

April 12, 1966

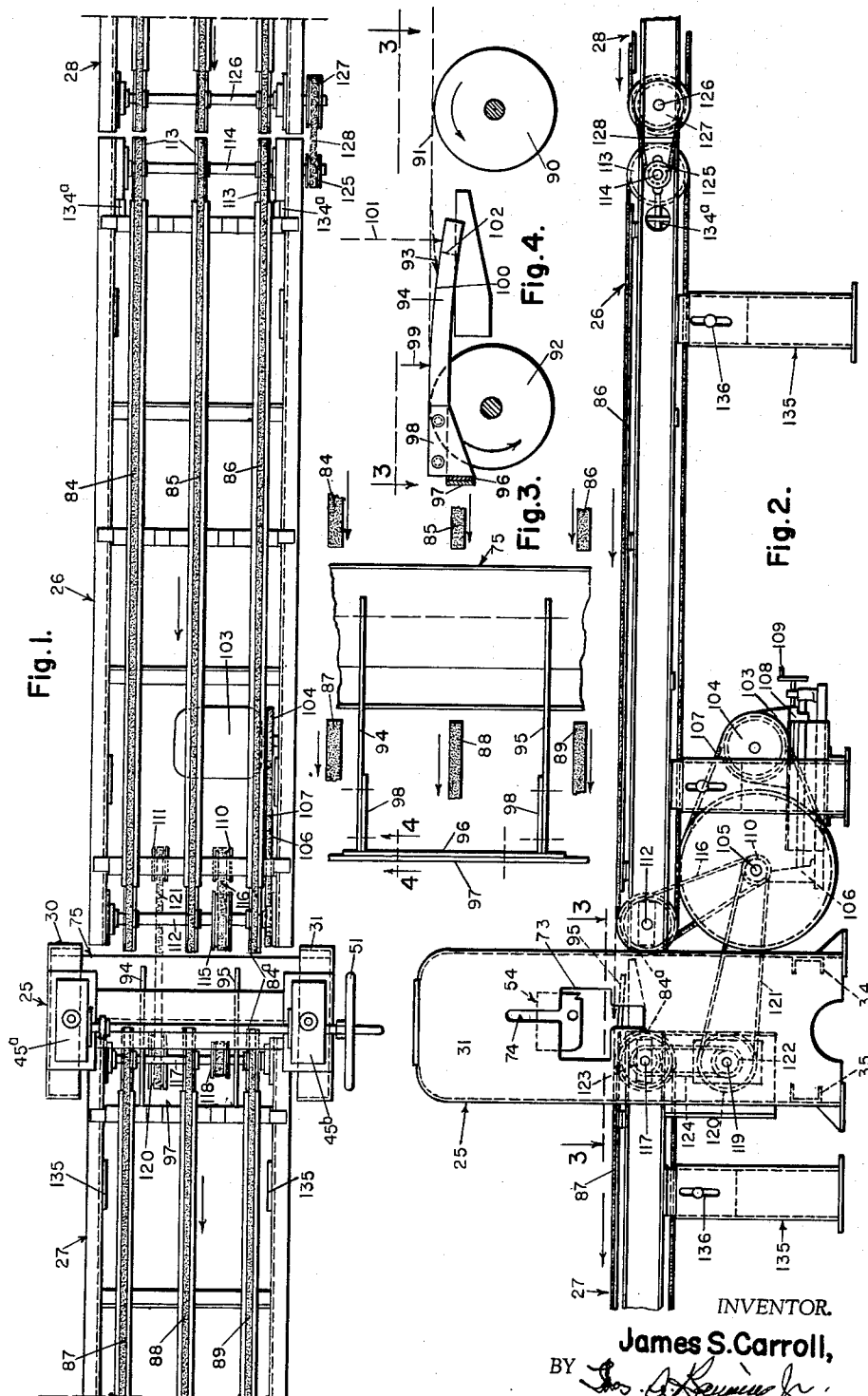
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3,245,380

SURFACE COATING MACHINES, AND THE LIKE

Filed July 17, 1962

6 Sheets-Sheet 1



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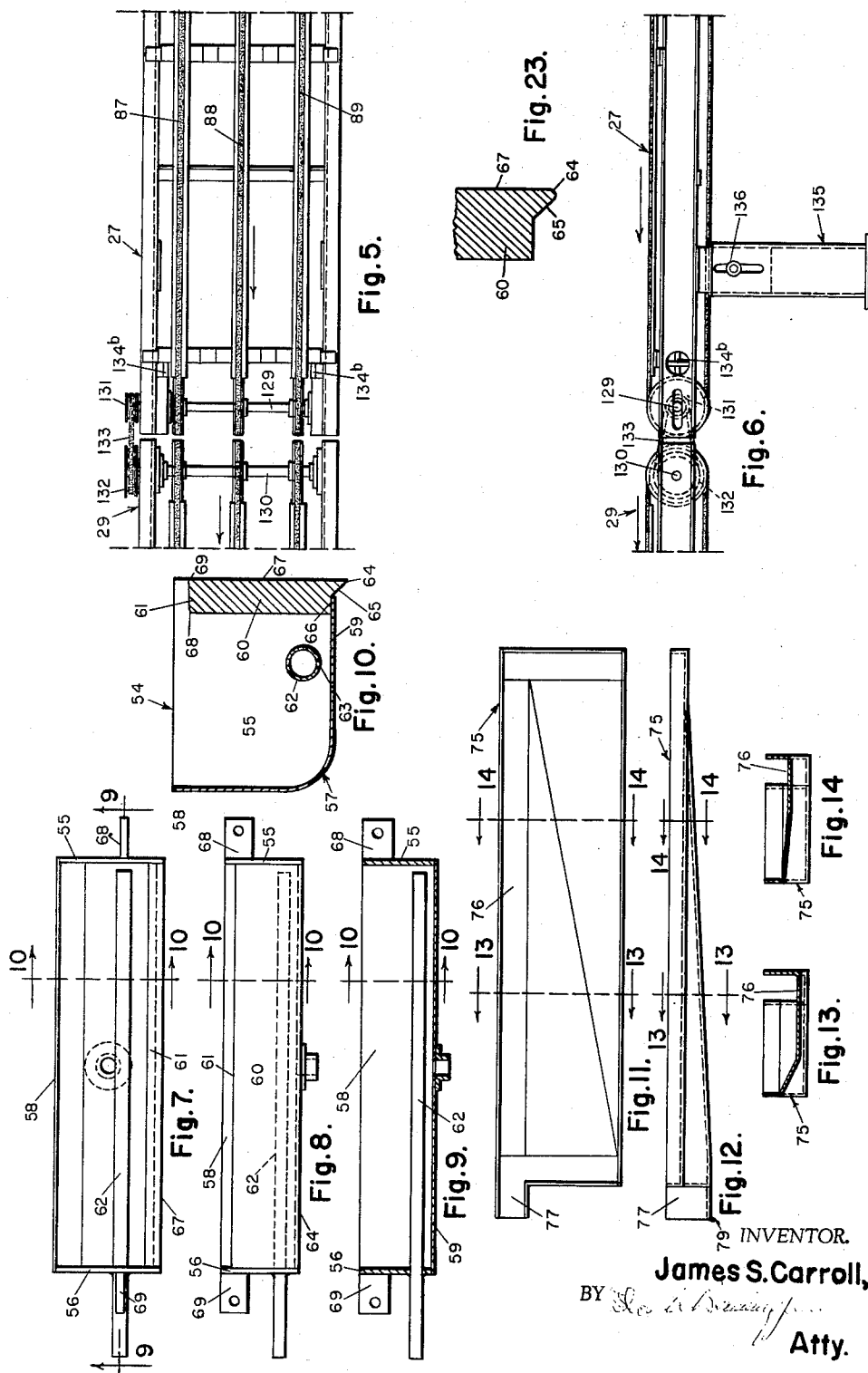
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SURFACE COATING MACHINES, AND THE LIKE

