Oct. 20, 1953 C. P. MANN 2,656,170

METHOD AND APPARATUS FOR HEATING OBJECTS

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FIG. 2.

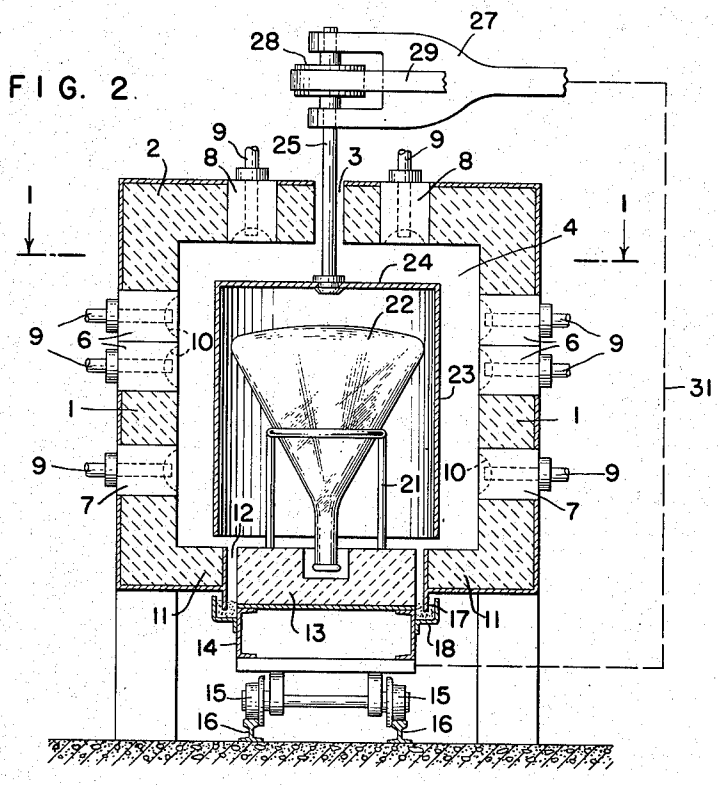
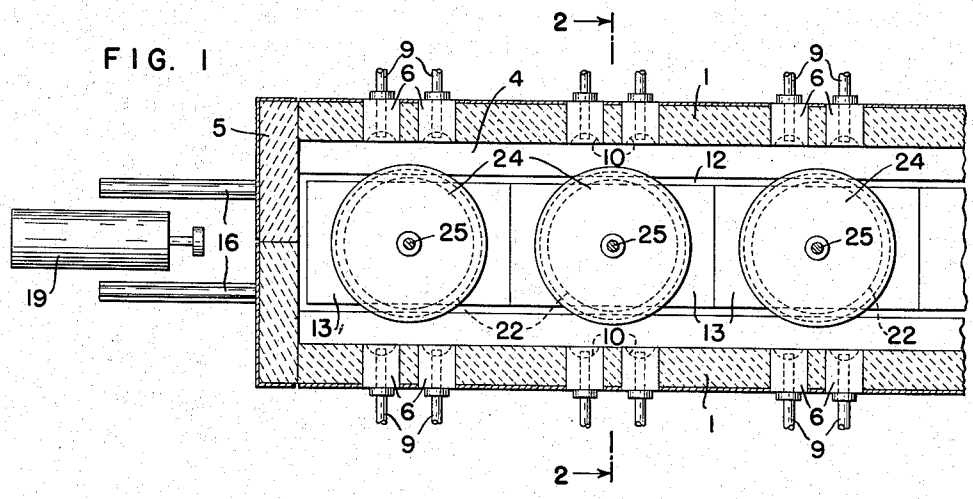


FIG. 1



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METHOD AND APPARATUS FOR HEATING OBJECTS

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6 Claims. (Cl. 263—2)

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The present invention relates to heating, and more particularly to a method and apparatus for applying radiant heat to an object evenly around its entire surface. The invention will be described in connection with the heating of a large glass object such as a television tube. It will be understood, however, that it is applicable to the heating of any other object that must be heated evenly around its entire surface.

Frequently, work is moved through an elongated furnace chamber where it is subjected to a heating cycle, and at times also to a cooling cycle. Burners or other heating elements are located in the side walls, and occasionally in the roof, of the chamber to heat the work. Those portions of the work near the sides of the chamber are subjected directly to the heat of the burners. Those portions of the work that are near the center of the chamber are not subjected directly to the burners and are therefore not heated as rapidly or to the same temperature as the portions thereof near the sides. In many cases the different speed of heating of different portions of the work is immaterial since conduction through the work will eventually even out its temperature. In other cases, however, it is essential that all portions of the object be heated at exactly the same rate. This is particularly true with respect to television tubes since the glass forming the screen is much thicker than the glass forming the cone and the stem. When all portions of the tubes are not heated evenly, the differential expansion set up therein frequently results in breakage of the tubes.

