

April 20, 1943.

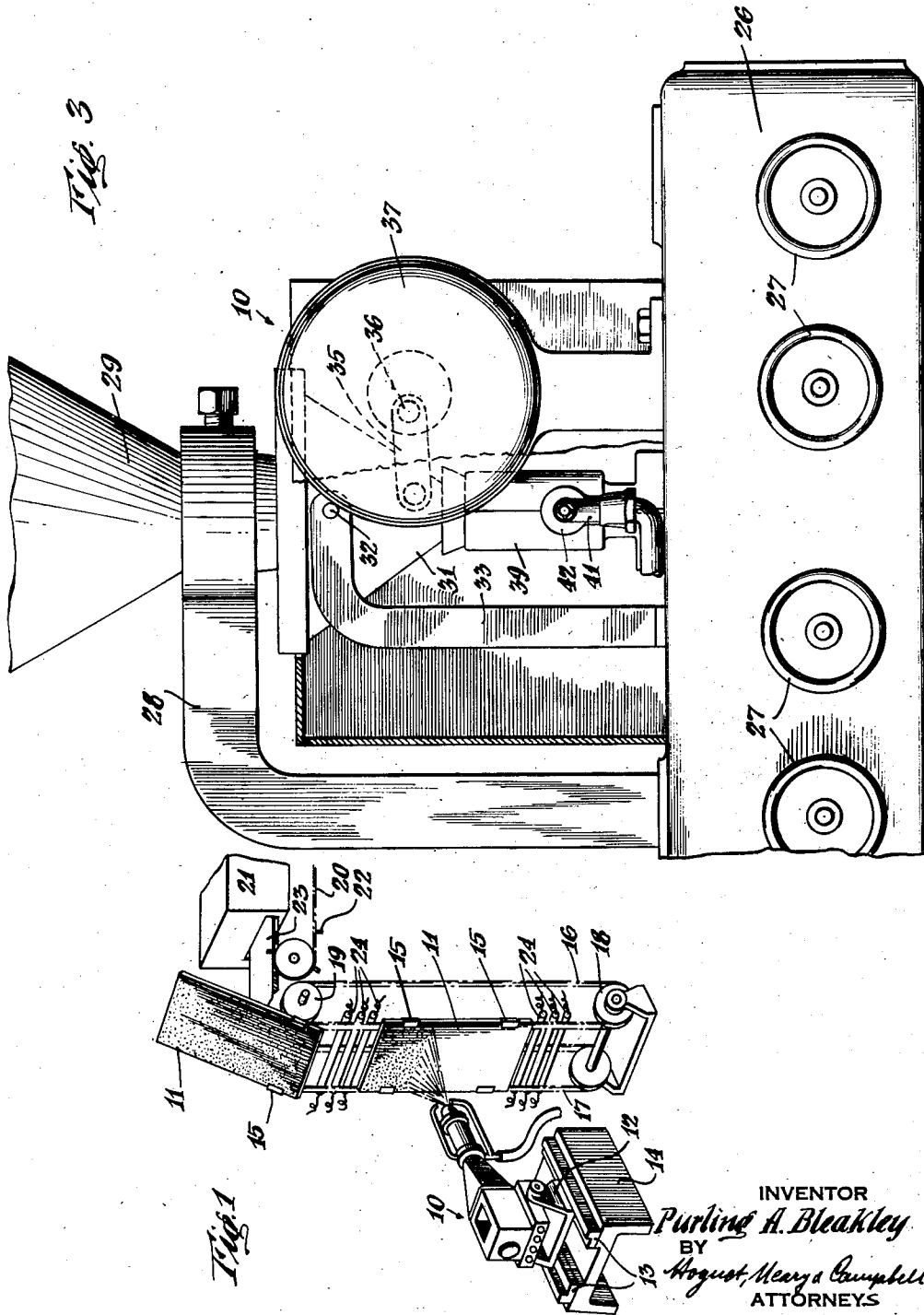
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Filed Feb. 1, 1940

