

May 12, 1942.

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2,282,926

APPARATUS FOR BAKING ENAMEL

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2 Sheets-Sheet 1

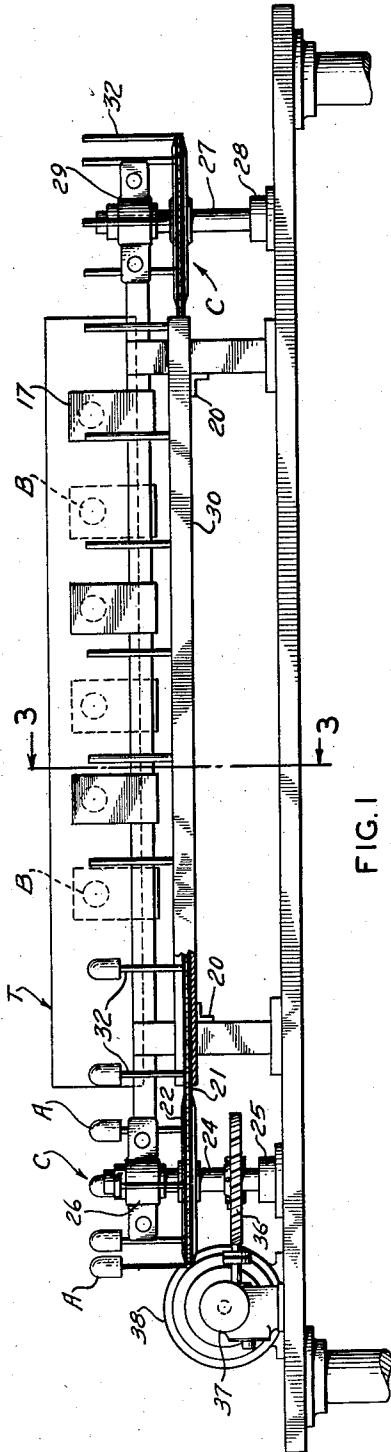


FIG. 1

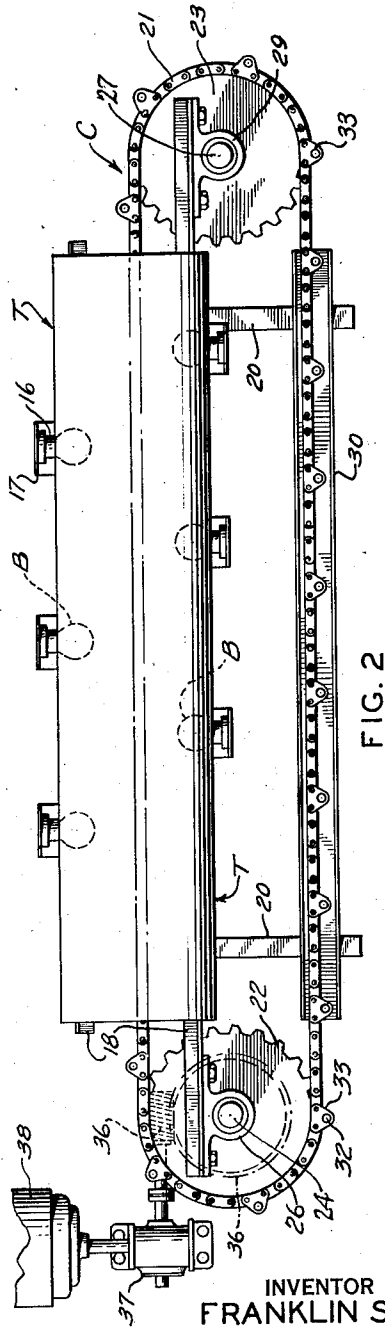


FIG. 2

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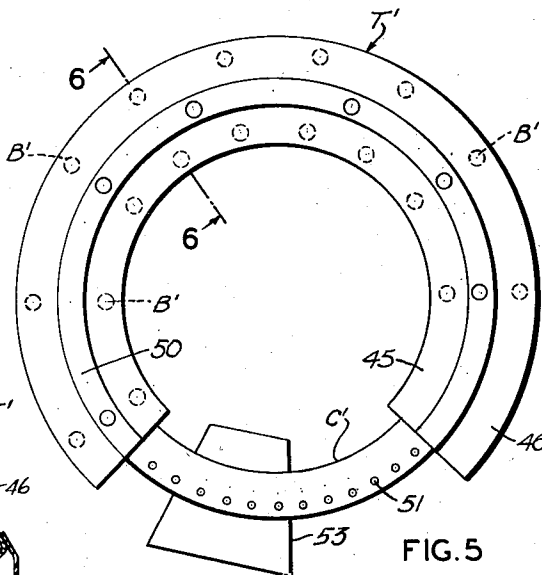
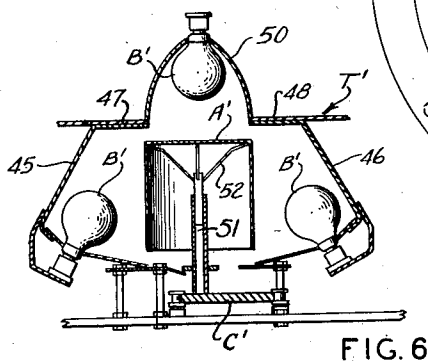
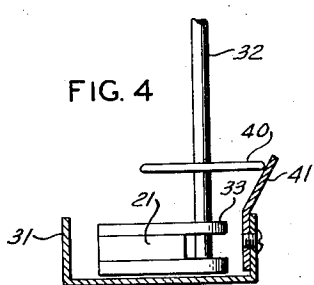
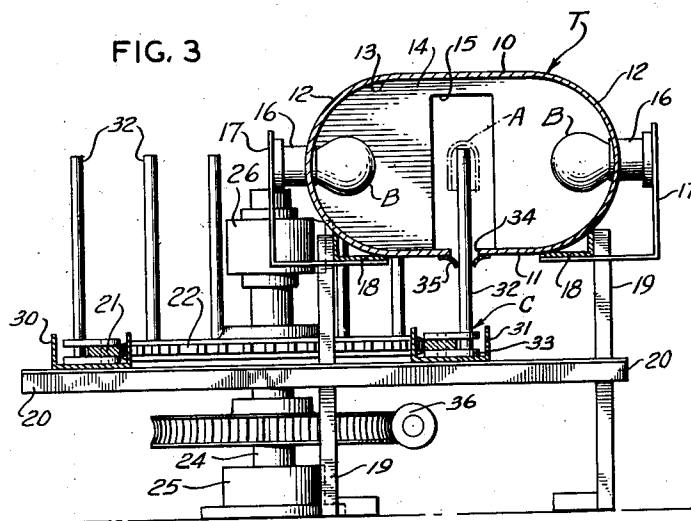
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APPARATUS FOR BAKING ENAMEL

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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APPARATUS FOR BAKING ENAMEL

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Application April 5, 1939, Serial No. 266,075

2 Claims. (Cl. 219—19)

This invention relates to the drying or baking of enamels and other similar industrial finishes and aims to provide an improved apparatus utilizing infra-red rays for this purpose.

Recently it has been suggested that enamels, lacquers and other industrial finishes of this general character, which usually require baking for an extended period in order that they may be properly set and dried, may be effectively baked and treated in a relatively short time by subjecting the coated surface to infra-red radiation, as disclosed in F. J. Groven Patent No. 1,998,615. Such infra-red radiation is probably best produced by means of the standard carbon filament lamp bulb wherein the major portion of the radiation is of a wave length within the near visible infra-red portion of the spectrum and of a length less than 1.6 microns. According to the methods proposed thus far, the