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6 Sheets-Sheet 2



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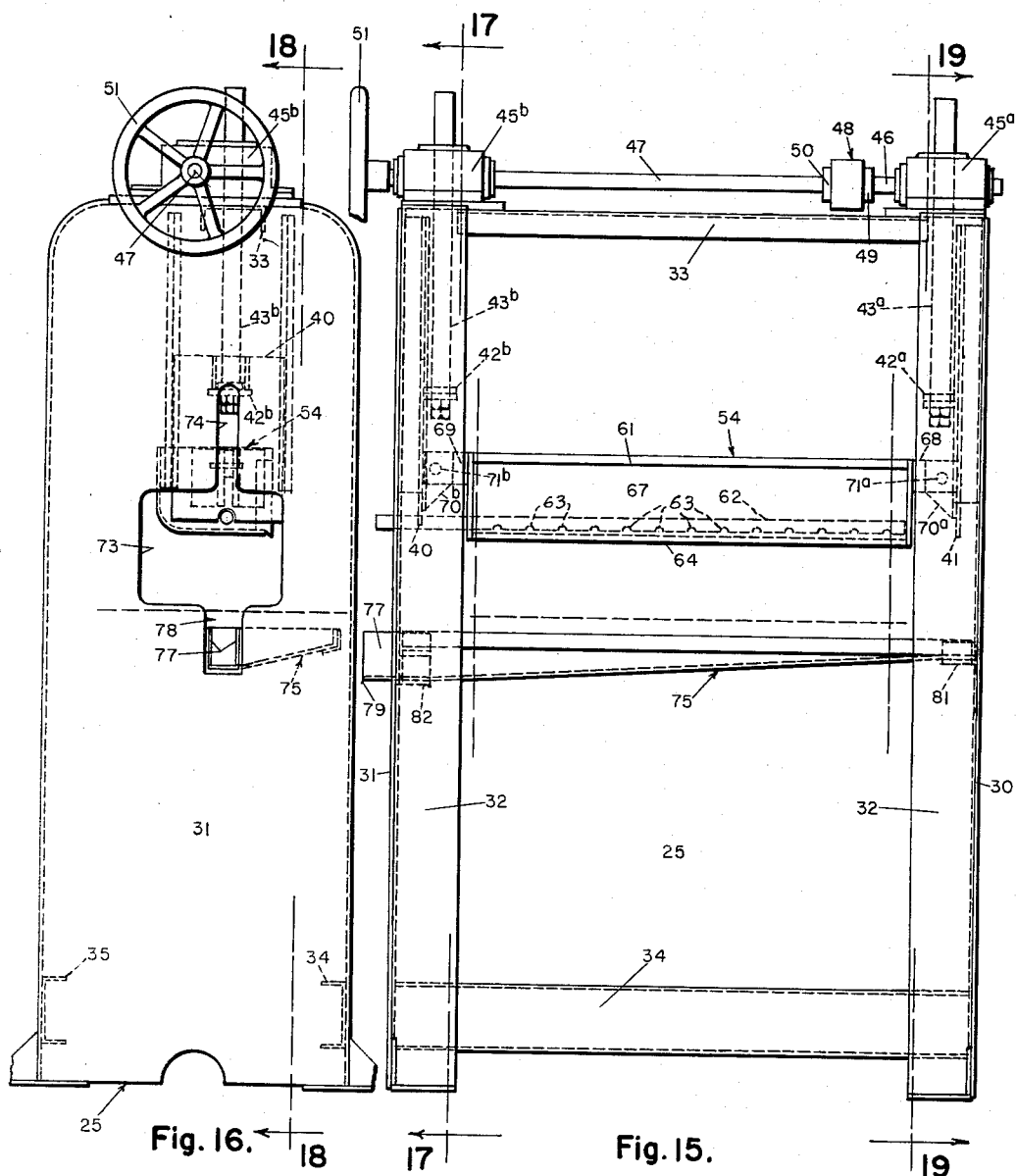
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SURFACE COATING MACHINES, AND THE LIKE

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6 Sheets-Sheet 3



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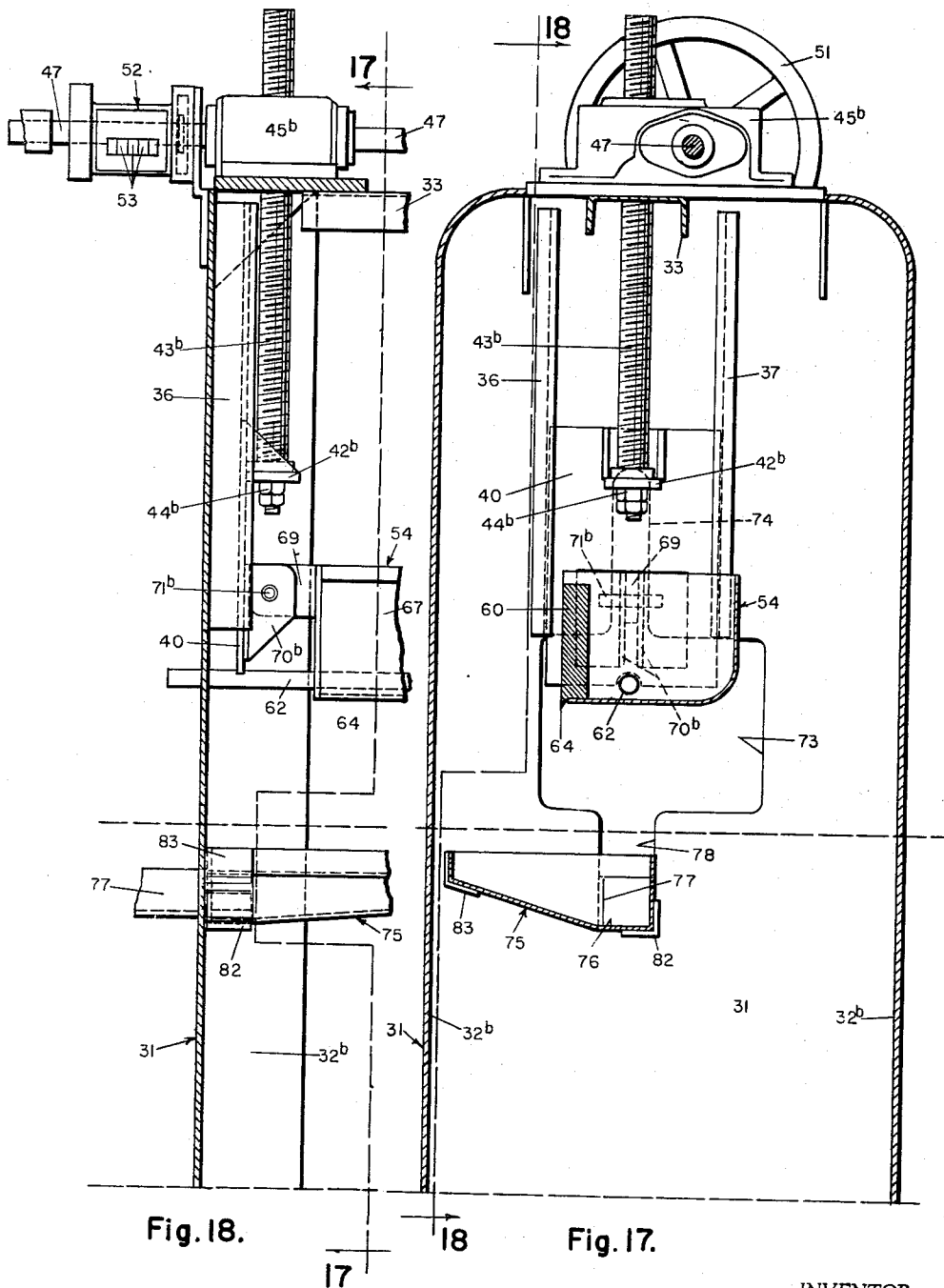
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SURFACE COATING MACHINES, AND THE LIKE

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6 Sheets-Sheet 4



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3,245,380

SURFACE COATING MACHINES, AND THE LIKE

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6 Sheets-Sheet 5

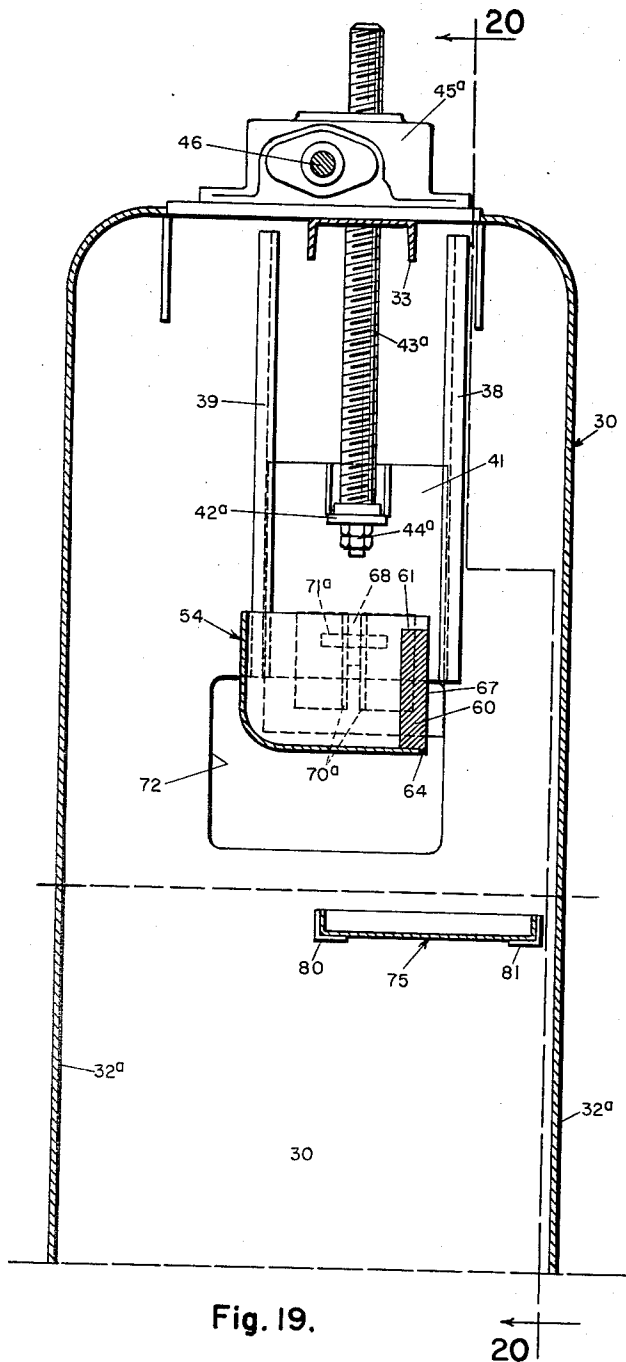


Fig. 19.

