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DRIER FOR DECORATED WARE

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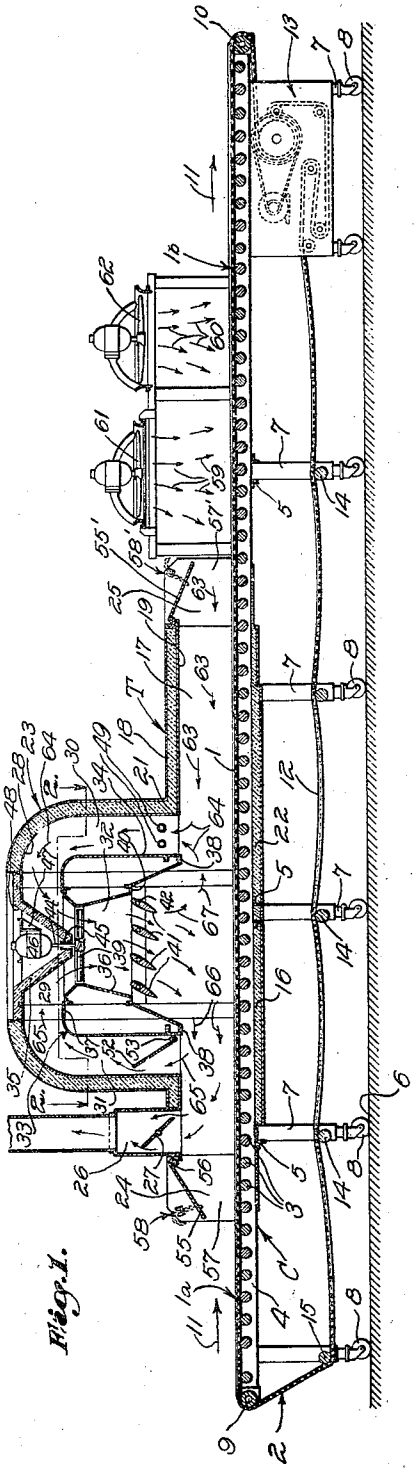


Fig. 1.

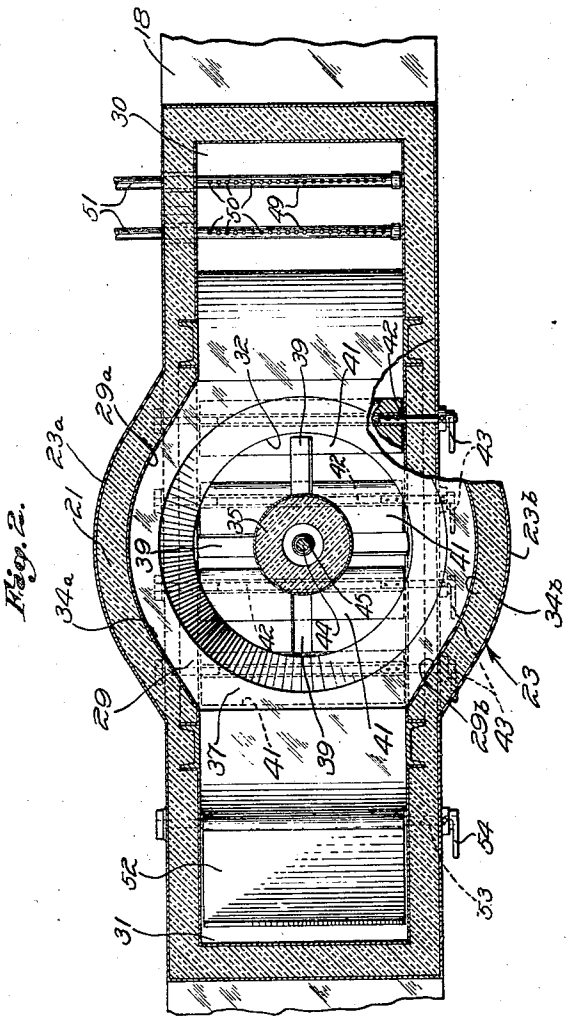


Fig. 2.

