

J. F. DODGE & H. C. ALLEN.
ENAMELING APPARATUS.
APPLICATION FILED MAR. 12, 1917.

1,268,778.

Patented June 4, 1918.
3 SHEETS—SHEET 1.

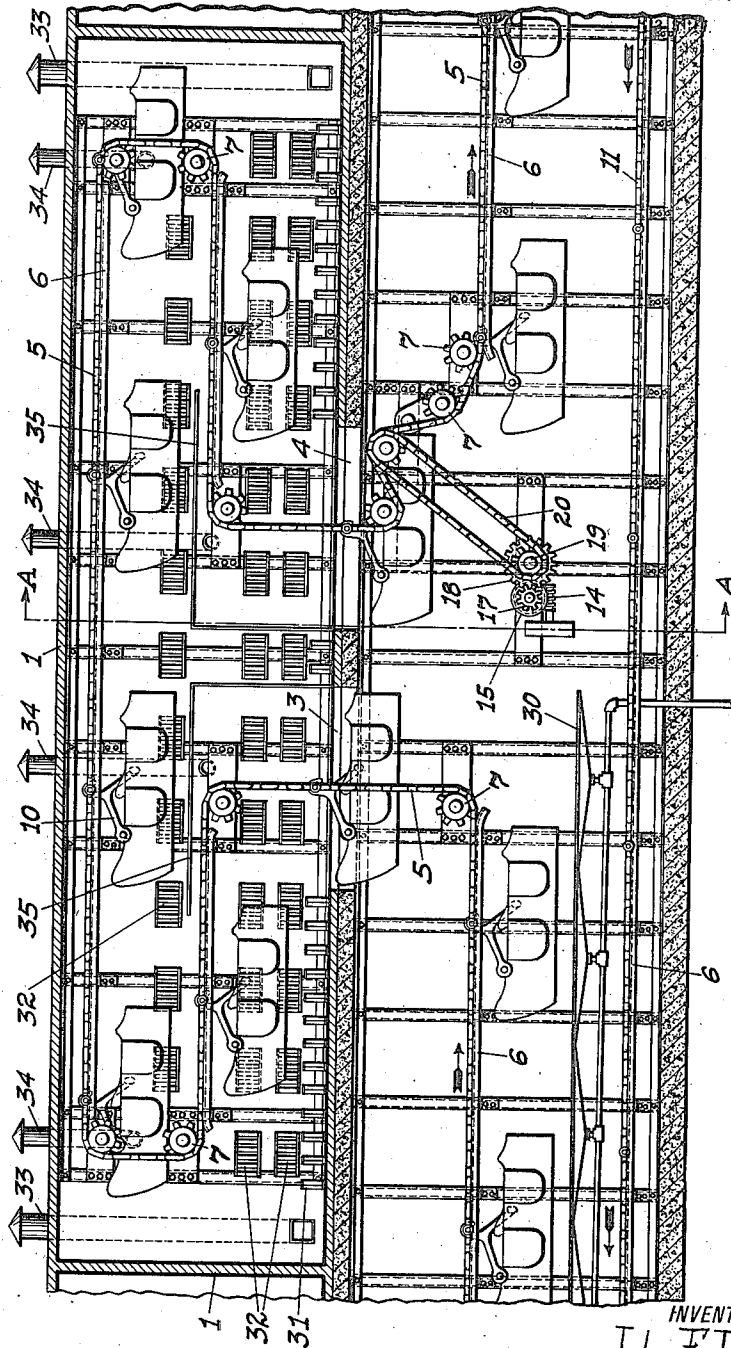


Fig. 1

INVENTORS
John F. Dodge
Harry C. Allen
BY
Newell & Neal
ATTORNEYS

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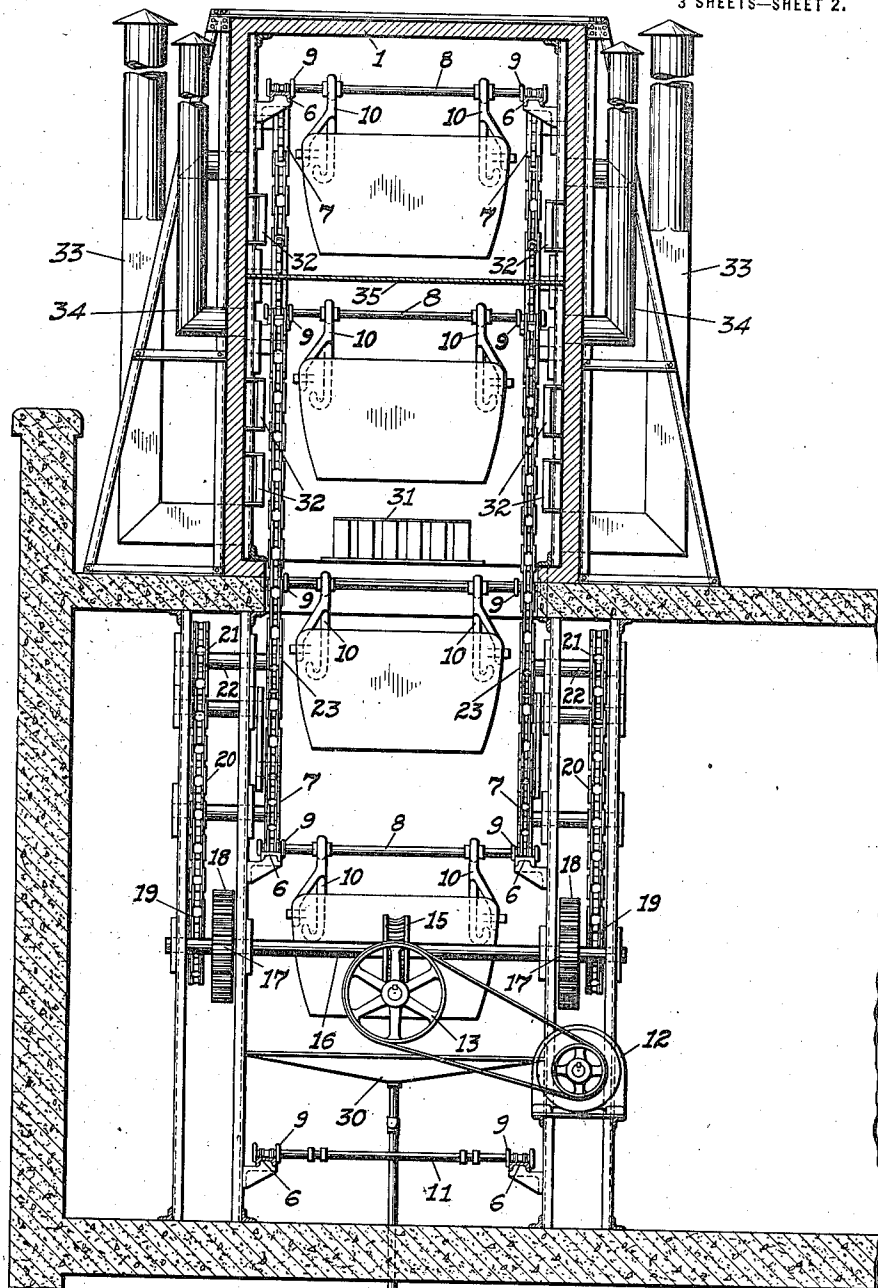