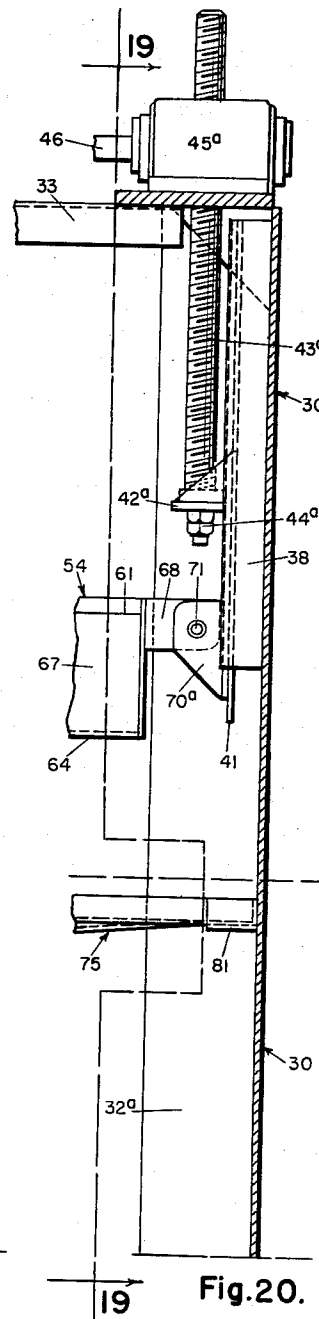


Fig. 20.

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SURFACE COATING MACHINES, AND THE LIKE

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6 Sheets-Sheet 6

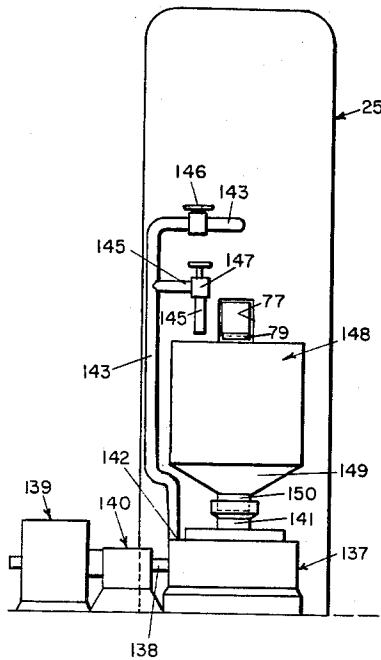


Fig.22.

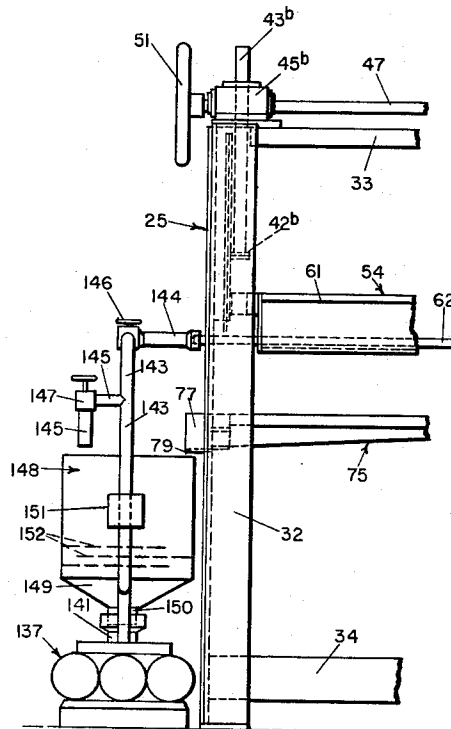


Fig.21.

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3,245,380 SURFACE COATING MACHINES, AND THE LIKE

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Filed July 17, 1962, Ser. No. 210,344

8 Claims. (Cl. 118-324)

This invention relates to improvements in surface coating machines, and the like. Such machines are used primarily in the spreading of thin coats of liquid material on the surfaces of travelling sheets which are to be thus coated. Such liquid may be one of various classes or categories, such as adhesives, fillers, paints, varnishes, and others, to mention only a few examples. The machines hereinafter disclosed are usable in the coating of the surfaces by any of such liquids, as well as others. It will also appear that such machines are of a type suitable for the coating of continuous strips of the sheet material, fed at substantially uniform speed through the coating unit; or for the coating of successively arriving panels, all of the same length or of different lengths coming in the sequence of arrival at the coating unit. I shall hereinafter fully disclose the coating unit as used for the coating of successive panels arriving at the coating unit, together with means to bring the successive panels to the coating unit, through the same, and to deliver the coated panels away from such coating unit, all in a continuous sequence of coating operations. The present invention includes the provision of the coating unit proper, as well as the means to bring the successive panels which are to be coated, into and through such coating unit, and to receive the coated panels as delivered from the coating unit and carry them to whatever point of reception or delivery may be intended. These structures are related to each other in manner to produce the desired uniformity of coating on the successive panels, as well as a high degree of uniformity of the coating operation produced over the large surface of each panel.

Briefly stated, I provide a liquid supply and delivery unit which is so constituted that it delivers a continuous thin sheet or curtain of the liquid falling down across the path of travel of the panels, so that during the travel of each panel through such sheet or curtain the desired thin coating is uniformly deposited on the panel surface under accurate control needed to ensure such uniformity of deposit. The panels arrive at the location of such sheet or curtain in succession, and properly spaced apart. Accordingly, there is a short interval between the completion of the coating of the retreating panel, and the arrival of the succeeding panel and commencement of coating thereof. During this short interval it is evident that, since the supply of the coating for production of the sheet or curtain is continuous, so that such sheet itself continues to flow down at the coating location, during the interval between presence of the retreating and succeeding panels at the coating location, provision must be made for receiving and collecting the material of the sheet during such interval. It is also true that some coating material will usually find its way down directly past the two edges of the panel, since the coating sheet or curtain must be of lateral dimension slightly greater than the width of the panels being treated in order to ensure complete coating over the full width of the panels. Thus any such coating material which arrives at the elevation of the panel but beyond the panel edges, will also be received and collected by such receiving and collecting means. Thus both the sheet or curtain producing means and the excess coating material receiving and collecting means are provided in the equipment hereinafter to be disclosed.

At this point it is shown that in order to produce a high degree of uniformity of the coating delivered to and left on the panel surface, special means must be provided

for producing and delivering to free fall the sheet or curtain of the material, and for ensuring to the highest degree possible that such sheet shall arrive at the panel surface in uniform condition, both as to the thickness of the sheet or curtain, and as to its linear regularity across the panel surface. In this connection it is also shown that, for many such coating operations, the thickness of the sheet or curtain material is small, approximating that of a film of the coating material. Such thickness may be of the order of a few mils (thousandths of an inch). Such a thin sheet is subject to serious disturbance by air currents coming against the curtain, as well as other local interferences. Also, the distance of free fall after leaving the supply element and until reaching the panel surface will affect the disturbances produced in the curtain by such outside influences. Thus it is desirable to make provision for adjusting the distance of such free fall to as small a value as is consistent with other operational conditions.

It is here noted that the thickness of the panels being treated during a continuous operation is substantially uniform, within manufacturing tolerances used in the production of such untreated panels, but that from time to time panels of different thicknesses will be coated by a given coating unit. Thus, the distance of free fall of the sheet or curtain would vary according to the panel thicknesses, in the absence of means to make corresponding adjustments in the coating unit.

I have provided means to vary the height of the sheet or curtain producing element, from time to time, assuming that the elevation of the conveyor surface remains unchanged, so that, for the treatment of panels of specified thickness the free fall may be adjusted to as small a value as experience dictates, to produce the close uniformity of the sheet or curtain as it arrives at the panel surface being coated. Such reduction of the free fall will also result in reduction of the undesirable interferences from air currents and other extraneous forces.