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DRIER FOR DECORATED WARE

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8 Claims. (Cl. 34—66)

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This invention relates to improvements in driers and more particularly to a drier which, although not limited to such use, is especially well adapted to dry decorating material which has been applied to glassware so as to facilitate and expedite preparation of the decorated glassware for heat treatment in a decorating lehr.

In decorating bottles, jars and other articles of glass ware, it is not unusual to apply decorating materials of a plurality of different colors separately to the ware. To avoid smearing, blurring or impairment of the decorative design, it then is necessary that each previously applied decorating material shall have dried or hardened and set on the ware before further decorating material, usually of a different color, is applied. Use of a drier of the present invention after each application of decorating material to the ware will greatly reduce the overall time required for multi-color decoration of such ware and will provide other benefits, including elimination of components of the decorating material which otherwise would produce fumes in the decorating lehr. The drier therefore may be used to advantage even though decorating material of but one color be applied or but one application of decorating material be required.

The drier also may be advantageously employed to preheat relatively cold ware to remove condensation therefrom and to bring the surface of the ware to a more suitable temperature and better condition for the application of decorating material thereto.

An object of the invention is to provide an efficient drier of the character described which can be moved readily as a unit and is sufficiently compact to be accommodated in the ware decorating department of a glass factory.

Another object of the invention is to provide a drier of the character described which is adapted for continuous operation and is suitably designed and constructed to permit convenient delivery of freshly decorated ware thereto and removal of dry decorated ware therefrom while the drier is operating to substantially its full capacity to effect drying of the decoration on still other ware.

Another object of the present invention is to provide a decorated ware drier having a moving conveyor for moving freshly decorated articles delivered thereto in one direction along a substantially horizontal path, and having means for causing initially fresh, atmospheric, air to move in a stream enveloping and counter to the direction of movement of the decorated articles on the moving

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conveyor, together with novel, economical and highly efficient means for applying heat to the air of said stream.

Another object of the invention is to provide a drier having a conveyor for moving decorated articles along a substantially horizontal path and cooperative means for first subjecting such articles to the action of heated drying air and then to the action of cooling air while the articles are being moved a'ong said path, the drier being adequately insulated and provided with effective means for removing fumes therefrom, whereby to make for comfort of an operator or attendant.

Another object of the invention is to provide a decorated ware drier having an open-ended horizontal tunnel structure through which the ware to be dried is move continuously by a moving conveyor and is subjected therein to a counter current of drying air, novel means being provided to circulate and re-circulate tunnel atmosphere, to apply heat thereto and to vent from the tunnel fumes from the decorating material on the heated weare, whereby to make effective use of the applied heat and additional heat recovered from the ware without causing or permitting an undesirable concentration of fumes from the ware at any place in the tunnel.

Other objects and advantages of the invention hereinafter will be pointed out or will become apparent from the following description of an illustrative drier of the invention, as shown in the accompanying drawing, in which:

Figure 1 is a partially diagrammatic longitudinal sectional elevation of the illustrative drier; and

Fig. 2 is a relatively enlarged sectional plan view of a hood portion of a tunnel structure which is included in the drier, the view being mainly along the line 2—2 of Fig. 1 and showing details of the heating provisions of the drier.

The illustrative drier shown in the drawing comprises a conveyor unit or assembly, generally designated C, and a cooperative open-ended horizontal tunnel structure T through which the decorated articles to be dried may be transported by the upper stretch 1 of an endless conveyor belt 2 of the conveyor unit or assembly C. The conveyor belt 2 may be of woven-wire construction and the upper stretch thereof may be supported for movement in a horizontal plane by a series of parallel rollers 3 which extend between a pair of longitudinal side rails, one of which is shown at 4 in Fig. 1, of the framework structure of the conveyor unit or assembly. The longitudinal side rails may be connected rigidly together at in-

tervals along their length by cross bars 5, thus providing an open top frame which may be supported in a horizontal position at a desirable level above a floor 6 by vertical supporting members or legs 7. These may be joined or connected at their upper ends to the side rails of the top frame and they may be provided with casters 8 at their lower ends so that the framework structure of the conveyor assembly, and the parts carried thereby, may be readily moved on the floor 6.