Fig. 2

INVENTOR
John F. Dodge
Harry C. Allen
BY
Newell & Neal
ATTORNEY

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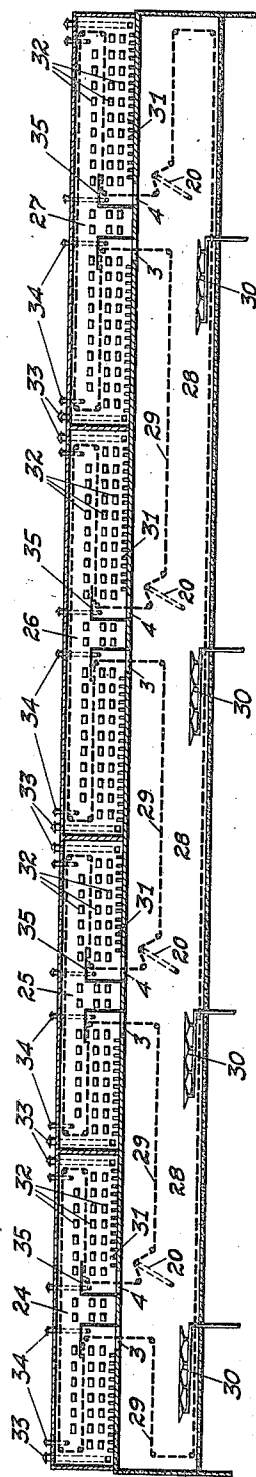


Fig. 3

INVENTORS
John F. Dodge
Harry C. Allen
BY
Newell & Neal
ATTORNEYS

UNITED STATES PATENT OFFICE.