An important feature of the present invention relates to the provision of means to initially produce the sheet or curtain which then falls free to the panel surface. To this end I have provided a material containing trough extending across the full width of panels to be treated, with some excess width at each side, together with coating material supply means to continuously supply the coating material to such trough at rate equal to the rate of drainage of the material by exit of the sheet or curtain from the trough. One side of such trough (extending across the path of travel of the panels) is lower than the opposite side and the two ends of such trough. Thus, by keeping the trough continuously filled with the coating material, and filled at a height slightly above the low side of the trough, a thin film of the coating material will flow over such low side's top to institute the formation of the sheet or curtain. Such low trough side constitutes an inverted weir over which such sheet initially flows to be delivered downwardly outside of the trough. The front or delivery surface of such low trough side is substantially vertical so that, by avoiding any tendency to production of cavitation of the material at the arriving and leaving edges of the weir, such material will, if it wets the material of the weir, cling to the outside surface (vertical) of the low side of the trough, and flow down over such surface to the edge of the surface, and will there leave such surface and commence its free fall. In order to ensure that the sheet or curtain thus leaving such surface is of uniform thickness, and to avoid wavering of such curtain, I have provided a special form of lower edge of such surface, by which the desired uniformity of curtain thickness across the full width of the panel will be assured. Such delivery edge is narrow, with its rear face retreating from the front, material carrying surface, so

that there is no interruption to the straight down travel of the curtain clear to the line of exit of such curtain from contact with such trough surface.

At the line where the thin curtain falls free of the surface of the trough, there is naturally a tendency for the liquid material (which wets the trough surface) to cling to such lower edge, thus enhancing the tendency for the curtain or sheet of material to waver and leave the trough surface unevenly. This tendency is reduced by slightly rounding the line of delivery of the curtain from such trough surface, so that such line of delivery is not a sharp edge, but a rounded edge of small radius (e.g., of the order of ten mils, or 0.010 inch).

In order to ensure uniform delivery of the coating material over the entire length of the weir, it is necessary that such weir be as nearly horizontal as possible, when the coating unit is installed at its operational location. To meet this requirement I have made provision for raising and lowering both ends of the trough simultaneously and to the same extent; but I have also included in the connections between such two trough ends means by which an initial adjustment may be made, to bring both trough ends at exact horizontality. Thereafter, further adjustments of the trough elevation will be made by equal amounts, and with both ends of the trough at exactly the same elevation, thus producing the intended horizontality of the weir surface.

In order to avoid cavitation and/or turbulence in the thin sheet of material flowing over the weir top I have provided a "wide," horizontal surface of such weir, sometimes known as a "broad-crested weir." I have found that a width of such crest, of substantially one-fourth the vertical height of the front surface of the weir (the front surface of the trough) substantially avoids cavitation and turbulence in the flow of the coating materials over such weir, when a small rounded edge is provided at each of the approaching and retreating edges of the weir. Such rounds may be of the order of $\frac{1}{2}$ inch when the thickness of the weir is of the order of 1 inch.

I have provided means to constantly supply the trough with the coating material at that rate which is found to ensure production of the curtain or sheet of desired thickness. In this connection, however, it is also noted that the thickness of the film of coating which will be produced on the panel surface depends not only on the thickness of such curtain or sheet, but also on the rate at which the panel is moved through such curtain. Evidently, the faster the panel is moved through the curtain, the thinner will be the deposit of the film of coating material, and vice versa, assuming that the thickness of the curtain remains unchanged. I have included in the present disclosures means to control the rate of panel travel through such curtain. Such rate control means is of form enabling close tolerance in the travel rate.

I have provided means to provide a constantly circulating movement of the coating material, including in such means, provision for pumping the material at controlled rate of delivery, valve means to control the input of such pumped material, into the trough, with provision for immediate return of excess material so pumped beyond that rate needed to keep the trough constantly filled for production of the desired rate of flow over the weir, such returned excess material being delivered to the supply tank from which the pumping element draws its material, and means to control the pressure at which the material is delivered to the valve means which controls the rate of input into the trough. In connection with the foregoing it is evident that the avoidance of turbulence in the material contained in the trough is most important, since any slight turbulence will seriously affect the evenness of flow of the material over the weir. Accordingly, I have provided, as the pumping means, a type of pump which delivers the liquid material at substantially uniform rate, completely without pulsing, at any adjusted

rate of pump delivery. As an example, such a pumping unit comprises a unit produced by the Robbins & Meyers Company, under the name or title "Moyno." Such a pumping unit includes intermeshing elements of rotary type, whereby constant rotational rate produces constant rate of delivery of the liquid, completely free of pulsing.

I have also provided delivery means for delivering the liquid into the lower portion of the trough in such manner as to completely avoid production of turbulence within such trough. This delivery element comprises a delivery pipe extending along the lower portion of the trough, close to the trough floor. Such pipe is provided with numerous, equally spaced small delivery orifices, facing towards the trough floor, and having a total cross-sectional area of such orifices, substantially equal to the cross-sectional area of the pipe itself. The size of such delivery pipe is chosen sufficient to ensure delivery of the material along such pipe at slow speed, so as to avoid turbulence both within the pipe itself, and at delivery, as much as possible.

The trough and the receiving and collecting pan which receives the excess material falling past the panel elevation, are both made removable from the coating unit proper. Such removability is provided through an opening or openings in the two ends of the coating unit (being at opposite sides of the panel). Thus such trough element and the receiving and collecting pan, may be readily removed for cleaning purposes or otherwise.

I have referred to the provision of means to bring the successive panels to the location of the coating unit proper, and means to receive the coated panels as delivered from the coating unit and carry them away from such unit. The embodiment hereinafter described includes panel supply conveyors and panel removal conveyors, located proximate to the panel supplying and delivering sides of the coating unit. To ensure full control of the panel movements towards and through the free falling curtain I have provided common means to drive both of such conveyors at exactly equal speed for any condition of speed adjustment. I have also made provision for readily adjusting such speed of such conveyors by provision of a continuously variable speed drive. One such continuously variable speed drive is that known as the Reeves Vari-Speed drive, and widely used for various speed driving and controlling operations.

It is found desirable to produce travel of the panels through the curtain or sheet at a speed greater than the speed of travel of the panels when being brought up towards the coating unit and away from such unit. By such greater speed of travel through the curtain or sheet of coating material, it is possible to use a thicker curtain for production of a panel coat of specified thickness than would be required for production of such coating thickness when using a slower panel travel through the curtain. But generally, such higher travel rate through the curtain is greater than the desired rate of travel of the panels at locations removed from the coating unit farther than the lengths of the panels being coated. Accordingly, I have made provision for production of slower rates of panel travel at such more removed positions from the coating unit, than the rate of travel through the curtain; and to ensure that all such rates of travel remain at all times properly coordinated, I have provided a common drive element for driving all such conveyor units.

The conveyors which deliver the panels directly to the coating unit, and carry the coated panels away from such coating unit, are set with the delivery end of the supplying conveyor and the receiving end of the removing conveyor close together; but necessarily separated some distance to allow for the downward movement of the coating curtain into the receiving and collecting pan during the interval between exit of the one panel which has been coated, from the curtain location, and entrance of

the leading edge of the succeeding panel into the curtain location. Thus there remains a short gap or discontinuity in the panel supporting and carrying means, at such curtain location. The length of such discontinuity is aggravated by the sizes of the conveyor wheels over which the conveyor belts run, since each conveyor moves down to a lower and non-panel supporting position (in the case of the supplying conveyor, and up from such a position, in the case of the panel receiving conveyor), so that the actual distance between the supporting tangents of the two conveyors is considerably greater than the actual space between the proximate conveyor wheels.

When coating panels of thickness to resist easy bending, the distance of non-panel support produced by such gap is not sufficient to permit such an amount of bend of the approaching panel end as to produce a misalignment with the surface of the receiving conveyor. Thus, for such relatively thick panels there is slight liability that the leading edges of the panels will fail to ride smoothly onto the tangent surface of the receiving conveyor. However, it frequently happens that the panels to be coated are so thin that a downward deflection of the leading edge of the panel would be sufficient to jam such leading edge against the upwardly riding portion of the receiving conveyor, riding up over its conveyor wheels. In such case the conveyor surface might be damaged, and the leading edge of the panel frayed or damaged; but more importantly, the unruffled form of the free falling curtain might be destroyed, with corresponding production of wavering and non-uniformity of the curtain reaching the panel surface behind its leading edge.

A further feature of the present invention resides in the provision of means to ensure that the leading edge of the panel approaching the receiving conveyor shall obtain such support at the location of the gap between the conveyors, as will prevent such an amount of downward deflection as would produce the above stated damaging condition; such means also being so constituted as to guide a downwardly deflected leading edge up and onto the supporting surface of the receiving conveyor. Such means, in the illustrated embodiment, comprises one or more fingers which are supported by one of the conveyors, and extend at least partially across the gap, and are of form which will produce the intended function of guiding the leading edge of the panel up and onto the conveyor surface of the receiving conveyor. In some cases such fingers may not project from the location of the receiving conveyor far enough to intersect the path of the curtain or sheet of coating material; and in such cases such fingers will not themselves be wetted by such curtain material. In other cases the fingers may extend far enough to intersect such curtain material; but in such cases the fingers are of form such that the leading edge of the panel arriving at the finger location will engage such finger beyond its wetted area, and at a location where such finger is un-wetted. In this connection it is noted that when the panel engages a finger portion which has been wetted by the coating material, some such material will be transferred to the underside of the leading edge portion of the panel, with production of streaks of the coating material on such portion of the panel surface.

In the embodiment hereinafter described such fingers constitute portions of a unit which is readily connected to an element of the receiving conveyor, if desired. In this connection the illustrated embodiment includes structural elements of such form that both the supplying conveyor and the receiving conveyor comprise independent units which may be brought to proper position relative to the coating unit; and the necessary conveyor driving connections to a common source of power may then be readily effected for the operational purposes already stated.