2 Sheets-Sheet 1



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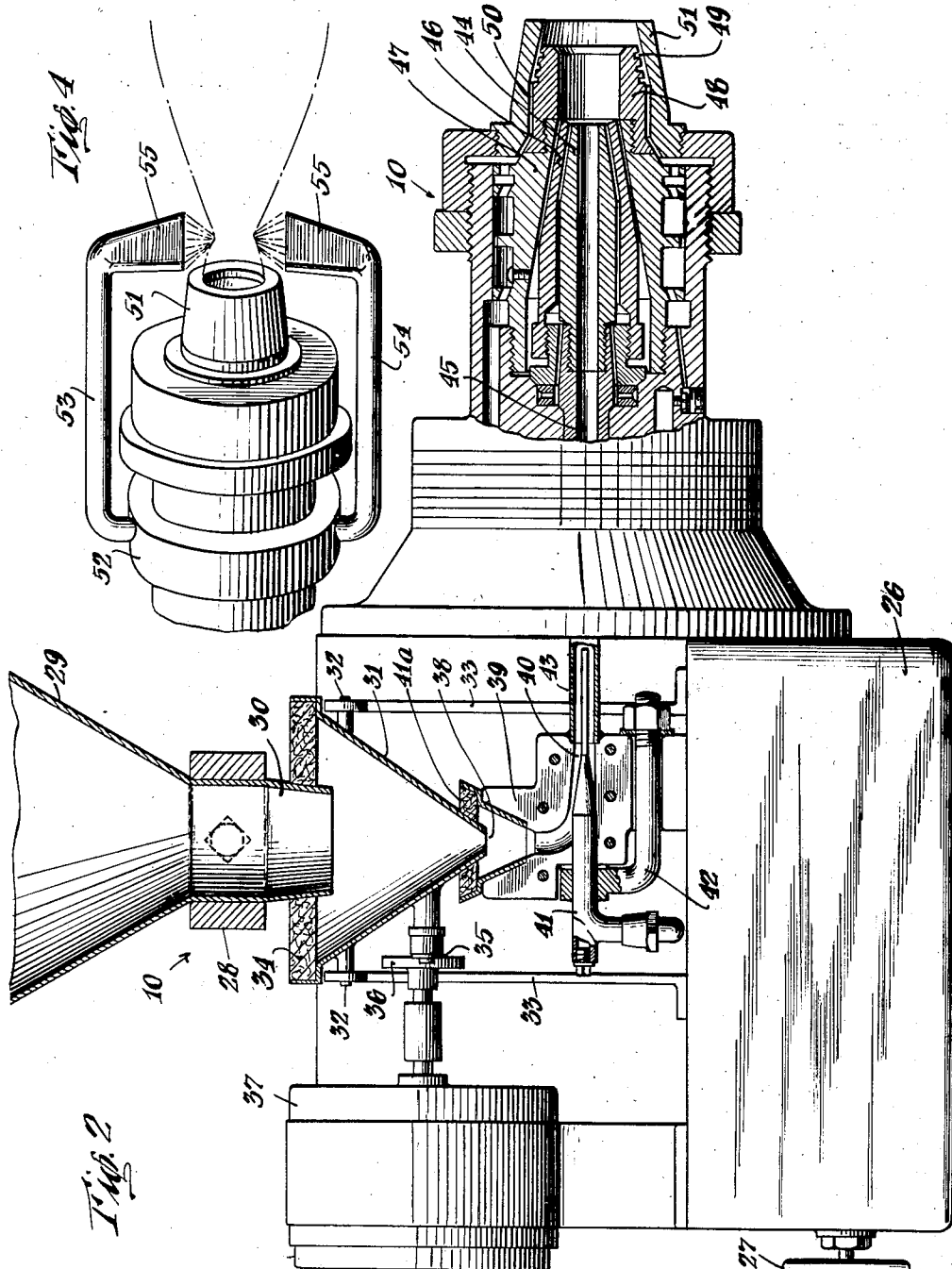
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APPARATUS FOR MELTING POWDERED MATERIALS

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4 Claims. (Cl. 91—12.2)

This invention relates to devices for applying coatings to articles and relates particularly to devices for applying high-melting point non-metallic coatings to metallic and non-metallic articles.