JOHN F. DODGE, OF DETROIT, AND HARRY C. ALLEN, OF HIGHLAND PARK, MICHIGAN,
ASSIGNORS TO DODGE BROTHERS, OF DETROIT, MICHIGAN, A CORPORATION OF
MICHIGAN.

ENAMELING APPARATUS.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that we, JOHN F. DODGE and HARRY C. ALLEN, citizens of the United States, residing at Detroit, Michigan, and Highland Park, Michigan, respectively, have invented certain new and useful Improvements in Enameling Apparatus, of which the following is a clear, full, and exact description.

This invention relates to the coating of metal or other objects with japan or similar protective material, and aims both to improve the method of effecting such coating and also to provide more efficient means therefor, whereby the quality of the resultant product may be improved and its quantity increased.

More particularly, the invention aims to provide improved means for quickly and cheaply applying baking heat to the coating of japan or the like, through which means objects to be treated may pass continuously in succession without sensibly varying the baking temperature and without in any way affecting the uniformity of the baking result.

The invention is herein illustrated as embodied in a series of ovens through which an endless conveyer carries the articles to be baked, each oven receiving and discharging the articles through its bottom and the conveyer having horizontal spans outside the ovens which provide for the reception and discharge of the articles to be treated and for the application of the successive coatings of japan or the like between the successive baking operations. It will be understood, however, that the invention is not restricted to the embodiment and uses herein set forth and that many features of the invention are of general applicability in the art to which it relates.

An important feature of the invention is the novel oven construction which permits the introduction and discharge of the articles to be treated through the bottom without affecting the baking temperature of the oven, a further important feature being the combination of this oven construction with an endless conveyer traveling in a

substantially closed path within the oven, said path being in the form of a vertical loop providing for the carriage of the articles successively through the lower and less intensely heated part of the oven and then through the upper part of the oven, and preferably again through the lower part of the oven just before the discharge of the articles. By this novel combination, and particularly by locating the points of charging and discharging near the middle of a horizontally elongated oven, provision is made for bringing the articles more gradually to the baking temperature of the upper part of the oven and also for bringing the articles more gradually to the outside temperature as they are discharged from the oven.

Another important feature of the invention is the provision of means for securing a uniform and proper heating effect in an oven through which articles to be treated are moved continuously in succession. In such an oven it is essential that compensation be made for the disturbance of the heat conditions due to the charging and discharging of the oven, to the movement of the articles through the oven and to the loss of the heat imparted to said articles, such compensation being particularly necessary in the novel oven hereinafter described, in which articles to be treated are constantly being carried into and out of the oven through normally open charging and discharging openings in its bottom. As the articles to be treated are thus moved along their path of travel, air at a temperature considerably lower than that in the oven is carried into the oven, in addition to that which would be drawn into the oven to replace that conducted out to carry away the volatile products of the baking operation, and some of the heated air of the oven is carried out with the articles. Moreover, the movement of the articles through and up and down in the oven herein shown, tends to produce currents in the air in the oven which disturb the desired heat conditions in different parts of the oven.

By the improved means of the present

invention not only is provision made for compensating for the disturbance in the heat conditions, due to the factors hereinabove enumerated, but an improved heating effect is also obtained which contributes to the rapid production of work of good quality and of uniform character.

Still another important feature of the invention is the arrangement of a series of horizontally elongated ovens in longitudinal succession, with the points of charging and discharging of the individual ovens adjacent, whereby space is provided between the ovens, in the path of travel of an endless conveyer passing through the successive ovens, for the performance of various operations upon the articles carried by said conveyer as they pass between the ovens, such, for example, as the application of additional coatings of japan or the like.

Other objects and important features of the invention will appear from the following description and claims when considered in connection with the accompanying drawings, in which—

Figure 1 is a longitudinal vertical section through an oven embodying the present invention;

Fig. 2 is a transverse section through the same oven taken on the line A—A of Fig. 1; and

Fig. 3 is a longitudinal vertical section through a series of such ovens showing their location relative to each other and also showing the complete path of the conveying chain.

In the particular application of this invention shown in the drawings, a system of ovens is illustrated adapted for baking japan or enamel upon sheet metal automobile bodies, although the same general arrangement may be used in baking the same or other kinds of coatings upon other articles.