carbon filament lamp bulbs are mounted in individual reflectors, of the usual parabolic or semi-spherical shape, and arranged in batteries so that the reflected rays have a considerable spread and may be suitably focused upon any large surface, or part thereof, which is to be baked. However, when individual reflectors are used for each of the carbon filament lamp bulbs, no matter how they are arranged, for example in staggered relation as suggested in F. J. Groven Patent No. 2,057,776, there is a space between the individual reflectors which permits useful heat produced by the source of radiation to escape, and, possibly even more important, allows convection currents to be set up so that dust and other foreign matter may be brought into contact with the coated surface before it is dry. In addition, the characteristics of individual reflectors are such that, although the rays are spread, there is a space immediately in front of the lamp bulb where no rays are transmitted. Furthermore, all forms of apparatus heretofore available have not been particularly suitable for the baking of coatings applied to the surfaces of relatively small articles, such as electric switch plates, compacts, index tabs, flashlight cases, and the like.

I have discovered that the above mentioned difficulties may be eliminated and the efficiency of the baking operation greatly increased, particularly as applied to relatively small articles, by confining the heat produced by the source of infra-red radiation in the region of the coated surface, while simultaneously reducing the motion of the air and other heated gases about the coated surface, and have devised a novel apparatus for accomplishing these desirable results.