Usually in applying vitreous coatings to various types of articles, it is necessary to exercise extreme care in order to avoid checking or failure of the coating material to bond to the material, and moreover, it is difficult and expensive to obtain a smooth, uniform coating of the non-metallic material on the article.

The present invention has as an object the provision of devices by means of which it is possible to rapidly apply non-metallic materials in a molten form to articles to produce smooth, uniform coatings and finishes.

Another object of the invention is to provide apparatus for applying initially powdered or granular high-melting point materials to articles in the form of a molten spray in order to obtain a uniform and even distribution of the material over the article.

Other objects of the invention will become apparent from the disclosure of typical embodiments of the invention hereinafter.

The devices utilized in converting the granular non-metallic material into a molten spray are generally of the type disclosed in the Bleakley Patent No. 2,092,150, that is, they may consist of spray guns which have a nozzle in which the material is reduced to a molten condition and projected therefrom by a gaseous blast in an enveloping sheath of gas. The gas preferably is of non-oxidizing nature so as to prevent oxidation of the surface of the article being treated and of the material being sprayed.

Various types of material can be sprayed with guns of this type, for example, silica, glass, enamels, feldspar, silicates of various types, for example, aluminum silicates such as nepheline syenite. These materials, either alone or in conjunction with suitable fluxes such as for example, lime or fluorspar, which are used for controlling the melting point of the material, are fed into the innermost nozzle of the gun by an air or gas blast and conducted into a melting chamber wherein a flame produced by the combustion of a fuel gas in the air blast reduces the material to a molten condition. The size of the melting chamber in the gun is critical, for the reason that it must provide a zone of high temperature of sufficient length to melt the granular material, but not so long that it will be burned

off by the intense heat generated by the flame in the nozzle.

The molten material under the gas pressures used is sprayed in the form of a finely divided shower under high pressure against the surface to be coated. The surface preferably is preheated to a temperature only slightly below the temperature of the molten material. The molten material will bond to this surface and when cooled gradually therewith, as by means of closely controlled heating elements and an oven of lower temperature, will solidify and contract with the surface being coated so that checking and cracking are almost entirely avoided.

For a better understanding of the present invention, reference may be had to the accompanying drawings in which:

Fig. 1 is a perspective view of a typical form of device for coating sheets with sprays of molten non-metallic material;

Fig. 2 is a view in side elevation and partly in section of a typical form of spray gun embodying the invention;

Fig. 3 is an end view, partly broken away, of the device disclosed in Fig. 2; and

Fig. 4 is a perspective view of a spray nozzle having devices attached thereto for spreading the spray into a narrow fan in order to coat relatively wide areas of an article.

As shown in Fig. 1, a typical embodiment of the invention may consist of a spraying gun 10 into which may be introduced finely divided vitreous or non-metallic material, for example, silica, feldspar, enamel and aluminum silicates, such as, nepheline syenite. The material is melted and projected in the form of a spray upon a sheet of material 11, such as for example, sheet steel. The spray gun 10 preferably is mounted in a carriage 12 which is slidably mounted on the rails 13 on a base member 14 so that the gun may be adjusted toward and from the sheet 11 to vary the area covered by the spray and the temperature at which the molten material strikes the sheet. The gun 10 may be pivotally supported in the carriage 12 so as to permit its adjustment to vary the direction of impingement of the spray upon the sheet.

The sheets before treatment with the coating material are preferably prepared by sandblasting, pickling, upsetting or in any other conventional way to provide a clean surface to which the molten material will adhere tightly. A plurality of sheets may be detachably supported by means of clips 15 upon a conveyor of any desired type, such as for example, a pair of chains 16 and 17

passing over suitable pairs of sprockets 18 and 19 so that they move in a vertical direction. Adjacent to the upper sprockets 19 is a second substantially horizontal conveyor which receives the sheets 11 and passes them through an oven 21. The conveyor may consist of one or more chains 20 having upwardly projecting pins 22 thereon which engage the ends of the sheets and slide them along the conveyor platform 23 through the oven 21.