The supporting structure of the conveyor unit or assembly includes end rolls 9 and 10, respectively, at the opposite ends of the top frame for reversing the direction of movement of the conveyor belt at each of these places. The direction of movement of the upper stretch 1 of the conveyor belt is from left to right, as viewed in Fig. 1 and as indicated by the arrows 11. The lower return stretch of the conveyor belt, designated 12 in Fig. 1, is supported and guided and motion is imparted to the belt by suitable, well-known means. As shown, the belt, after leaving the end roll 10, passes through a belt tightening and driving mechanism which may be of conventional construction and mode of operation and which therefore is shown more or less diagrammatically at 13 in Fig. 1. After leaving this mechanism, the lower, return stretch of the belt may pass over a series of supporting idler rolls 14 and beneath an end guiding roll 15. Thereafter, it passes around the end roll 9 to provide the upper, active or ware-transporting stretch 1.

The conveyor unit or assembly, as above described and as shown in Fig. 1, does not per se form part of the present invention. A conveyor unit or assembly of any suitable known or conventional construction may be employed.

The tunnel structure T is mounted on the conveyor frame structure, being attached to the latter by any suitable known means (not shown). It comprises a substantially horizontal bottom wall 16, a pair of side walls, one of which is shown at 17 in Fig. 1, and a top wall 18, all suitably joined together to define an elongate open-ended substantially horizontal chamber or passage 19 through which a portion of the upper stretch 1 of the conveyor 2 passes. As shown, the tunnel bottom wall 16 is located directly beneath the level of the conveyor top frame so that the portion of the conveyor upper stretch in the tunnel is located in the bottom portion of the tunnel chamber or passage 19, leaving the space in the latter unobstructed for the greater part of its height to accommodate decorated articles on the conveyor belt and to permit envelopment of such ware by moving air currents in the tunnel, as hereinafter will be described. The walls of the tunnel structure may be formed of any suitable known material or materials and be heat-insulated or include heat-insulating material, as indicated at 21 for the top wall structure in Figs. 1 and 2 and at 22 for the bottom wall structure in Fig. 1.

The tunnel top structure includes a hood portion 23 which may extend for the full width of the tunnel (see Fig. 2) and for only part of the length thereof (see Fig. 1). As shown, the hood portion 23 of the tunnel structure is located nearer to the front or ware-entry end 24 of the tunnel proper than to the rear or ware-exit end 25 thereof. The tunnel is provided with an upstanding stack or exhaust flue 26 at its top in advance of and adjacent to the front of the hood. A pivoted damper 27 is provided in the stack, the interior of which is in open communication at its bottom with the top of the tunnel passage or chamber 19.