Other objects and uses of the invention will appear from a detailed description of the same, which consists

in the features of construction and combinations of parts hereinafter described and claimed.

In the drawings:

FIGURE 1 shows a plan view of a coating unit embodying the features of the present invention, but without showing the liquid material supplying and circulating elements; and this figure also shows in plan, portions (or all) of the supplying and receiving conveyors, the common drives for such conveyors; and such figure also shows the delivery end of another slow speed conveyor which brings the panels to the entering end of the supplying conveyor of high speed, with common drive to such slow speed conveyor from the proximate end portion of the high speed supplying conveyor;

FIGURE 2 shows a side elevation of the structures shown in FIGURE 1;

FIGURE 3 shows a fragmentary plan section taken on the line 3—3 of FIGURES 2 and 4, on enlarged scale as compared with such figures; and FIGURE 3 shows the details of the fingers at the location of the gap between the supplying and receiving conveyors;

FIGURE 4 shows a cross-section taken substantially at the location 4—4 of FIGURE 3, looking in the direction of the arrows;

FIGURE 5 shows a plan view companion to the left-hand end portion of FIGURE 1; and FIGURE 5 shows the receiving end portion of a slow speed delivery conveyor which receives the coated panels from the receiving high-speed conveyor of FIGURE 1 by a common drive from such high-speed conveyor;

FIGURE 6 shows a side elevation of the structures shown in FIGURE 5;

FIGURE 7 shows a plan view of the material receiving trough, on enlarged scale as compared to FIGURES 1 and 2;

FIGURE 8 shows a front elevation of the trough unit of FIGURE 7;

FIGURE 9 shows a longitudinal section taken on the line 9—9 of FIGURE 7, looking in the direction of the arrows;

FIGURE 10 shows, on enlarged scale as compared to FIGURES 7, 8 and 9, a cross-section taken on the lines 10—10 of such figures;

FIGURE 11 shows a plan view, on enlarged scale as compared to FIGURES 1 and 2, showing the coating material receiving pan which underlies the path of the panels through the coating unit, and receives and collects the coating material not retained by the panels being coated;

FIGURE 12 shows a front elevation of the pan shown in FIGURE 11;

FIGURES 13 and 14 show cross-sections taken on the lines 13—13 and 14—14, respectively, of FIGURES 11 and 12, looking in the directions of the arrows;

FIGURE 15 shows a front elevational view of the coating unit, removed from the conveyors, and on enlarged scale as compared with FIGURES 1 and 2;

FIGURE 16 shows a left-hand face view of the coating unit shown in FIGURE 15;

FIGURE 17 shows a cross-section through the left-hand portion of the coating unit shown in FIGURES 15 and 16, being a section taken on the lines 17—17 of FIGURES 15 and 18, looking in the directions of the arrows;

FIGURE 18 shows a section taken on the lines 18—18 of FIGURES 16 and 17, looking in the directions of the arrows;

FIGURE 19 shows a cross-section through the right-hand portion of the coating unit shown in FIGURES 15 and 16, being a section taken on the line 19—19 of FIGURE 15, looking in the direction of the arrows, and the line 19—19 of FIGURE 20, looking in the direction of the arrows;

FIGURE 20 shows a section taken on the line 20—20 of FIGURE 19, looking in the direction of the arrows;

FIGURE 21 shows, more or less schematically, a front

elevational view of the coating unit, together with the rotary pump, motor driven by a continuously variable speed reduction unit, for supplying the coating liquid under pressure and under valve control of such pressure and valve control of the rate of flow, to the trough, together with connections to return non-used coating material to such pumping unit;

FIGURE 22 shows a view of the foregoing units, taken at right-angles to FIGURE 21; and

FIGURE 23 shows an enlarged detail of the lower, rounded edge at the junction 64 of the surfaces 67 and 65 of the front wall of the trough.

FIGURES 1 and 2 show plan and side elevational views respectively, of a typical installation including my present improvements. This installation includes the coating unit 25, the supplying conveyor unit 26, and the receiving conveyor unit 27. The latter unit is shown broken off to shorten the figures, but FIGURES 5 and 6 show leftward extensions of such receiving conveyor unit. FIGURES 1 and 2 also show the slow speed conveyor unit 28 delivering the panels to the supplying conveyor unit 26; and FIGURES 5 and 6 also show the slow speed conveyor unit 29 to which the panels are delivered by the receiving conveyor unit 27. The drives for all of these conveyor units will be described hereinafter.

The illustrated coating unit includes the end stands 30 and 31, preferably of generally pan shape for stiffness with the flanges 32 of such pans extending towards each other (see FIGURES 15 and 16). The bar 33 extends between and is secured to the upper portions of both such stands; and the bars 34 and 35 extend between and are secured to the lower portions of the flanges 32 of both of the stands. Thus a rigid framework is provided which carries the elements presently to be described. As shown in FIGURE 15 the central portion of this framework is completely open, the proximate end portions of the two conveyors 26 and 27 reaching close to such open portion of the framework (supplying conveyor 26) or partially into such open portion (receiving conveyor 27). Thus such proximate conveyor portions are brought close to the liquid coating material trough and the pan, presently to be described.

Guide rails 36 and 37 are secured to the inside face of the stand 31, and corresponding guide rails 38 and 39 are secured to the inside face of the stand 30. All of these guide rails are vertical, and they provide trackways for support of the plates 40 and 41 and to guide such plates in their vertical movements for adjustment of their elevations in the stands. Such vertical adjustments are produced by the following means (the adjustment elements for both of such plates 40 and 41 being like numbered for the two stands and plates, but with the suffixes "a" and "b" for the elements of the stands 30 and 31, respectively). The brackets 42 are secured to such plates 40 and 41, and extend inwardly far enough to receive the lower end portions of the adjustment screw-threaded rods 43 which are secured to such brackets by the nuts 44. These rods extend upwardly through the upper portions of the respective stands, and into and through the gear boxes 45. The horizontal and aligned shaft sections 46 and 47 also extend through such gear boxes; and gear connections are provided between such shaft sections 46 and 47, and the vertical screw-threaded shafts 43^a and 43^b, respectively, such that simultaneous rotations of the shaft sections 46 and 47 produce equal rising or falling movements of such shafts 43^a and 43^b. When such shafts 43^a and 43^b are retained against rotation, such vertical movements may be produced by the use of screw-threaded nuts or the like, threaded on such shafts, and rotated by the rotations of the shaft sections 46 and 47, respectively.

Both of the shaft sections 46 and 47 are drivingly connected together, as by the element 48 (see FIGURE 15). This element 48 includes the two sections 49 and 50 which may be readily drivingly connected together in adjusted angular relation, so that, once such angular adjustment

has been made, both of the shaft sections will rotate by equal angular amounts, but with their angular relation to each other fixed at such adjusted condition. The details of such unit 48 are not illustrated herein, since such a device is fully disclosed in Letters Patent of the United States, No. 2,326,429, for Improvements in Glue Spreader, Surface Coater, and the Like, August 10, 1943, on the application of John E. Black et al. The combined shaft element 46-47 may then be rotated in convenient manner, as by the hand wheel 51 to simultaneously raise or lower the two bracket plates 40 and 41, with their brackets 42^a and 42^b; and the amount of such raising or lower movement may be controlled by the amount of such shaft rotation. During such shaft rotation both of the bracket plates will be raised or lowered by equal amounts. If the brackets 42^a and 42^b are not in horizontal alignment (or if the trough, presently to be described is not in horizontal alignment), the desired horizontality may be secured to a very close tolerance by changing the angular relationship between such shaft sections 46 and 47, by use of the unit 48, and according to the principles disclosed in such earlier patent; or by other convenient and suitable means.

Sometimes it may be desirable or needful to make such vertical adjustments to an exact and known amount, as, for example, to adjust the clearance between the free falling start position of the curtain or sheet of coating material, presently to be described, and the surface to be coated by such curtain. For a given installation, and a known pitch of the threads on the shaft elements 43^a and 43^b it is possible to pre-determine the amount of angular rotation of the wheel needed to produce a desired amount of such vertical adjustment; but I have herein disclosed a counter element which shows, by the amount of change of its reading during such an adjusting operation, exactly the corresponding vertical adjustment which has been effected. This is the counter element 52 (see FIGURE 18) which is geared to the shaft section 47 so that its digital elements 53 will display, by their changed readings, exactly the amount of vertical adjustment which has been effected. Such digital elements may be driven at rate to display vertical adjustments as small as mils (thousandths of an inch), or the like. In the embodiment shown in FIGURE 18 the three right-hand digital elements display such mils, and the two left-hand digital elements display full inches.