The sheets 11 are raised to and maintained at a temperature similar to that of the molten material, by means of a series of heating elements 24 which are located adjacent the upper and lower ends of the vertical conveyor and between the passes of the chains 16 and 17. The upper series of heating elements 24 prevent too rapid cooling of the sheets with consequent checking or cracking of the coating. Any desired type of heating element may be used, for example, gas burners or electric heating coils, the latter being preferred because their temperature may be closely controlled.

A typical form of spray gun 10 is shown in Figs. 2 and 3. This gun is constructed to provide for uniform feed of the powdered material to the spray nozzle and to maintain in the nozzle the proper temperatures and conditions for melting the powdered material.

The device consists of a base member 26 which is provided with a series of control valves (not shown), which have the operating handles 27 for controlling the velocity and pressure of the fuel gas and air to the various passages in the spray gun nozzle. Detachably supported on the base 26 by means of an L-shaped bracket 28 is a hopper 29 for receiving the powdered or granular material. The outlet end 30 of the hopper 29 is disposed within an agitator funnel 31 which is supported by means of pivot pins 32 in a pair of similar L-shaped brackets 33 mounted on the base member 26. Interposed between the upper edges of the funnel 31 and outlet spout of the hopper 30 is a resilient gasket 34 which permits movement of the funnel 31 relatively to the hopper, while preventing escape of the granular material therefrom. The funnel 31 is oscillated about the pivot pins 32 by means of a pitman 35 and a crank 36 which are driven by means of a pneumatic motor 37 on the base 26. Upon operation of the motor 36, the funnel 31 is oscillated, thereby feeding the material downwardly at a uniform rate through the outlet 30 of the agitator into an aspirator by means of which the material is fed to the spray nozzle. The aspirator consists of a split housing 38 having a generally L-shaped passage or chamber 40 and an air inlet nozzle 41 of reduced diameter which is disposed substantially centrally thereof. A resilient gasket 41a is interposed between the lower end of the funnel 31 and the housing 38. The air inlet nozzle 41 is detachably connected to the housing 38 by means of an L-shaped ring bolt 42 having a shank which passes between the elements of the housing 38 beneath the passage 40.

The housing 38 is connected to a tube 43 which extends longitudinally of the device and is provided at its right hand end with an enlarged or thickened air and material inlet nozzle 44. The bore 45 of the tube 43 and nozzle 44 is of uniform diameter throughout so that the steady flow of the granular material is not impeded, thus avoiding clogging of the bore 45, even under conditions of continuous use.

Similarly to the gun disclosed in the Bleakley

Patent No. 2,092,150, a concentric nozzle 46 is provided through which an annular stream of fuel gas is delivered for combustion in the air stream which delivers the finely divided material to be melted and sprayed. Another concentric nozzle 47 is provided through which additional or secondary combustion supporting gas may be delivered. The nozzle 47 is provided with an extension 48 which forms a melting chamber and controls to a large degree the temperature conditions therein. The length of the extension 48 must be such that it will be maintained at substantially a cherry-red heat without being softened so that it loses its shape during operation. If the nozzle is shorter, it will not maintain the proper operating temperature, and the coating material will not melt, and if materially longer, it will be burned off by the flame. The nozzle may be cooled somewhat by means of radiating fins 49 adjacent the end thereof and by the passage of additional air or a mixture of air and hydrogen or non-oxidizing gas through the annular passageway 50 defined by the nozzle 48 and a concentric outer nozzle 51, which projects beyond the end of the nozzle extension 48.

In operation the finely divided vitreous or non-metallic material is fed into the hopper 29 and falls into the agitator 31 where the oscillation of the latter causes it to be fed at a continuous rate into the chamber 39 of the aspirator. The blast of air through the nozzle 41 withdraws the material from the chamber and blows it along the tube 43 out of the nozzle 44. The fuel gas which is blown through the nozzle 46 is ignited in the air stream and the resulting flame causes melting of the granular material. The high velocity gaseous blast forces the molten material out through the nozzle 48 and the nozzle 51 in the form of a generally conical spray which impinges upon the article to be sprayed. By regulating the amount of additional air injected through the passageway between the nozzles 46 and 47 and the amount of air or non-oxidizing gas injected through the passageway 50, it is possible to form a non-oxidizing gas sheath about the sprayed molten material so that oxidation of the molten material or the surface being sprayed is largely avoided.