The hood provides this tunnel passage or chamber with a communicating top chamber 28. This top chamber may be divided transversely for part of its height from its bottom—which may be located at the level of the top of the main tunnel passage or chamber 19—to provide an upper mixing passage or space 29, an open-ended vertical rear uptake passage 30, an open-ended vertical front uptake passage 31, and an open-ended vertical intermediate downtake or return passage 32. All of these vertical passages within the top chamber 28 communicate at their upper ends with the top mixing passage or space 29 and at their lower ends with the main tunnel passage or chamber 19 at the top and throughout the full width or substantially the full width of the latter. These passages are provided in the chamber 28 in the construction shown by mounting a fan housing 33 therein in suitable relationships to the walls of the chamber 28. As shown, the fan housing 33 is a hollow-walled unitary sheet-metal structure which comprises a substantially vertical outer wall member 34 of sufficiently less length than the chamber 28 to provide the aforesaid vertical rear and front uptake passages 30 and 31, respectively, and of sufficient width to fit tightly between the side walls of such chamber when the fan housing is positioned within the chamber 28 intermediate of the length of the latter with the lower end of the fan housing flush with the bottom end of this chamber. As shown, the upper portion of the hood 23 bulges at its opposite sides at 23*a* and 23*b*, Fig. 2, and the corresponding portions of the sides of the outer wall member 34 are similarly bulging at 34*a* and 34*b*, respectively, to fit snugly against the bulging portions of the hood. The arrangement is such that the mixing passage or space 29, which is defined in part between the top of the fan housing and the inner wall of the top of the hood—the fan housing being of less height than chamber 28 within the hood—will have arcuately curved bulging side portions as indicated at 29*a* and 29*b*, respectively, in Fig. 2. This top mixing passage or space is further defined by an inverted conical central portion 35 of the top of the hood 23 which depends from the top of the hood into the upper, intake end of the intermediate, return passage 32 and thus gives an annular form to the mixing passage where the latter communicates directly with the upper, intake end of the passage 32. This will aid thorough commingling of gases passing to the passage 32 from the uptake passages 30 and 31 as hereinafter will be further explained. The unitary, hollow-walled fan housing 34 also comprises a generally frusto-conical inner wall member 36 which forms the wall of the downtake or return passage 32, a generally convexo-concave top wall 37 which forms the bottom wall of the mixing passage or space 29 and merges the latter into the downtake or return passage 32, and a narrow, substantially horizontal bottom wall member 38 which connects the lower ends of the outer and inner wall members of the fan housing.

A blower fan 39 is provided in the narrower, intake, upper end of the passage 32 for blowing fluid downwardly through such passage into the tunnel passage or chamber 19. The wall of the passage 32 is abruptly enlarged or stepped outwardly to provide a downwardly facing shoulder or ledge thereon at 40, Fig. 1. A plurality of vanes 41 extend transversely of the passage 32 beneath the shoulder or ledge 40. These vanes

are spaced apart and are supported to swing vertically about horizontal axes extending longitudinally of the upper edge portions of the vanes and transversely of the passage **32**, as by means of transversely extending pivot shafts **42**, Figs. 1 and 2. As shown in Fig. 2, these pivot shafts may be provided with individual handles **43** which are located outside of the hood **23** in position to be manipulated to adjust the angular relations of the supported vanes relative to the horiozntal plane in which their pivotal axes are located. When the vanes are substantially horizontal, they will conjointly substantially close off the portion above from the portion of the passage **32** below the shoulder **40**. When the vanes are turned downward but inclined forwardly or rearwardly, they will impart a component of movement in that direction to the currents of fluid blown downwardly through the spaces between them into the tunnel atmosphere. As shown in Fig. 1, the downwardly turned vanes are inclined forwardly. Some of them may be inclined forwardly and others rearwardly as they are individually adjustable and various combinations of fluid current directing and distributing results may thus be produced at different times. The fan **39** may be carried by a shaft **44** which extends vertically through a suitable vertical opening **45** in the portion **35** of the top of the hood to a suitable fan shaft driver, such as a motor **46**, which may be supported by a bracket **47** within the cone-shaped external cavity **48** of the part **35**.

The uptake passage **30** is provided with means for applying heat to the fluid passing upwardly therethrough. As shown, such heating means comprises a pair of combustible gas burners in the form of pipes **49** which, as best seen in Fig. 2, extend transversely across the lower part of the passage **30**, are closed at their free ends, and are provided with closely spaced jet holes **50** in their upper portions so as to distribute heat throughout substantially the entire cross-section of the passage **30**. However, any other suitable known heating means may be employed. The pipes **49** have external extensions **51** through which combustible fuel may be supplied thereto.

The uptake passage **31** is provided with an upwardly openable pivoted door or damper **52**, shown as being supported at its inner edge by a transversely extending pivot shaft **53** which is provided with an external handle **54**, Fig. 2, at one side of the hood **23**. The damper **52** thus may be conveniently opened to the desired extent to permit a predetermined, regulable amount of tunnel atmosphere to enter and pass upward in the passage **31** or closed to exclude tunnel atmosphere from such passage.