Referring to Fig. 1, 1 represents the insulating material forming the walls, ceiling and floor of the oven which is maintained at the desired temperature by any suitable means, but preferably by such means arranged in such manner that the desired effects hereinafter set forth may be obtained. Through this oven the articles to be baked are constantly moving at a uniform speed, their entrance into the oven being through the opening 3 in the floor and their exit through the opening 4. The movement of the articles to be baked is accomplished by the use of two endless parallel flexible metal belts or chains 5 which pass into the oven through the opening 3 and out of it at 4, being supported in the horizontal portions of their path of travel by the channel irons 6 and passing around sprocket wheels 7 at the points where their direction of movement

is changed. At suitable intervals in these chains cross rods 8, as shown in Fig. 2, are provided. These rods are provided with rollers 9 upon their outer ends which roll upon the channel irons. Each of these rods is also provided with suitable hangers 10 for carrying the automobile bodies. These hangers are arranged so that they may be removed easily from the cross rods and are taken off when the bodies have reached the limit of their travel which enables the chains to be led back more conveniently, as shown at 11 in Fig. 1.

The chains may be driven by any suitable means, the method illustrated in the drawings being an electric motor 12 belted to the pulley 13. This pulley is mounted on the same shaft with the worm 14 which is engaged with the worm gear 15. This gear is carried by the shaft 16 near the ends of which the pinions 17 are mounted. These pinions are engaged with the gears 18, carried on the same shafts with two sprockets 19, which are connected by chains 20 to other sprockets 21 mounted on the same shafts 22 as the sprockets 23 which are in engagement with the body carrying chains. In Fig. 3, which shows diagrammatically a series of four ovens with a continuous conveying chain passing through all of them, the conveying chain is shown to be driven at four points through the chains 20 which are driven by electric motors as shown in Fig. 2.

In applying this invention to practice, as many ovens may be used in series as are required for the various coats of japan or other material applied to the work, the length of time the work is in each oven being sufficient to bake one coat and the portion of the travel of the bodies which is on a level below the ovens being utilized for applying the successive coats, which may be done without interrupting the movement of the bodies. Thus, in Figs. 3, 24, 25, 26 and 27 are four ovens through which the work passes in sequence for baking successive coats of material and which may be maintained at the same or different temperatures as is required. Below the ovens a space is shown where the different coatings may be applied to the work and where it may be inspected after each coating has been baked, the application of coatings and the inspection taking place while the material is traveling in the horizontal portions 28 of the path of the conveying mechanism. The methods found most suitable for applying the coatings to the work are: first, by spraying the coating on, and second, by flooding it on with a stream from a hose, drip pans being provided to receive the excess coating material which runs off or drips from the bodies before they enter the oven, the

coating material thus recovered passing through pipes to suitable filtering apparatus and storage tanks not shown. With both of these methods, the operation is performed very rapidly and the continuous motion of the work does not interfere with the process or affect the results.

By introducing the bodies through the openings in the bottom of the oven, the loss of heat experienced in an oven which has openings in its ends is almost entirely eliminated, thus increasing the efficiency of the oven and making it possible to keep the internal temperature constant in spite of the fact that the openings are never closed.

As the time required for the baking of each coat is considerable, a very long oven would be required if the bodies entered at one end and passed out at the other. By making the oven of sufficient height so that the bodies may travel in both directions, the length of the oven is reduced by one-half.

As hereinabove suggested, an important feature of the invention is the means for securing a uniform and proper heating effect in each of the ovens. In the illustrated construction the ovens are heated by means of electric heating units, there being a series of electric heating units 31 spaced along the bottom of the oven and several series of units 32 spaced along the sides of the oven. Air entering the openings 3 and 4 in the bottom of the oven will pass over the heating units 31, and as it is heated by said units will rise to the top of the oven. To insure movement over the floor heating units 31 of the air which enters the opens 3 and 4, baffles 35 are arranged to project over these openings.

The bodies which enter the opening 3 are at the temperature of the room in which the coating was applied, and in order to insure the gradual heating of these bodies to the baking temperature before they reach the upper part of the oven where the heat is more intense, some of the heating units 32 are preferably arranged along the lower path of travel of the bodies as shown in the drawings. Others of the heating units 32 are arranged along the upper path of travel of the bodies to insure the maintenance of the baking temperature in this part of the oven, and to compensate for the disturbance in heat conditions due to the movement of the bodies through the oven.

