

PATENT SPECIFICATION

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DRAWINGS ATTACHED



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(72) Inventor DENNIS GEORGE FURNELL

(54) IMPROVEMENTS IN OR RELATING TO DRYING AND CURING OVENS

(71) We, AYRODEV PROCESSES LIMITED, a British Company of Prestons Road, Poplar, London E.14, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to drying and curing ovens which effect rapid and uniform solvent evaporation and curing of varnish films, particularly on hollow or irregularly shaped objects.

When drying and curing varnishes, lacquers and the like it is customary to apply heat in order to evaporate the solvent and cure the binder medium as rapidly as possible. This can be effected in static ovens or horizontal drying tunnels, which have the following attendant disadvantages:—

When ovens are employed, opening of doors to permit entry of the varnished object causes loss of heat and a consequent time lag before the oven re-attains equilibrium temperature. Heat transfer to the object to be dried is slow if natural convection is employed. When forced circulation is employed heat transfer is improved but is frequently irregular, as particularly when the object is hollow, certain sections of it may remain exposed to high air velocities, while others remain in relatively becalmed zones. This can give rise to uneven evaporation of the solvent and non-uniform rates of cure of the varnish medium. Furthermore, drainage of the varnish prior to setting can give rise to uneven film formation.

In particular, when drying and curing varnished electrical parts which may consist of annularly disposed wire coils, the use of such ovens gives rise to slow, uneven cure and, if the annular part is positioned in a horizontal stream of heated air so that the stream flows both through and around the part, drainage during the solvent evaporation stage leads to excessive thickening of the varnish along the lower sections, with consequent risk of blistering, solvent trapping and undercure.

[Price 25p]

It has been found that rapid, uniform heating of objects coated with varnishes and lacquers can be achieved by means of an oven as hereinafter described.

Furthermore, the rate of entry of objects into the oven can be controlled in order progressively to flash evaporate most of the solvent in the coating of the objects as they enter the oven, thereby ensuring uniform cure of the varnish medium and avoiding building up to a dangerous concentration of solvent vapour within the oven.

According to the present invention there is provided an oven for drying and curing varnish or lacquer-coated articles which comprises spaced apart inner and outer walls, said inner wall enclosing an article drying compartment which is open at the bottom and to which heated air is delivered in a downward direction through a space or spaces between said two walls so as to enter and pass upwardly through said compartment from the bottom thereof, one or more ducts for exhausting air from the compartment, the ducts extending from the top of said drying compartment and being connected to means for reheating and recirculating said exhausted air back through said space or spaces to the bottom of the compartment, a ventilating duct also extending from the top of said compartment and fitted with an adjustable damper to enable a balanced air flow to be maintained at the open bottom of said compartment, the periphery of the bottom of the compartment being provided with air deflecting means for minimising turbulence of air at the bottom of the drying compartment.

The oven is illustrated by the diagrammatic drawing accompanying the Provisional Specification, which is a vertical section through an oven in which direct combustion is employed as the heating medium.

Referring to the drawing, a mixture of air from impeller 1, and diesel fuel from pipe 2 is ignited in tube 3 so that the flame emerges into the venturi chamber 4 where it meets the stream of circulating air from an annular space 5 impelled by fan 6. The mixture of heated air

and combustion products is introduced into the bottom of a compartment 13 after passing down a space or spaces 19 formed between the inner and outer walls 7 and 8 of the oven. This mixture is withdrawn by said fan 6 from one, or preferably two or more exit ports 9 and 10 and continuously re-circulated. In order to compensate for air and combustion products emerging from the tube 3, additional ducting 11 incorporating, if desired, a fan or other suitable means of withdrawal is also incorporated in the top of the compartment 13. This ducting also incorporates an adjustable damper 12, in order to control the rate of ventilation and thereby facilitate achieving a state of balanced air flow at the open bottom of the compartment 13. The compartment 13 is supported by suitable means, such as legs 14 above the floor to permit entry of the object to be heated. Objects may be either hoisted into the compartment by means of a chain 15 or chains winched at 16 above the compartment roof, or raised into the compartment by mechanical, pneumatic or hydraulic means, for example by a hydraulically operated and elevatable table 17. When objects are raised into the compartment, it is important that they are supported in such a manner, such as by a slatted frame 18, that the circulation of the heated air is not impeded. Alternatively, the raisable tackle itself may be of open construction.