The trough unit is shown at 54 in various figures. It includes the two end plates 55 and 56, between which extends the sheet 57 formed to provide the back wall of the trough 58 and the trough bottom 59. Such sheet has its ends sealed in liquid-tight manner to the end plates 55 and 56. The front of the trough takes the form of an inverted weir 60. This extends between the end plates, and has its lower edge connected to the trough bottom 59 in liquid-tight fashion; but such lower edge of the weir is also of special form, as will be presently explained. The top edge of such inverted weir 61 lies below the top edges of the end plates and of the back wall of the trough, so that liquid may be filled into the trough continuously to the amount which brings such liquid up to the elevation of such top weir edge 61, after which further flow of the liquid into the trough must be accompanied by overflow over the weir at amount or rate equal to the rate of input of the liquid into the trough.

The liquid is introduced into the trough through a pipe 62 extending through the trough end plate 56 at an elevation slightly above the bottom or floor of the trough, such pipe being sealed in liquid tight fashion to such end plate 56. Such pipe extends close to the opposite end plate 55, and the end of the pipe is closed. Such pipe is, however, provided with numerous small holes 63 (see FIG. 15) opening downwardly towards the floor of the trough, and through which the coating liquid is delivered into the trough. In the embodiment illustrated such holes face directly down, but some departure from such direction of liquid delivery is permissible, it being intended that

by introducing the liquid into the lower portion of the trough at low linear rate, and in direction to avoid production of turbulence by such introduction, the liquid will rise evenly in the trough, without turbulence, and move evenly laterally towards the top edge or face of the weir. Then, assuming that such weir is straight across the trough, and that its surface is exactly horizontal, the rising liquid must be delivered over the weir surface evenly along such surface, and according to well understood principles of overflow weirs. However it is understood that the overflowing coating material must be so controlled during its overflow that the desired curtain or thin sheet of such material will be produced, so that the use of such weir as herein disclosed is of a highly specialized nature, to produce a highly specialized form of the liquid delivery. Accordingly, the following additional disclosures are included.

The holes 63 of the inflow pipe are spaced equidistantly along the pipe, and the cross-sectional area of all such holes is made substantially equal to the cross-sectional area of the pipe itself. For holes $\frac{1}{8}$ inch diameter, provided in an inlet pipe 1 inch internal diameter, the number of holes (to provide a total hole cross-sectional area equal to that of the pipe), will be 64. For a pipe 12 inches long (across the panel, being probably sufficient for feeding a trough intended to coat panels up to ten inches width), such holes should be spaced 0.1875 center to center. Since the holes are assumed to be $\frac{1}{8}$ (0.125) inch diameter, they would be separated from each other by 0.0625 inch, or $\frac{1}{16}$ inch. Thus there would be provided a substantially continuous orifice along the downwardly facing surface of the inlet pipe for the entire length intended. The coating liquid would thus be introduced into the lower portion of the trough in a substantially continuous jet for the full length of such trough, assuming that the trough was only slightly more than 12 inches in length.

The front wall or weir of the trough may comprise a block of mild steel, substantially one inch thick, and four to five inches high. The lower edge of such block is sealingly connected to the front edge of the floor of the trough, and the top edge face of the block is formed at right-angles or normal to its height. The approaching and departing edges of such top weir face are provided with rounds of the order of $\frac{1}{32}$ inch radius to avoid cavitation and other disturbances in the overflow of the coating liquid.

Examination of FIGURE 10 in particular, shows that the lower front edge of the weir block is carried straight down to a delivery edge 64, and that from such delivery edge the back face of the block slants upwardly and rearwardly on the angling surface 65 to meet a flat surface of the block 66 which is sealed to the front edge of the top surface of the floor sheet 59. Such slant is shown as being at an angle of substantially 45 degrees from the vertical. The front surface of such weir block is smooth, and the delivery edge 64 is rounded on a small radius, of substantially 0.010 inch (see FIG. 23).

When the coating materials comprise liquids which wet the weir surface 61 and the front surface 67 of the weir block, such liquids will cling uniformly to such weir surfaces 61 and 67, from the approaching edge 68 to the leaving edge 69 of such weir substantially without cavitation at such edges, for all expected rates of liquid flow over such weir surface 61. Thus the curtain or sheet of coating material which flows down over the surface 67 will be uniform as to thickness, and descending at substantially the same rate across the full width of the weir. Thus, too, the curtain falling free of the weir block edge 64 will commence its fall under the best obtainable conditions, and, in the absence of disturbing influences exterior to the curtain itself, such curtain will continue its fall as a continuous sheet across the full width of the panel to be coated.

It is noted, however, that such a falling sheet or curtain will contract in thickness as its rate of fall rises during its descent; and if such distance of fall is excessive, the curtain will eventually become discontinuous, and gather into separate streams of the liquid. Accordingly, it is highly desirable to be able to adjust the distance of fall from the edge 64 to the panel surface to as small a value as is consistent with proper handling of the panels, taking into account, also, the thickness of the panels being coated. Such adjustment of the distance of free fall is readily accomplished by the following provisions:

The lugs 68 and 69 are secured to the end plates 55 and 56 of the trough element and project towards the plates 41 and 40, respectively, which plates have been described hereinbefore, and are vertically adjustable. The pairs of brackets, 70^a and 70^b are secured to the lower portions of the plates 41 and 40, respectively and project towards the proximate ends of the trough element at opposite sides of the lugs 68 and 69 which are connected to the trough end plates. Cross pins 71^a and 71^b connect the lugs to the proximate brackets 70^a and 70^b, respectively, as shown in FIGURES 17, 18, 19 and 20 and elsewhere. Due to such pinned connections of the lugs to the brackets it is evident that any slight adjustment by use of the unit 48, needed to bring the trough into exact horizontality, may be effected, since such an adjustment would involve raising or lowering one end of the trough (by raising or lowering the corresponding plate 40 or 41, as the case may be), more than the other such plate. Thus such horizontal adjustments may be made without producing binding or other improper effects on the elements of the unit.

It is also here noted that such connections between the trough lugs and the brackets by the pins 71^a and 71^b are such that by withdrawing the pins the trough may be disconnected from the plates 40 and 41, to release such trough for its removal or cleaning. In this connection, also, the stand 30 is provided with an opening 72, and the stand 31 is provided with an opening 73, both such openings being so located and proportioned and sized that the trough may be readily inserted or removed through either such opening, after the pins 71^a and 71^b have been removed. These openings also serve other purposes hereinafter described. It is noted also that the input pipe 62 which supplies the coating material to the trough is carried leftwardly (see FIGURES 7, 8, 9, 15 and 18) far enough to reach through the proximate opening 73, or the upward extension 74 thereof (see FIGURES 2, 16 and 17). Such upward extension 74 accommodates such pipe extension when the trough unit is raised to accommodate panels of such thickness as to require such trough raising.

The pan 75 is supported beneath the trough and at a level below the panels being coated. This trough is well shown in FIGURES 15 to 20, inclusive. It is of width, measured in the direction of panel travel, sufficient to receive any drippings of the coating material which may come from the panels during the coating operation; but primarily such pan receives the full down flow of the curtain during the interval between movement of the trailing edge of the panel just treated, from the curtain, and the arrival of the leading edge of the successive panel at such curtain location. Conveniently such pan is provided with a floor which slants from the location of the stand 30, downwardly to the location of the stand 31, and also slants downwardly from front to rear of the pan (measured in the direction of panel travel), to a gutter 76 extending along the back edge of the pan, and also slanting downwardly as evident from examination of FIGURE 12 and 15, in particular. This gutter terminates in a chute-like extension 77 which reaches through the opening 73 of the stand 31, or a downward extension 78 of such opening (see FIGURES 15, 16, 17 and 18). Such extension has

its floor terminated in a slight downwardly extending lip 79 from which the outflowing coating material spills into a suitable receptacle for retrieving such material. This will be referred to further during the description of the circulation producing means and equipment.

The pan is conveniently supported by the brackets 80 and 81 secured to the inside face of the stand 30, and the brackets 82 and 83 secured to the inside face of the stand 31. Such pan is readily removed from its location within the coating unit through either of the openings 72 or 73 of the stands 30 and 31.

Referring to FIGURES 1 and 2, the gap between the supplying conveyor 26 and the receiving conveyor is shown at 84^a. It is seen that during the interval previously referred to between the exit of the just coated panel and the entrance of the succeeding panel to the curtain of coating material, such material falls directly into the pan. In FIGURES 3 and 4 I have shown, in fragmentary form, the delivery end portions of the conveyor belts 84, 85 and 86 of the supplying conveyor 26, and the receiving portions of the conveyor belts 87, 88 and 89 of the receiving conveyor 27. The pan 75 is shown directly beneath such conveyor belt portions. In FIGURE 4 I have also shown one of the conveyor wheels 90 over which such supplying conveyor belts travel downwardly, and have shown by the dashed line 91 the elevation of the supporting surface provided by the belts, being also the elevation of the bottom faces of the supplied panels. One of the conveyor wheels 92 over which the receiving conveyor belts travel, is also shown; and the line 91 is seen to come tangent to the belt travelling over such wheel 92. Without panel support between the locations at which such line 91 comes to the two wheels 90 and 92, the front or leading edge portion of a panel might deflect downwardly as shown at the downwardly slanting dashed line 93, coming from the line 91, so that by the time such leading edge would come to the belts of the receiving conveyor, there would occur an abrupt change of direction (upwardly) of such leading edge, with possible damage to the conveyor belts, and also to such panel leading edge. I have therefore made the following provision for supporting the panel sufficiently during its travel over the gap, to avoid such damaging condition:

I have provided a series of fingers, such as the two fingers 94 and 95 (see FIGURES 3 and 4), extending from the supporting bar 96 backwardly over all or a substantial portion of the gap, such fingers being conveniently located between proximate conveyor belts of the receiving conveyor. Such bar 96 is conveniently secured to one of the cross bars 97 of such receiving conveyor as shown in FIGURE 1. The brackets 98 are secured to the face of such bar 97, and the ends of the fingers are then secured to such brackets as shown in FIGURE 4. Such fingers are conveniently shaped as follows: each finger has its top edge straight and lying substantially on the extension of the line 91, from the bar 96 to the point 99, at which point the finger commences a downward curve 100 to a level sufficiently low to ensure that any approaching panel, thin enough to materially deflect, shall come against such curved portion and be guided by it upwardly to the level of the conveyor belts of the receiving conveyor.