According to the present invention, the objects being heated, described herein by way of example as television tubes, are moved through an elongated furnace chamber. A shield is placed over each object, and is rotated as it is being moved with the object through the furnace chamber. Thus the shield is heated by the burners, and heat is transmitted by it to the object. Since the shield is being rotated in front of the burners all portions of the shield will be heated evenly. This even heat is transmitted by radiation from the interior of the shield to all portions of the object.

It is an object of the invention to provide means for heating each portion of the surface of a work piece at the same rate. It is a further object of the invention to provide a means of heating a work piece evenly all around its surface as it is being moved through a furnace having heating elements only along the sides thereof.

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Another object of the invention is to provide a method and apparatus for heating or cooling all portions of a work piece evenly and at the same rate even though the heating elements are not disposed evenly around the work piece.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages and specific objects attained with its use, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described a preferred embodiment of the invention.

In the drawings:

Figure 1 is a plan view, partly in section, and taken on line 1—1 of Figure 2 showing the furnace; and

Figure 2 is a transverse section taken on line 2—2 of Figure 1.

Referring to the drawing, there is shown an elongated furnace having side walls 1 and a roof 2 through which there is a slot 3 that extends from end to end of the furnace. The walls and the roof, together with a floor described below, form a furnace chamber 4 in which the work is heated. The furnace may be constructed in accordance with ordinary furnace practice, in which the walls are of a suitable refractory material, that is backed up by sheet metal and is suitably reenforced by structural steel members. The ends of the furnace chamber are closed by doors 5 that are shown herein as being opened by movement from the center toward the sides.

Burners are inserted in the furnace wall at spaced points or stations along the side and the roof thereof. As shown, there are pairs of burners 6 in the upper portion of each side wall and single burners 7 in the lower portion of each side wall at each station. There are also burners 8 inserted in each of the roof sections of the furnace in line with the burners 6 and 7. These burners may take any conventional form, but are shown herein as being burners of the type described in Hess Patent 2,215,079. These burners are supplied with a combustible mixture of gas and air through suitable pipes 9. The burners are supplied with this mixture through suitable manifolds and valves in a conventional manner. The details of the fuel supply to the burners forms no part in the present invention. Burners of the type disclosed herein are provided on the face in the furnace chamber with a cup 10. The fuel mixture is supplied in a plurality of radial

jets to the cup and burned therein to heat these cups to incandescence. Heat is transferred to the work by radiation from the incandescent cups as well as by convection from the hot products of combustion which escape through the slot 3 in the roof.

The bottom of the furnace includes portions 11 which project inwardly from the sides 1. These portions have between them a longitudinally extending opening 12 which is closed by the platforms 13 of furnace cars 14.

When the system is operating, the cars 14 which are provided with wheels 15 traveling on tracks 16, are moved one after another through the furnace so that a continuous floor is formed for the furnace by the platforms 13 of the cars. It is noted that seals are formed between the side portions 11 of the furnace floor and the cars which comprise flanges 17 extending downwardly from the edges of portions 11, which flanges are received by troughs 18 on the cars. These troughs will be filled with sand or other suitable material to form a seal, and thereby prevent the flow of air into the furnace chamber to cool it down. The cars are moved through the furnace one after the other by means of a car moving mechanism which is shown diagrammatically herein at 19.

Each of the cars has on it a work support 21 to hold the work 22 which is shown herein as being a television tube. The work is covered by a cylindrical shield that includes a skirt portion 23 and an end 24. This shield is suspended over the work by means of a rod 25 the upper end of which is received in bearings on the end of a cantilever type support 27. The rod 25 has mounted on it a pulley 28 which is driven by a belt 29. In the operation of the system, the shield carrying support 27 is moved synchronously with the cars 14 as indicated by the dotted line 31.

Ordinarily, when objects that are round, such as the television tube 22, are moved through a furnace for treatment, the portions of the tube closest to the burners will be heated more rapidly and to a higher temperature than the portions of the tube which are at right angles to the burners. In some cases, this does not make any difference since the heat will flow through the work to even out the temperature as it is traveling through the furnace. When, however, the work is something similar to a television tube in which one wall is considerably thicker than the other walls, the work is frequently damaged by the differential expansion in the work due to the different rates of heating of the portions close to and the portions away from the burners. The operation of the presently disclosed apparatus will insure that all portions of the work will heat evenly and at the same rate. In the operation of the system, the television tubes are mounted in the work supports 21 on the cars, and the shield is placed over the work as is best shown in Figure 2 of the drawing. The cars and the shield support are then moved by the mechanism 19 into the furnace. It is intended, in the operation of the present system, that the movement of the cars be intermittent. Therefore, the burners in the furnace walls are placed so that they will be directly opposite a shield in the position of each car, as is shown in Figure 1. Since the burners are directed toward the shield, the shield itself will be heated and will transfer heat to the work. The shield is being rotated so that all portions of it are heated to the same temperature, and therefore, heat will be radiated from the interior of the shield equally to all parts of the surface of the work. Thus, although all the burners are placed at opposite sides of the furnace all portions of the work, either those directly in front of the burners or at right angles thereto, will be heated at the same rate. In the annealing of television tubes for example, or the evacuation of such tubes under heat prior to sealing them off, the burners will be fired at a rate to raise the temperature of the furnace chamber to approximately 1000° F. The tubes themselves will be heated to from 600° F. to 800° F. by heat transferred to them from the interior of the shields. The final temperature of the tubes will vary with the length of time a car is in the furnace.

