying arm, respectively, so that the entire liquid circulation system follows the rotational movement of the vertical column and carrying arm.

3. A coating machine as defined in claim 2, wherein of each liquid circulation system the applicator head is permanently attached to its carrying arm, the liquid collecting trough below it is suspendable from the carrying arm and releasable therefrom, when the carrying arm is in the operating position above the conveyor gap, for depositing the trough in the gap below the plane of the moving workpieces.

4. A coating machine as defined in claim 3, wherein of each liquid circulation system the liquid container and its liquid circulation means are directly attached to the vertical column, the container further including at least one support roller arranged between its bottom and the work floor to carry part of the container weight.

5. A coating machine as defined in claim 4, wherein each liquid container is attached to the vertical column with the help of quick release means such as hooks, allowing quick substitution of one container for another which may hold a different liquid, the

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liquid containers together enclosing the vertical column on an angle of approximately 225°.

6. A coating machine as defined in claim 1, wherein two complete, independent liquid circulation systems are arranged on each carrying arm for the simultaneous application of two liquids or liquid components to the workpieces.

7. A coating machine as defined in claim 1, wherein the hub supports two horizontal carrying arms arranged at right angles to one another, and the predetermined angular positions on the vertical column are two and are 90° apart so that, whenever one carrying arm with its applicator head is in operative alignment with the conveyor gap, the other carrying arm with its applicator head is positioned out-side and alongside the conveyor line.

8. A coating machine as defined in claim 1, wherein the predetermined angular positions on the vertical

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column are determined by indexing means arranged between the column base and the vertical column.

9. A coating machine as defined in claim 1, wherein the hub moving means include a vertical spindle, a spindle nut engaging the hub while travelling on the spindle, and an electric gear motor mounted on top of the vertical column, the gear motor driving the spindle.

10. A coating machine as defined in claim 1, wherein the column rotating means include a double-acting pneumatically actuated horizontal ram, one end of the ram being connected to the machine frame, while the other end of the ram is connected to the rotatable vertical column at a distance from its rotational axis.

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