In accordance with my invention, articles may be coated with a material which polymerizes or otherwise sets into a hard film when subjected to heat, and the coated surface is then exposed

to infra-red radiation, preferably produced by a carbon filament lamp bulb, while simultaneously confining the heat produced by the source of radiation in the region of the coated surface and reducing the motion of air and other heated gases about the coated surface. One form of apparatus with which this advantageous method may be practiced may consist of an elongated oval-shaped tube or tunnel having a polished inside reflecting surface, and a plurality of carbon filament lamp bulbs suitably disposed adjacent said reflecting surface and throughout the length thereof. The elongated tube is preferably partially closed at the ends thereof with only a sufficient opening being provided so that the articles to be baked may be passed into the tube by means of a conveyor which travels beneath the tube. In order that the articles to be baked may be continuously moved through the tube, an elongated narrow slot is provided in the bottom side of said tube. This slot is of such width that carrier members secured to the conveyor may project upwardly and into the tube so that the articles which are to be carried on said members will be properly positioned with respect to the sources of infra-red radiation within the tubes. Means associated with the carrier members and the conveyor may also be provided for rotating said carrier members as they move continuously through the tunnel. By having a continuous and uninterrupted reflecting surface within the elongated tube which is partially closed at the ends thereof and provided with an elongated and narrow slot in its lower side, I have found that, even though the articles are moving continuously through the tunnel, there will be no detrimental convection currents set up and the heat produced by the sources of radiation is effectively confined in the region of the coated surface so that the rate of baking is increased and the quality of the finish improved.

The above and other features and objects of my invention will become apparent upon consideration of the following detailed description of preferred embodiments thereof, and the accompanying drawings in which:

Fig. 1 is a side elevational view of a drier construction embodying the apparatus features of my invention, and with which my improved method may be practiced;

Fig. 2 is a horizontal plan view of the apparatus shown in Fig. 1;

Fig. 3 is a somewhat enlarged vertical sectional view taken substantially along the line 3—3 of Fig. 1;

Fig. 4 is a fragmentary detail elevational view, partly in section, illustrating one form of means for rotating the carrier members;

Fig. 5 is a plan view, somewhat diagrammatic,

illustrating another form or arrangement of apparatus embodying my invention; and

Fig. 6 is a vertical sectional view taken substantially along the line 6—6 of Fig. 5.

As shown in the drawings, particularly in Figs. 1, 2 and 3, relatively small articles A, having a thin film of a coating material which is to be baked, applied to its outside surface, are led through a drying tunnel or tube T by means of a suitable conveyor C. The conveyor C is arranged, and may be adjusted, to move the articles A through the tube T continuously and at any desired rate of speed, the rate of movement in any instance depending, in the main, on the thickness of the coating, the color of the coating and the size and shape of the articles. It is in the tube T, while the coated articles A are continuously moving therethrough at a constant rate of speed, that the coating material is exposed to infra-red radiation which is produced by a plurality of carbon filament lamp bulbs B; and it is due to the design and construction of the tube T that the heat produced by the source of radiation is confined in the region of the coated surface and the motion of the heated air and gases about the coated surface is reduced.

In the form of the invention shown in Figs. 1, 2 and 3, the tunnel T comprises an elongated and substantially oval shaped shell or tube having substantially flat upper and lower surfaces or portions 10 and 11 respectively, and substantially semi-cylindrical side wall portions 12, 12. The tube T may be constructed of any suitable sheet material, such as copper or brass, and is provided with a highly polished inside reflecting surface 13 which may be gold or chromium plated, if desired. Closures 14, having apertures 15 of sufficient size to permit the articles A and carrier members of the conveyor to pass therethrough, may be provided and suitably attached to the ends of the tube T. Arranged at spaced intervals along each of the curved side walls 12 are a plurality of the carbon filament lamp bulbs B. These bulbs are mounted in sockets 16 which are supported on suitable brackets 17, and connected to any convenient source of electric power. Said bulbs B are preferably arranged in staggered relation as indicated in Fig. 2 and centrally disposed with reference to the semi-circular curved side walls 12 so that the infra-red rays produced thereby will be effectively radiated therefrom and reflected from the polished reflecting surface 13 over the entire coated portion of the article A.