By the use of electric heating units, the heat can be applied exactly where it is needed to secure uniform and proper heat conditions in the oven, and to this end the heating units are preferably arranged to be separately controlled, or at least to be controlled in groups, whereby either by manual control or by automatic thermostatic control the required heat conditions in any part of

the oven may be obtained and maintained. As hereinabove pointed out, the movement of the bodies into and out of the oven and along their lower and upper paths of travel in the oven, disturbs somewhat the heat conditions in the oven by reason of the carrying of the air into and out of the oven with the bodies and the movement of the air in the oven along with the bodies. By arranging heating units along the floor and along the sides of the oven in the manner hereinabove described, and providing for separate control of these units or groups of units, the aforementioned disturbance in the heat conditions in the oven may be compensated for.

In the baking operation certain volatile products are formed, and to prevent the saturation of the air in the oven these must be conducted away. For this purpose ventilators 33 and 34 are provided, the ventilators 33 communicating with the oven near its bottom and the ventilators 34 at different levels along the sides of the oven, the ventilators 33 being larger than the ventilators 34 and serving to carry away the heavier volatile matter driven off by the baking operation. Air to replace that conducted out of the oven through the ventilators 33 and 34 enters through the openings 3 and 4 and is heated in the manner hereinabove described, being directed over the floor heating units 31 by the baffles 35.

It will be noted that between the successive ovens the endless conveyer has a considerable horizontal travel, indicated at 29 in Fig. 3 of the drawings, the first part of this travel of the conveyer with the bodies being utilized to cool the bodies sufficiently so that the next coat of japan may be applied. Before the application of the next coat of japan, the bodies are also sanded, if necessary, to remove any dirt which may be noticed in the enamel. All of these operations are performed while the bodies are being moved continuously by the conveyer.

What we claim as new is:—

1. In apparatus of the class described, an oven, conveying means comprising a chain moving in a nearly closed path inside said oven, and having another loop-like path outside said oven and connected with the inside loop through the oven bottom, said inside path having horizontal portions and vertical portions, the horizontal portions being longer than the vertical portions.

2. In apparatus of the class described, an oven normally open in a part of its lower side and conveying means comprising a chain moving in a nearly closed path inside said oven, said path having horizontal portions and vertical portions, the horizontal portions being longer than the vertical por-

tions and the points of exit and entrance of said chain through the open lower side of the oven being adjacent.

3. In apparatus of the class described, a series of horizontally elongated ovens arranged in longitudinal succession and each constructed to receive and to discharge the articles to be baked near the same point in its bottom, and an endless conveyer arranged to carry the articles continuously between and through said ovens, said conveyer having horizontal spans between successive ovens to provide for treatment of the articles to be baked which are carried by said conveyer, while said conveyer moves continuously between said ovens.

4. In apparatus of the class described, a series of horizontally elongated ovens arranged in longitudinal succession and each constructed to receive and to discharge the articles to be baked near the same point in its bottom and in substantially the same relative location in said bottom with respect to the succeeding oven, and a continuously moving endless conveyer arranged to carry the articles between and through said ovens, said conveyer having a horizontal span extending substantially between the openings of each two successive ovens.

5. In apparatus of the class described, a series of horizontally elongated ovens arranged in longitudinal succession and each constructed to receive and to discharge the articles to be baked near the same point in its bottom and in substantially the same relative location in said bottom with respect to the succeeding ovens, and a continuously moving endless conveyer arranged to carry the articles between and through said ovens, said conveyer having a horizontal span extending substantially between the openings of each two successive ovens, and lower and upper horizontal spans within and lengthwise of each oven.

6. In apparatus of the class described, a series of horizontally elongated ovens arranged in longitudinal succession, and an endless conveyer arranged to carry the articles for the most part horizontally and lengthwise between and through said ovens, said conveyer having relatively long horizontal spans between and within successive ovens and said ovens being provided with openings in the bottoms through which said inside and outside horizontal spans are connected by substantially vertical spans.

7. In apparatus of the class described, a series of ovens, each having a relatively long horizontal dimension, said ovens being arranged in substantial contiguity in succession, and an endless conveyer arranged to carry the articles for the most part horizontally between and through said ovens, and having relatively long horizontal spans between and within said ovens, said ovens

having openings through the bottoms through which the outside and inside horizontal spans are connected.

8. In apparatus of the class described, a series of horizontally elongated ovens arranged in substantial contiguity in longitudinal succession and each constructed to receive and to discharge the articles to be baked near the same point in its bottom and in substantially the same relative location in said bottom with respect to the succeeding oven, whereby the points of discharge of the respective ovens are longitudinally spaced from the receiving points of the succeeding ovens, and an endless conveyer arranged to carry the articles between and through said ovens and having horizontal spans between said ovens, said conveyer traveling in a double horizontal path through each oven.