A door **55**, Fig. 1, may be hinged at its rearward edge, as at **56**, to the top of the front end of the tunnel structure and may be swung outwardly and upwardly between a pair of front sideboards, one of which is shown at **57**, until the free edge of the door is just high enough to clear articles of glassware of a given height on the upper stretch **1** of the conveyor belt. The door may be retained releasably in this position by any suitable fastening means, such as that indicated at **58**. A similar structural arrangement may be provided at the rear end of the tunnel, as shown in Fig. 1 in which **55'** designes the rear door, **57'** a rear sideboard, and **58'** the rear door fastener.

The upper stretch of the conveyor and its supporting structure extend a substantial distance at the front of the drier tunnel and, in the example shown, a considerably greater distance beyond the rear end of the tunnel. The forwardly extending portion, designated *1a*, of the upper stretch of the conveyor may serve as the ware receiving portion thereof. The ware to be treated in the tunnel may be placed on this portion of the conveyor by hand or by any suitable known ware stacking or transfer means, none being shown. The portion of the upper stretch of the conveyor extending beyond the rear end of the tunnel is designated *1b*. On leaving the tunnel, the ware on this portion of the conveyor may first be subjected to forced cooling from one or more cooling devices, as by air blasts as indicated by the arrows **59** and **60** from the overhead blower fans **61** and **62**, respectively, Fig. 1. This may be desirable to assure cooling of the ware to a comfortable handling temperature after the ware leaves the tunnel and subsequent unloading or removal of the cooled ware from the conveyor belt without requiring undue length of the rearwardly extending portion *1b* of the upper stretch of the conveyor. If there is sufficient time of travel of the ware on the portion *1b* of the conveyor belt for natural cooling of such ware to the temperature desired, forced cooling may be omitted or dispensed with. These blowing fans may be constructed and arranged ina known manner for the additional function of aiding or retarding inflow of atmospheric air to the drier tunnel, as a factor in controlling drift in the drier tunnel.

The operation of the drier, as hereinbefore described, will be readily understood. Articles of glassware or the like, to which decorating material has been applied, will, on being placed upon the portion *1a* of the conveyor belt, be carried by the latter through the drier tunnel at the desired rate of speed. This, of course, may be relatively low. The ware thus transported will be heated and cooled in a highly effective and economical manner. As will be apparent from Fig. 1, fresh, cool, atmospheric air will enter the rear end of the tunnel and flow forwardly therein, as indicated by the arrows **63**, meanwhile abstracting heat from the ware in this portion of the tunnel. Some or all of this preheated air may then pass upwardly into and through the heating uptake passage **30** and into the overhead mixing space **29**, as indicated by the series of arrows **64**. The thus heated gases supplied to the space **29** from the heating passage **30** will be commingled in the space **29** with recirculated gases which have moved upwardly from the upper part of the tunnel passage **19** through the recirculation uptake passage **31**, as indicated by the arrows **65**. From the mixing space, the commingled gases will be drawn downwardly into the passage **32** by the fan in the latter and blown by such fan downwardly through the spaces between the vanes **41**, as indicated by the downwardly directed arrows in this portion of Fig. 1. When the vanes are set as shown, some of the gases thus blown downwardly into the drier tunnel passage **19** may turn forwardly in the upper part of such passage, as indicated by the arrow **66**, and again become part of a recirculation of tunnel gases through the uptake passage **31**. Other gases may turn rearwardly and upwardly along the path indicated by the arrows **67** for recirculation through the heating uptake passage **30**. The remainder of the gases blown downwardly into the tunnel passage **19** may move forwardly in the latter after their downward fan-impelled movement has ceased and in due course may enter and be vented from the tunnel through the stack **26** as shown by the arrows leading to the latter. The gases thus

vented will carry away fumes produced by the drying of the decoration on the ware. The fumes produced or resulting from the drying operation will thus be kept mainly in exhaust currents of air and will not become concentrated or persist in the drier tunnel or prevent desirable circulation and recirculation of tunnel gases for conservation and economy in the use of heat. The drying operation may usually be accomplished without heating the ware above a temperature in the order of 300° F. to 500° F., which is well below the strain point of glass. The amount of heat required, which of course may vary for different operations, may be applied to the tunnel gases and by them supplied to the ware at a relatively low cost.