To coat wider areas of the sheet, it may be desirable in some instances to provide means for spreading the spray into a narrow fan-like shape. In Fig. 4 is disclosed a construction for so spreading the spray. Mounted on the outer nozzle 51 is a ring-header 52 having outlet pipes 53 and 54 of generally similar shape which extend longitudinally of the nozzle 51 and terminate in nozzles 55 of flattened formation having narrow slit-like outlets which are directed substantially transversely of and disposed adjacent to the outlet of the nozzle 51. When, for example, natural gas is directed by means of these nozzles 55 against opposite sides of the spray, they tend to flatten it and spread it into the fan-like shape. Moreover, the streams of the natural gas will tend to deoxidize the gas sheath and thus will provide additional protection against oxidation of the molten material.

It will be understood that when it is desired to spray a comparatively wide sheet, more than one nozzle may be used, for example, two, three, four or more depending upon the area to be covered. Moreover, while the device has been illustrated as utilizing a horizontally disposed spray gun, the spray gun or spray guns may be disposed vertically to spray the molten material

downwardly upon articles or sheets carried by a horizontal conveyor over suitable heating elements and through a suitable oven. The only change required to convert the form of device illustrated into a vertically disposed gun is to arrange the agitator at the end of the device rather than in its side, this being readily accomplished without material change in the shape, proportions or construction of the gun.

From the foregoing description it will be apparent that I have provided a simple and effective device for converting granular or powdered high-melting point material into a molten spray and applying it as a surface coating to various types of articles. Moreover, I have provided a simple and effective device for applying such difficultly applicable substances as enamels, porcelain, glass and various types of high-melting silicates to the surface of articles without substantial loss due to checking or cracking of the coating material.

It will be understood that the devices disclosed herein are susceptible to modification and that they should be considered as illustrative, only, and not as limiting the scope of the following claims.

I claim:

1. In a device for melting and spraying finely divided non-metallic substances the combination of a base member; a carriage supporting said base member for pivotal movement; a gun for melting and spraying pulverulent material mounted on said base member, said gun comprising a nozzle having a passageway for said granular material, a second nozzle substantially concentric with said passageway for delivering fuel gas, and a third nozzle concentric with said second nozzle for delivering additional combustion supporting gas having a portion projecting beyond the end of the first mentioned nozzle and forming a combustion chamber for the fuel gas in which said material is melted, means supported on said base member for receiving said granular material, and an aspirator for withdrawing said material from said receiving means and blowing the material through said passageway.

2. In a device for melting and spraying a finely divided substance the combination of a base member, a hopper mounted on said base member, an aspirator, an agitator communicating with said hopper for delivering said substance to said aspirator, and a spray gun on said base member comprising a nozzle communicating with said aspirator, additional nozzles for supplying fuel gas and combustion-supporting gas to produce a flame and melt said substance, and means forming a chamber in which said substance is melted.

3. In a device for melting and spraying a finely divided substance the combination of a base member; a melting and spraying gun on said base member comprising a nozzle having a central passageway and a plurality of additional annular passageways for fuel and combustion-supporting gas, means forming a substance-receiving chamber in which said fuel gas is burned, a housing having a chamber communicating with said central passageway, and a small nozzle in said central passageway to direct gas therethrough and withdraw said substance from said chamber; a funnel-like member supported on said base member communicating with said chamber; means on said base member for vibrating said member and a hopper on said base member communicating with said member for delivering said substance to said member.

4. In a device for melting and spraying a finely-divided substance the combination of a base member, a hopper mounted on said base member, a pivotally supported funnel beneath said hopper, means for oscillating said funnel, a spray gun on said base member having a nozzle, a housing on said base member forming a chamber communicating with said nozzle, means for delivering a blast of gas through said nozzle to draw said substance from said chamber and blow it through said nozzle, and means for directing fuel gas around said nozzle for combustion to melt the substance blown through said nozzle.

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