As shown herein, the work is supported on the cars for a heating operation such as annealing. In some cases, the individual cars are provided with mechanisms to evacuate the tubes and seal them during the time that heating is taking place.

Tubes of the type disclosed herein have a thick screen or face, whereas the cone and stem are relatively thin. Therefore, in order to bring the temperature of all portions of the tube up to the desired temperature at substantially the same rate, it is necessary that more heat be supplied to the upper portion of the shield than is supplied to the lower portion thereof. For this reason, each station in the furnace has two pairs of burners 6 which are directed toward the upper portion of the shield along with the burners 8 in the roof of the furnace, while there is only a single pair of burners 7 in the lower portion of the furnace wall at each station. This means that the upper portion of the shield will be heated to a higher temperature than the lower portion thereof so that more heat can be transferred by radiation from the shield to the top of the tube. Since the top of the tube is thicker than the bottom of the tube, however, it will require more heat to bring it to a given temperature than will the lower portion of the tube.

If the cars were moved through the furnace continuously instead of intermittently, the burners would be spaced evenly along the length of the chamber rather than being concentrated at stations. The same pattern of the burners transversely of the furnace would be maintained, however, since this is determined by the cross-section of the tube. It will be obvious that burners can be placed in the furnace walls to give the heat pattern for the work that is being treated. Also by reducing the heat supplied by the burners, the temperature of the work can be evenly reduced during the latter portion of its travel through the furnace chamber, for example.

From the description, it will be seen that there is provided apparatus for heating evenly all portions of an object and to heat all portions of the object at the same rate even though various portions thereof are at varying distances from the burners. There is also provided apparatus by means of which the proper pattern of heat may be obtained to insure that there is an even heat distribution to the work for the purpose of raising its temperature uniformly.

While in accordance with the provisions of the statutes, I have illustrated and described the best form of embodiment of my invention now known to me it will be apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit and scope of the invention, as set forth in the appended claims, and that in some cases certain features of my invention may be used to advantage without a corresponding use of other features.

What is claimed is:

1. The method of heating an article evenly around its surface which comprises supporting the article to be heated, placing a shield around the article to be heated and out of contact therewith, heating the shield from a plurality of spaced points, and rotating the shield relative to the article.

2. The method of heating an article evenly by the use of radiant heat which comprises placing the article within a shield and out of contact therewith, applying heat to the exterior of the shield at a plurality of spaced points to heat the same, and rotating the shield so that it will be heated evenly and transfer its heat to said object.

3. In apparatus for heating an object evenly by radiant heat, the combination of an elongated furnace having a chamber therein, said chamber having heating means located at spaced points along its walls and having an opening extending lengthwise of its bottom, a plurality of cars each having a platform thereon of a size to fit in said opening whereby said cars form a floor for said chamber, means on each car to support an object to be heated, a plurality of shields, means to support a shield in position to cover each object, means to rotate said shields, and means to move said cars and shields through said furnace chamber to positions in which said shields are in front of the heating means in said furnace walls.

4. In apparatus for heating an object, the combination of an elongated furnace, heating means located at spaced points along the side of said furnace, a plurality of cars upon each of which is mounted an object to be heated, a plurality of shields, means to hold a shield to surround an object on each car, means to move said cars and shields through said furnace to positions in which said shields are between the objects and said heating means, and means to rotate said shields.

5. In apparatus for heating objects by radiant heat, the combination of a furnace having a chamber therein, burners located on opposite sides of said chamber, means to support an object to be heated between said burners, a cylindrical shield surrounding said object and out of engagement therewith and extending between the same and the burners, and means to rotate said shield.

6. In apparatus for heating an object, the combination of an elongated furnace having a chamber therein, said furnace being provided with an opening extending throughout the length of the bottom thereof and a slot extending throughout the length of the top thereof above said opening, a plurality of furnace cars each having a platform thereon of a size to fill the width of said opening whereby the platforms of said cars form a floor for said chamber, a plurality of burners in said chamber located at spaced points opposite said cars, work holding means on each of said cars, a shield to cover the work on said cars and extend between the same and said burners, means extending through said slot to support said shield, means to rotate said shield, and means to move said cars and shields through said furnace chamber.

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