The drying operation which may be accomplished by use of the drier may be varied to meet different service requirements at different times. Various changes in and modifications of the illustrative embodiment of the invention shown in the drawing and herein particularly described will readily occur to those skilled in the art and I therefore do not wish to be limited to the details of such embodiment.

I claim:

1. An apparatus of the character described comprising a tunnel open at its ends, a conveyor having a substantially horizontal portion extending through the tunnel and on which decorated glass articles or the like may be placed so as to be carried through the tunnel when the conveyor is driven, means for driving the conveyor, a hood on said tunnel having a chamber therein in open communication at its bottom with the interior of the tunnel throughout substantially the full width of the latter and for only part of the length thereof, the place of communication of said chamber with said tunnel being nearer to the article-entry end thereof than to its article-exit end, means within said chamber to divide it transversely for part of its height into a rear substantially vertical uptake passage nearest to the exit end of the tunnel, a downtake passage directly in front of the rear uptake passage, a front uptake passage in front of said downtake passage, and a mixing space above and in communication with the upper ends of said uptake and downtake passages, a fan in the upper part of said downtake passage for drawing gases upwardly from the tunnel through said uptake passages into said mixing space and thence to the downtake passage and for blowing gases downwardly through the latter back into the tunnel, heating means in said rear uptake passage, and a dampered stack communicating with said tunnel in advance of said chamber.

2. An apparatus as in claim 1 and, in combination therewith, a damper in said front uptake passage.

3. An apparatus as in claim 1 and, in combination therewith, means in said downtake passage below said fan for controlling the direction of egress into the tunnel of gases blown downwardly through longitudinally different portions of the downtake passage.

4. An apparatus as in claim 1 and, in combination therewith, a series of transversely extending gaseous flow directing pivoted vanes in said downtake passage below said fan.

5. An apparatus as in claim 1 and, in combination therewith, a series of transversely extending, gaseous flow directing, pivoted vanes in said downtake passage below said fan, said vanes being independently adjustable angularly about their pivotal axes, and a damper in the lower part of said front uptake passage.

6. An apparatus as in claim 1 wherein said substantially horizontal potrion of said conevyor projects for substantial distances from the tunnel at both ends of the latter, and, in combination therewith, means for blowing cooling air onto the articles on the portion of said conveyor projecting from the exit end of the tunnel.

7. Apparatus as in claim 1 wherein said hood has a portion of its top wall of inverted conical shape depending into said mixing space above said downtake passage in axial alignment with the fan in the latter.

8. An apparatus of the character described comprising a tunnel open at its ends, a conveyor having a substantially horizontal portion extending through the tunnel and on which decorated glass articles or the like may be placed so as to be carried through the tunnel when the conveyor is driven, means for driving the conveyor, a hood on said tunnel having a chamber therein in open communication at its bottom with the interior of the tunnel throughout substantially the full width of the latter and for only part of the length thereof, means within said chamber to divide it transversely for part of its height into a rear substantially vertical uptake passage nearest to the exit end of the tunnel, a downtake passage directly in front of the rear uptake passage, a front uptake passage in front of said downtake passage, and a mixing space above and in communication with the upper ends of said uptake and downtake passages, a fan in the upper part of said downtake passage for drawing gases upwardly from the tunnel through said uptake passages into said mixing space and thence to the downtake passage and for blowing gasess downwardly through the latter back into the tunnel, heating means in one of said uptake passages, and a dampered stack communicating with said tunnel in advance of said chamber.

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