For the drying of small articles, I have found that a tube or tunnel T about six feet in length and having three bulbs B, spaced about eighteen inches apart, and mounted in staggered relation in each side thereof, provides a suitable drying tunnel. With this arrangement the sources of infra-red radiation are spaced substantially nine inches from the entrance end of the tube T. By placing the first bulb B about eighteen inches from the entrance end of the tube T, there is provided, in effect, a preheating zone for the coated article, so that the temperature of the coating material may be effectively raised considerably above room temperature before being subjected to the direct infra-red rays from the first source of radiation. I have found that a considerable amount of useful heat is created by the carbon filament lamp bulb B, and by the above described construction and shape of the tube T, with its continuous and uninterrupted reflecting surface, such heat is effectively con-

fined in the region of the coated surface as the articles pass through the tube. Moreover, by reason of the shape of the tube T and the partial closures at the ends of said tube there will be substantially no relative movement between the coated surface and the heated air and gases within the tube. That is, the shape and construction of the tube T reduce the convection currents to a minimum. This is regarded as a very important feature of construction since it prevents dust and other foreign matter from coming in contact with the coated surface during drying or baking. To increase the efficiency of the heating, as distinguished from infra-red radiation produced by the carbon filament lamp bulbs B, the entire outside surface of the tube T may be covered with any suitable heat insulating material, is desired.

As best shown in Fig. 3, the tube T and lamp socket brackets 17 are supported by longitudinally extending angle bars 18 which form part of a framework including a plurality of vertical supports 19 and extended horizontal supports 20. This framework also forms the support, in part, for the conveyor C which comprises a suitable endless chain 21 looped around sprockets 22 and 23 horizontally disposed adjacent the entrance and exit ends, respectively, of the tube T. Sprocket 22 is mounted on a vertically disposed shaft 24 which has its lower end journaled in a suitable bearing 25 provided on the main support or table upon which the entire apparatus is mounted, and its upper end supported and journaled in a suitable bearing structure 26 secured to one of the longitudinal supporting angles 18. Similarly the sprocket 23 is mounted on a shaft 27 which is journaled in bearings 28 and 29, corresponding respectively to the bearings 25 and 26. The chain 21 in passing between the two sprockets may be conveniently supported by a channel bar 30 mounted on the extended portion of the horizontal member 20 and a second channel bar 31 mounted on the member 20 beneath the tube T and centrally disposed with respect thereto.

Carrier members, which in the present instance take the form of vertical pins 32, are rotatably mounted in outwardly extending ears 33 provided at regularly spaced intervals throughout the entire length of the endless chain 21. When the chain 21 is travelling along the channel member 31 beneath the tube T, the pins 32 extend upwardly through an elongated slot 34, provided in the bottom or lower wall 11 of the tube T, and into the drying chamber. The slot 34 is relatively narrow but of sufficient width to permit the pins 32 to pass therethrough. If desired, resilient closing flaps 35, composed of some suitable insulating or heat resisting material such as asbestos, may be attached to the lower wall 11 on each side of the slot 34 so as to keep it substantially closed as the pins are moving through the tube. It will be noted that the pins 32 are of such height that the articles A which are supported thereby will be effectively positioned with respect to the carbon filament lamp bulbs B as they move continuously through the tube T at any desired rate of speed. In the present instance, the movement of the carrier members through the tube T is effected and controlled by means of suitable gears 36 associated in driving engagement with the shaft 24 of the sprocket 22 and connected through a suitable speed reducer and controller 37 with a motor 38.

With certain types of articles, it is desirable

that they be rotated as they are passing through the tube T so that the entire coated surface may be completely and effectively baked. To accomplish such rotation, I have provided circular friction discs 40 on each of the pins 32, as shown in Fig. 4. These discs 40 are adapted to bear against an inclined flange 41 which may be attached to the channel 31 in any convenient manner. Thus, as the pins 32 move throughout the length of the tube T, they will be caused to rotate continuously by the contact of the friction discs 40 with the inclined flange 41.

It is believed that the operation of this form of apparatus will be apparent from the foregoing description. The articles A which have been coated with the material to be baked and dried are placed on the pins 32 at the entrance end of the tube T adjacent the sprocket 22. The chain 21 has previously been set in motion at the desired rate of speed so that the freshly coated articles enter the tube T and pass through the pre-heating zone and directly into the drying and baking zone between the carbon filament lamp bulbs B. As they pass out of the tube T at the exit end thereof they are completely dried and may be removed from the pins. I have found that small articles of the type illustrated in the drawings, when coated with black "Polymerin" may be thoroughly baked in a passage through the tube T consuming fifty-two seconds; whereas if the articles are coated with a white coating material of the same general type, a passage of one minute and thirty-six seconds is required for complete drying. I have found, moreover, that if air is caused or permitted to circulate through the tube T during the drying operation, the time is considerably increased and, in many instances, the appearance of the dried coating is impaired by the presence of dust particles or other foreign matter which contacts therewith due to the circulation during drying.