In FIGURE 4 I have shown, by the dashed line 101 the location of the falling curtain of coating material. In that figure I have also shown the finger as extending rearwardly far enough to intersect such curtain's path. Under such circumstances the rightward, lower end portion of the finger would be wetted by such curtain. If, however, the downwardly deflecting leading edge of the panel should not deflect more than a small amount it would come to the top edge of the finger at such a position as shown by the line 93, being beyond the wetted portion of the finger. Thus no coating material would be transmitted to the underface of such panel by engage-

ment with a wetted portion of the finger. Again, if the finger should be terminated at the position 102 in FIGURE 4, it would not intersect the curtain and thus would not be wetted thereby. With the finger cut off at the location 102 the front edge of the oncoming panel would still strike the curved portion 100 of the finger and thus restore the leading edge of the panel to its elevation needed for travel on the receiving conveyor belts.

A conveyor drive motor 103 is provided and supported within the supplying conveyor 26. This drive motor includes a continuously variable speed reduction element (not shown), such as the Reeves Vari-Speed drive type already referred to. Thus the output pulley 104 is driven at selected adjusted speed. A back shaft 105 is journaled across the delivery end portion of the frame of the supplying conveyor 26, and such shaft carries the large driven pulley 106 which is belt driven from the motor unit output pulley 104 by the belt 107. The drive motor, including its continuously variable speed reducer element, is carried by a base plate 108 which can be adjusted endwise of the conveyor frame by use of the hand crank 109. Thus the belt tension of the belt 107 is readily adjusted.

The back shaft 105 carries the two output pulleys 110 and 111 (see FIGURE 1), such output pulleys conveniently being small. The delivery end of the supplying conveyor unit 26 has journaled in it the cross shaft 112 which carries the pulleys 90 over which the conveyor belts 84, 85 and 86 ride. Preferably all such conveyor belts are of V-section, and the pulleys over which they ride are correspondingly V-grooved. Such conveyor belts also travel over companion V-grooved pulleys 113 carried by the shaft 114 at the entrance end of such supplying conveyor. Thus such shaft 114 is driven by the travels of the belts. The shaft 112 carries the driven pulley 115 on such shaft 112, and the belt 116 drives such pulley 115 from the back shaft pulley 110. The sizes of the motor unit output pulley 104, of the pulley 106, and of the pulleys 110 and 115 are all proportioned to enable conveyor belt drive at a speed suitable for passage of the panels through the curtain under the best curtain coating operating conditions. Of course such conveyor belt speed is at all times also under control by use of the continuously variable speed element of the drive motor unit.

The receiving conveyor unit 27 is provided with the shaft 117 at its entering end, the belt conveyor pulleys being carried and driven by such shaft. Such shaft carries and is driven by the pulley 118. A back shaft 119 is journaled in the entering end portion of such receiving conveyor. This back shaft carries and is driven by the pulley 120 aligned with the output pulley 111 of the back shaft 105; and the belt 121 drives the pulley 120 from the pulley 111. The back shaft 119 and the conveyor shaft 117 carry aligned pulleys 122 and 123, which are drivingly connected together by the belt 124. Thus the receiving conveyor belts are driven from the back shaft 105, from which the supplying conveyor is also driven; such back shaft being driven by the drive motor unit. The sizes of the pulleys 111, 120, 122 and 123 and of the receiving conveyor V-grooved pulleys, are all proportioned to produce linear belt speed of such receiving conveyor equal to the linear belt speed of the supplying conveyor. Thus, as the panels move under drive of the supplying conveyor belts, across the gap and through the coating curtain, they reach the conveyor belts of the receiving conveyor, also travelling at the same speed as such panels. Accordingly, the panels ride onto the receiving conveyor belts under smooth operating conditions.

The shaft 114 at the entering end of the supplying conveyor 26 is carried through the frame of such conveyor and carries and has drivingly connected to it the pulley 125. The proximate end portion of the frame of the low speed conveyor 28 journals the shaft 126 which is the driving shaft of such low speed conveyor unit. Such

shaft 126 is carried through the frame of such conveyor, and carries and has secured to its the driven pulley 127 in alignment with the pulley 125. The V-belt 128 drivingly connects the pulleys 125 and 127 so that the low-speed conveyor is driven from the supplying conveyor. The drive ratio between the pulleys 125 and 127 is shown as substantially one to two; so that such low-speed conveyor is driven at substantially one-half the linear speed of the supplying conveyor. Under these speed conditions it is evident that the spacing, center to center, between successive panels carried by the supplying and receiving conveyors, will be substantially double the spacing between such panels carried by the low-speed conveyor 28.

Comparing FIGURES 1 and 5, it is seen that the belts of the receiving conveyor 27 pass over pulleys carried by and secured to the shaft 129 journaled across the delivery end portion of such receiving conveyor. Thus such shaft is rotated at the full speed of the receiving conveyor structure. The low-speed conveyor is provided with the shaft 130 journaled across the entrance end of its frame, and carries the grooved pulleys over which the belts of such low-speed conveyor run. The projecting end of the shaft 129 of the receiving conveyor carries and has secured to it the small pulley 131; and the projecting end of the shaft 130 of the low-speed conveyor 29 carries and has secured to it the larger pulley 132. The belt 133 connects the pulleys 131 and 132 together. The driving ratio from the pulley 131 to the pulley 132 is shown as one to two; thus such low-speed conveyor has its belts driven at substantially one-half the speed of the receiving conveyor. The result is that the panels arriving at high-speed from the receiving conveyor of the coating section are again driven at low speed, and closer spacing than existed between them during their passage through the coating curtain. Suitable tension take-up elements are provided for the conveyor belts of the supplying and receiving conveyors to ensure sufficient tension in such belts to produce drive thereof without slipping, notwithstanding that such conveyor belts are called upon to drive the low-speed conveyors in addition to performing their usual functions of conveying the panels which they support. Such tension take-up elements are shown at 134^a in FIGURES 1 and 2, and at 134^b in FIGURES 5 and 6.

The several conveyors are conveniently supported by the stands, such as 135 in FIGURES 2 and 6; and such stands are provided with telescoping upper portions, shown at 136, by which the conveyor frames may be brought to exactly the intended operational levels for optimum operations.

FIGURES 21 and 22 show, more or less schematically, elevational views of the coating unit or section, together with means to supply the trough of such coating unit continuously with coating material at a rate to produce the desired curtain or sheet of the coating material, and means to trap and return the excess coating material to such trough supplying elements, for re-circulation. Such means include the following elements:

I have provided the rotary, non-pulsating pump, 137, with its drive shaft 138 driven by the drive motor 139 through the continuously variable ratio speed element 140 (such as a Reeves Vari-Speed drive unit). Such pump may be of the type previously referred to under the name "Moyno." It includes intermeshing rotary elements which draw the coating material from the top inlet opening at 141 and deliver such liquid material under pressure at the outlet or delivery opening 142. Such delivery opening 142 connects to the delivery pipe 143 which connects, in turns, with the projecting end portion of the coating material supply pipe 62 already described. Such connection may be readily made by use of a section of flexible tubing 144. When the delivery pipe is to be disconnected from such pipe end 62, this can be readily effected by customary operations. The branch pipe 145 connects to the pressure delivery pipe 143 at a location in front of the connection

to the pipe 62; and the control valve 146 is placed in such pipe 143 beyond the connection of the pipe 145 to the pipe 143. This control may be adjusted manually or otherwise, to determine the rate of inflow of the coating material into the trough.

The drive of the pumping unit is adjusted to a speed which will exceed the rate of liquid delivery to the trough; and the excess liquid is returned to the pump inlet opening for recirculation. The pressure relief valve 147 is placed in the line 145. This relief valve may be of conventional form, and is adjustable to open at a pre-set pressure to allow excess liquid to pass in quantity needed to maintain such pressure in the line 143.