According to a modification, and as an alternative to the fan 6 for impelling and recirculating heated air to the venturi chamber 4, recirculation may be maintained by a fan situated between the venturi chamber 4 and the compartment 13, in which case said fan may also be drawn in combustion air to the burner to eliminate fan 1.

Entry of air into the compartment is by way of a space or spaces between the exterior and interior walls 7 and 8. The space may completely surround the interior vertical wall 7. If the compartment is of circular section, the space may be annular. The object of the venturi chamber 4 is to prevent interference with the flame when direct heating is employed, for example by creating back-pressure or blowing the flame out.

The burner 3 and venturi 4 may be so designed and positioned that the gaseous ignition entrains the heated air and thereby impels it, thus eliminating the need for fan 6.

While, on grounds of economy and ignition of evaporated solvents to prevent the build-up of dangerous inflammable vapour concentrations, direct heating is preferred, which may be conveniently based upon gas, or disel oil, indirect heating of the circulating air may also be employed, based, for example, on electricity or high pressure steam.

In order to minimise turbulence of air at the bottom of the compartment 13, deflector

rims or louvres are incorporated along the periphery of the inlet edge of the inner wall of the oven. In order to facilitate control of the flow of the heated air, and consequently a balance at 13, adjustable dampers may be incorporated into, for example, the space between the interior and exterior oven walls 7 and 8. It should be understood that for thermal efficiency the compartment and circulatory ducting should be adequately lagged.

In order that a multiplicity of objects may be heated on differing cycles, the oven may incorporate a plurality of winched chains or pneumatic or hydraulically raisable tables.

WHAT WE CLAIM IS:—

1. An oven for drying and curing varnish or lacquer-coated articles comprising spaced apart inner and outer walls, said inner wall enclosing an article drying compartment which is open at the bottom and to which heated air is delivered in a downward direction through a space or spaces between said two walls so as to enter and pass upwardly through said compartment from the bottom thereof, one or more ducts for exhausting air from the compartment, the ducts extending from the top of said drying compartment and being connected to means for reheating and recirculating said exhausted air back through said space or spaces to the bottom of the compartment, a ventilating duct also extending from the top of said compartment and fitted with an adjustable damper to enable a balanced air flow to be maintained at the open bottom of said compartment, the periphery of the bottom of the compartment being provided with air deflecting means for minimising turbulence of air at the bottom of the drying compartment.

2. An oven as claimed in Claim 1, wherein drying air is directly heated by a burner and a mixture of air and combustion products is introduced into the bottom of said compartment.

3. An oven as claimed in Claim 2 wherein air and combustion products from said burner pass through a venturi chamber and thence to the bottom of the compartment.

4. An oven as claimed in Claims 1, 2 and 3 wherein a mixture of air and combustion products is recirculated by means of a fan withdrawing it through the top of the compartment and recirculating it to the venturi chamber.

5. An oven as claimed in Claims 1, 2 and 3, wherein recirculation of air is maintained by a fan situated between said venturi chamber and said compartment.

6. An oven as claimed in Claim 1, wherein said drying air is indirectly heated, e.g. by electricity or high pressure steam.

7. An oven as claimed in any of the

and combustion products is introduced into the bottom of a compartment 13 after passing down a space or spaces 19 formed between the inner and outer walls 7 and 8 of the oven. This mixture is withdrawn by said fan 6 from one, or preferably two or more exit ports 9 and 10 and continuously re-circulated. In order to compensate for air and combustion products emerging from the tube 3, additional ducting 11 incorporating, if desired, a fan or other suitable means of withdrawal is also incorporated in the top of the compartment 13. This ducting also incorporates an adjustable damper 12, in order to control the rate of ventilation and thereby facilitate achieving a state of balanced air flow at the open bottom of the compartment 13. The compartment 13 is supported by suitable means, such as legs 14 above the floor to permit entry of the object to be heated. Objects may be either hoisted into the compartment by means of a chain 15 or chains winched at 16 above the compartment roof, or raised into the compartment by mechanical, pneumatic or hydraulic means, for example by a hydraulically operated and elevatable table 17. When objects are raised into the compartment, it is important that they are supported in such a manner, such as by a slatted frame 18, that the circulation of the heated air is not impeded. Alternatively, the raisable tackle itself may be of open construction.