In Figs. 5 and 6, I have shown a modified form of apparatus embodying my invention, which form is particularly suited for the baking of coatings applied to slightly larger articles than those adapted to be treated in the above described apparatus. In general principles of construction and operation it is substantially identical with the construction shown in Figs. 1 to 3. However, the details of the apparatus are somewhat different. As shown, the drying apparatus comprises a tunnel or tube T' which is arranged in an arc occupying the major portion of a circle. Such a construction permits the use of a circular conveyor C' which has no ineffective or waste conveying portion, such as the major portion of the chain 21 between the sprocket 23 and 22 and over the channel 30. The circular tunnel T' comprises lower left and right angular sheet metal sections 45 and 46, respectively, having horizontal inwardly projecting flanges 47 and 48, respectively, at the upper edges thereof. A parabolic shaped section 50 is mounted upon the flanges 47 and 48. Each of the three sections 45, 46 and 50 is provided with carbon filament lamp bulbs B' which may be arranged in progressively staggered relation, in the manner indicated in Fig. 5. Due to the fact that the tops or upper portions of the articles tend to dry more quickly if the lamp bulbs are uniformly arranged, I have provided a greater number of lamp bulbs in the angular section 45

and 46 than in the upper curved section 50, and said sections 45 and 46 are designed to concentrate the rays on the lower portions of the articles.

The conveyor C' may be provided with carrier members 51 somewhat similar to the carrier members 32 and rotated in the same manner as illustrated in Fig. 4. However, in order that the pins may be adapted to carry larger articles they may be provided with a plurality of outwardly and upwardly projecting fingers 52 which are arranged to support effectively a larger cylindrical shaped article A'. With this construction the articles to be dried are placed on the carrier member and removed therefrom in a dried condition in the space between the ends of the tunnel T where a suitable table 53 or a spray booth may be provided for the convenience of the attendant or operator.

From the foregoing description, it will be apparent that by my present invention I have provided an improved apparatus for drying enamels or other industrial finishes which have been applied to comparatively small articles. This apparatus is possessed of many advantages not present in drying or baking devices heretofore available. It is cheap to construct and efficient in its operation and requires relatively little space. While I have described my apparatus as utilizing carbon filament lamp bulbs, it will be understood that if other infra-red radiation devices are commercially available in the future, they may be used to advantage in carrying out my improved method of baking. While I have described the preferred embodiments of the apparatus features of my invention, it will be apparent that various changes may be made in the construction, and certain features may be employed without others without departing from my invention or sacrificing any of its advantages.

What I claim is:

1. Apparatus for drying relatively small articles coated with enamel, comprising a tunnel having a continuous and uniform reflecting surface on the inside thereof and a narrow slot-like opening in a wall thereof; a plurality of sources of infra-red radiation disposed within said tunnel and adjacent said continuous reflecting surface; conveyor means; carrier members mounted on said conveyor means and projecting through said narrow slot-like opening into said tunnel; and means for rotating said carrier members, said continuous and uniform reflecting surface co-operating with said sources of infra-red radiation and being so constructed and shaped as to concentrate the infra-red rays over the entire outside surfaces of the coated articles carried by said carrier members.

2. Apparatus for drying articles coated with enamel, comprising a tunnel having a uniform and continuous reflecting surface on the inside thereof, and a plurality of sources of infra-red radiation disposed within said tunnel and adjacent said continuous reflecting surface, said continuous reflecting surface including two oppositely disposed angular portions which are adapted to concentrate the infra-red rays on the lower portion of a coated article and an upper curved portion which is adapted to concentrate the rays on the upper portion of the coated article.

FRANKLIN S. BATES.

4

CERTIFICATE OF CORRECTION.

Patent No. 2,282,926.

May 12, 1942.

FRANKLIN S. BATES.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, first column, line 62, for "from the entrance end of the tube T," read --apart throughout the length of the tube T.--; and page 3, second column, line 52, claim 1, for "uinform" read --uniform--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 30th day of June, A. D. 1942.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.