The returned or re-circulated liquid coming from the pipe 145 and the liquid caught by the pan 75 are both returned to the inlet opening 141 of the pumping unit. For this operation I have provided the open top pan shaped, circular receptable 148, having the cone shaped floor 149 which terminates in a central delivery opening provided with a downwardly extending nipple 150. The chute extension 77 from the gutter 76 of the pan 75 drains directly into such receptable 148. The nipple 150 is threaded into the liquid inlet opening 141 of the pumping unit, so that all nonused liquid is retained in the circulating system. From time to time additional coating material may be supplied to the element 148 as needed to ensure a continuous uninterrupted circulation of the coating material through the system.

The following comments are pertinent respecting the provision of the desired continuous and uniform coating operation by passage of the panels through the curtain or sheet:

(1) Several elements are provided by which adjustments of the coating operation may be effected. These include

A. Adjustment of the rate of travel of the panel through the curtain. This comprises the variable speed unit which is driven by the drive motor 103, by way of illustration.

B. Adjustment of the thickness of the curtain or sheet through which the panel is passed. On the assumption that the curtain is so controlled as to maintain its continuity and uniformity of thickness across the panel, substantially without waver or other like disturbance, the rate of liquid flow over the weir may be controlled by use of the valve 146. As long as such rate of flow remains constant, and such uniformity of thickness of the curtain without waver is maintained, the elevation of the trough (and therefore, the distance of free fall), may be varied without change of the rate of deposit of the coating material on the panel surface, since reduction of the thickness of the curtain, produced by increased distance of free fall, is compensated by the increased velocity of the falling curtain at the surface of the panel.

C. Adjustment of the elevation of the trough above the panel surface to be coated. This comprises the hand wheel 51 and connected parts, already described. Such adjustment is provided to enable proper coating operations to be performed on panels of various thicknesses supported by the conveyors, and also to enable the control of the distance of free fall of the curtain when the coating unit is being used to coat panels of any such thickness. This will, in turn make it possible to bring the curtain thickness (at the location just above the panel surface) to that value which enables production of optimum coating results.

The controls above stated are effective when the curtain is uniform and free of waver, so that the coating will be uniformly applied to the panel surface. Certain controls have been provided relating to the means to produce the desired circulation of such coating material, and constituted to ensure, most effectively, the production of a

curtain of such acceptable characteristics as above stated. These controls therefore relate to the coating liquid circulation producing equipment. They include the following:

(2) The coating liquid circulation producing controls. These include

D. Control of the rate of coating liquid flow over the weir. This entails control of the rate of input of such liquid to the pipe 62 in the lower portion of the trough. That, in turn is directly controlled by the valve 146; but here again the pressure at which the liquid is brought to such valve is controlled by the setting of the relief valve 147. The pressure reducing function of such relief valve depends on the pressure and rate of supply from the rotary pump. Thus, all of these elements affect the condition of the supply of the coating liquid to the trough. If the throttling effect which must be produced by the valve 146 is great, due to an excessively high pressure setting of the relief valve 147, excessive turbulence will be produced in the liquid delivered to the trough pipe 62. Thus it is highly desirable to be able to produce a condition under which the desired rate of flow over the weir will be produced with a minimum amount of throttling at such valve 146.

E. By setting the pump speed at an adjustment which produces a greater rate of liquid delivery than that demanded for supply of the weir, the relief valve 147 and the throttle valve 146 may be adjusted to bring the rate of flow to the desired value. Such adjustments of these valves may be effected by first throttling the valve 146 to a point which permits delivery of the desired rate at the then setting of the relief valve; this will cause the excess rate of the pumped liquid to be returned to the element 143 for re-circulation; but the flow through the throttle valve 146 will occur under pressure conditions existing at that valve, dependent on the setting of the valve 147 and the back pressure corresponding thereto. By then reducing the setting of the relief valve 147, the pressure delivered to the throttle valve 146 will be correspondingly reduced, with corresponding reduction of turbulence produced at that valve, but corresponding reduction of the rate of delivery to the trough. The throttle valve may now be opened slightly to restore the rate of flow to the full desired value, under the condition of lowered production of turbulence at such valve. By alternate valve adjustments of the valves 146 and 147, the rate of flow may be brought to its correct value, with a minimum pressure setting of the relief valve, and corresponding minimum pressure at the throttle valve, with production of a minimum turbulence.

Although the introduction of the liquid into the lower portion of the trough through downwardly facing holes is advantageous in the sense that it correspondingly reduces the tendency to produce turbulence within the trough, and although I have also disclosed other elements of structure which will further reduce the tendency towards production of turbulence within the trough, and also ensure production of the desired characteristic of the curtain, still it is also highly important to reduce the tendency towards production of turbulence by ensuring as smooth and undisturbed an entrance of the liquid into the lower portion of the trough through the pipe 62. This result is produced by the combination of pumping and control elements previously described. The size of the reservoir 148 is also an important factor in the reduction of turbulence in the flow conditions of the liquid to and in the trough 54. It must be remembered also that it is highly important to eliminate, as far as possible, the

production of bubbles in the liquid delivered into and contained within such trough 54 since the presence of such bubbles seriously interferes with the production of a smooth, uniform, and unbroken curtain or film of the liquid material delivered onto the surface of the work body being treated.

The elimination of bubble formation is materially enhanced by the provision of a relatively large receptacle 148 from which the liquid is delivered directly, and by a short connection 141 to the liquid intake of the pump 137. As shown in FIGURES 21 and 22 this receptacle 148 is of substantially the full available height between such pump intake and the spillway 79 which delivers the liquid to such receptacle from the pan 75, for recirculation. The receptacle is also of considerable cross section (horizontally), and is thus of considerable capacity. Accordingly, the rate of flow of the recirculated liquid to the pump inlet is small, allowing ample time for release of such bubbles as may have been produced by the entrance of the spill from such pan 75 into the receptacle 148. All of these factors operate cumulatively to ensure final pump delivery of a smooth and non-aerated stream of liquid into the trough 54.

It is also noted that, due to the considerable height of the receptacle 148 and thus, the considerable height of the body of liquid which may be contained therein, there is produced a substantial pressure head of the liquid supplied to the pump, which pressure head ensures smooth and uninterrupted supply of the liquid to the positive displacement elements of the pump, and assures against possible production of cavitation which results in production of bubbles in the delivered liquid. These beneficial results are enhanced also by the provision of one or more baffles 152 located in the lower portion of the receptacle 148 just above the conical bottom 149 of such receptacle; such baffles being so related to each other that the liquid must move through a path of some length within such receptacle, thus aiding the elimination of bubbles or cavitation effects.

Examination of various figures shows that the pan 75 is shallow so that any bubbles produced at the surface of such pan's contained liquid will readily and quickly rise to the surface of the liquid contained in such pan, before such liquid is delivered from the pan at the area 79. If desired, a filter 151 (see FIGURE 21) may be included in the line 143 between the delivery connection from the pump and the pressure release connection 145, to ensure against possible movement of foreign materials to the trough.

I claim:

1. A surface coating machine including in combination a trough having a back and end walls, and a vertical front wall of less height than said back and end walls and constituting an overflow weir, the top edge of said front wall lying in a plane and the front outside surface of said front wall lying in a plane at substantially right angles to the plane of said top edge, means to introduce coating liquid into the bottom portion of said trough at substantially uniform rate of introduction of said liquid along the bottom portion of the trough, said means comprising a conduit extending along the lower portion of the trough and provided with coating liquid delivering opening means along its length constituted to deliver the coating liquid at such uniform rate of introduction into the lower portion of the trough throughout the length of the trough, means to support the trough with the top edge of the front wall substantially horizontal and the outside surface of such front wall substantially vertical, means to supply liquid coating material to the conduit at uniform rate with production of a uniform rate of overflow of the coating material over the length of the top edge of said front wall and over the front outside surface of said front wall to the lower edge of said surface, the lower edge of said front wall being provided with a backwardly and upwardly slanting surface joining the lower edge of the front wall

17

surface on a slightly rounded edge, the coating material flowing down over the outside surface of the front wall to said slightly rounded edge of the lower portion of the front wall, and with free fall from said slightly rounded edge in the form of a curtain of the coating material, together with conveyor means to deliver panels in succession into and through said curtain.

2. Means as defined in claim 1, wherein the front wall of the trough comprises a block of ferrous material, and wherein the front outside surface of said front wall comprises a smooth surface of said block of ferrous material.

3. Means as defined in claim 1, wherein the front wall of the trough comprises material which is wetted by the coating material.

4. Means as defined in claim 1, together with companion receiving conveyor means in alignment with the conveyor means which delivers the panels in succession into and through the curtain, both said conveyor means being separated at the location of the curtain to produce a gap between the first mentioned conveyor means and the receiving conveyor means, the curtain descending through said gap at intervals between penetration of the curtain by successive panels.

5. Means as defined in claim 4, together with means to support the panels during traverse of said gap by said panels, said supporting means comprising fingers extend-

18

ing at least part way across the gap at the location of the panel transverse of said gap, and means to support said fingers in such position.

6. Means as defined in claim 5, wherein said fingers are of contour to provide panel supporting surfaces to guides the leading edges of panels traversing the gap, upwardly to the elevation of the receiving conveyor means.

7. Means as defined in claim 6, wherein said fingers extend through the curtain.

8. Means as defined in claim 6, wherein said fingers do not extend through the curtain.

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