According to a modification, and as an alternative to the fan 6 for impelling and recirculating heated air to the venturi chamber 4, recirculation may be maintained by a fan situated between the venturi chamber 4 and the compartment 13, in which case said fan may also be drawn in combustion air to the burner to eliminate fan 1.

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The burner 3 and venturi 4 may be so designed and positioned that the gaseous ignition entrains the heated air and thereby impels it, thus eliminating the need for fan 6.

While, on grounds of economy and ignition of evaporated solvents to prevent the build-up of dangerous inflammable vapour concentrations, direct heating is preferred, which may be conveniently based upon gas, or diesel oil, indirect heating of the circulating air may also be employed, based, for example, on electricity or high pressure steam.

65 In order to minimise turbulence of air at the bottom of the compartment 13, deflector

rim or louvres are incorporated along the periphery of the inlet edge of the inner wall of the oven. In order to facilitate control of the flow of the heated air, and consequently a balance at 13, adjustable dampers may be incorporated into, for example, the space between the interior and exterior oven walls 7 and 8. It should be understood that for thermal efficiency the compartment and circulatory ducting should be adequately lagged.

In order that a multiplicity of objects may be heated on differing cycles, the oven may incorporate a plurality of winched chains or pneumatic or hydraulically raisable tables. 80

WHAT WE CLAIM IS:—

1. An oven for drying and curing varnish or lacquer-coated articles comprising spaced apart inner and outer walls, said inner wall enclosing an article drying compartment which is open at the bottom and to which heated air is delivered in a downward direction through a space or spaces between said two walls so as to enter and pass upwardly through said compartment from the bottom thereof, one or more ducts for exhausting air from the compartment, the ducts extending from the top of said drying compartment and being connected to means for reheating and recirculating said exhausted air back through said space or spaces to the bottom of the compartment, a ventilating duct also extending from the top of said compartment and fitted with an adjustable damper to enable a balanced air flow to be maintained at the open bottom of said compartment, the periphery of the bottom of the compartment being provided with air deflecting means for minimising turbulence of air at the bottom of the drying compartment.

2. An oven as claimed in Claim 1, wherein drying air is directly heated by a burner and a mixture of air and combustion products is introduced into the bottom of said 110 compartment.

3. An oven as claimed in Claim 2 wherein air and combustion products from said burner pass through a venturi chamber and thence to the bottom of the compartment. 115

4. An oven as claimed in Claims 1, 2 and 3 wherein a mixture of air and combustion products is recirculated by means of a fan withdrawing it through the top of the compartment and recirculating it to the venturi chamber.

5. An oven as claimed in Claims 1, 2 and 3, wherein recirculation of air is maintained by a fan situated between said venturi chamber and said compartment. 125

6. An oven as claimed in Claim 1, wherein said drying air is indirectly heated, e.g. by electricity or high pressure steam.

7. An oven as claimed in any of the



preceding Claims including the provision of adjustable dampers in the air flow or spaces leading to said compartment.

5 8. An oven as claimed in any of the preceding Claims, including the provision of means for hoisting or raising articles into said compartment.

10 9. A drying and curing oven for varnish or lacquer coated articles, constructed and adapted to function substantially as herein-

before described with reference to and as illustrated by the drawings accompanying the Provisional Specification.

10. Varnish or lacquer coated articles dried and cured in an oven as claimed in any 15 of the preceding Claims.

HERBERT J. W. WILDBORE,
Agent for the Applicants,
101 Leadenhall Street,
London, EC3A 3AU.

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