9. In combination, a series of ovens in longitudinal alinement and provided with openings in their lower sides for charging and discharging, space being provided below said ovens and between the openings of adjacent ovens for applying protective coatings to metal objects moving continuously between said ovens, and conveying mechanism adapted to convey objects through each of said ovens and through said space.

10. In apparatus of the class described, in combination with an oven, conveying mechanism traveling in a closed path and comprising horizontal portions disposed vertically one above the other at four different elevations, the portions at the lower two of said elevations being located in a space at ordinary low temperature and the portions at the upper two of said elevations being located in said oven at a higher temperature.

11. In apparatus of the class described, a series of horizontally elongated ovens arranged in horizontal succession and each being constructed to receive and discharge the articles to be baked near the same point in its bottom and in substantially the same relative location in said bottom with respect to the other ovens, and an endless conveyer arranged to carry the articles between and through said ovens and having a horizontal receiving span at one end of the line of ovens and a horizontal discharging span at the other end.

12. In apparatus of the class described, a series of horizontally elongated ovens arranged in horizontal succession and each being constructed to receive and discharge the articles to be baked near the same point in its bottom and in substantially the same relative location in said bottom with respect to the other ovens, and an endless conveyer arranged to carry the articles between and through said ovens and having a horizontal receiving span at one end of the line of ovens and a horizontal discharging span at

the other end, said conveyer traveling in a double horizontal path through each oven.

13. In apparatus of the class described, an oven constructed to receive and discharge the articles to be baked near the same point in its bottom, said oven being horizontally elongated, and a conveyer for carrying the articles through said oven, said conveyer being arranged to carry the articles horizontally both through the lower part of said oven and through the upper part thereof.

14. In apparatus of the class described, a horizontally elongated oven constructed to receive and discharge the articles to be baked near the same point in its bottom, and a conveyer for carrying the articles to be baked through said oven, said conveyer being arranged to carry the articles through a horizontal path near the lower part of said oven at the beginning of their travel through said oven, and then through a horizontal path at the upper part of said oven, and again through a horizontal path near the lower part of said oven at the end of their travel through said oven.

15. In apparatus of the class described, a series of ovens arranged in horizontal succession and each being constructed to receive and discharge the articles to be baked through its bottom, and an endless conveyer arranged to carry the articles between and through said ovens, said conveyer having a horizontal span at each end of the line of ovens and having horizontal spans between successive ovens.

16. In apparatus of the class described, an oven constructed to be charged and discharged through its bottom, and separately controllable heating means arranged along the sides and along the bottom of said oven.

17. In apparatus of the class described, the combination with an oven constructed to be charged and discharged through its bottom, of means for moving articles to be treated continuously through said oven, heating means along the bottom of said oven, and separately controllable heating means along the sides of said oven for compensating for disturbances in the heat conditions of the oven due to heat loss to the articles and to movement of the articles through the oven.

18. In apparatus of the class described, the combination with a horizontally extended oven, of means for carrying articles to be treated in said oven along lower and upper horizontal paths in said oven, heating means along the bottom of said oven, and heating means along the upper path of travel of said articles.

19. In apparatus of the class described, the combination with a horizontally extended oven, of means for carrying articles to be treated in said oven first along a lower and then along an upper horizontal path

in said oven, heating means alongside the lower path of travel of said articles, and other heating means alongside the upper path of travel of said articles.

20. In apparatus of the class described, the combination with an oven constructed to be charged and discharged through its bottom, of means for moving articles to be treated continuously through said oven, and means for imparting heat of variable intensity to the air in said oven at different points along the path of travel of said articles.

21. In apparatus of the class described, the combination with a horizontally extended oven constructed to be charged and discharged through its bottom, of means for moving articles to be treated in said oven continuously in succession through said oven in lower and upper horizontal paths, heating means arranged to heat gradually the articles as they come into the oven and other heating means located along the upper path of travel of the articles through the oven for insuring the maintenance of a baking heat along said path.

22. In apparatus of the class described, an oven having an opening in its bottom through which the articles which are treated in said oven pass, means along the bottom of said oven for heating it, and a baffle arranged to direct air which enters the oven through said opening over the heating means along the bottom of said oven.

23. In apparatus of the class described, the combination with an oven constructed to be charged and discharged through its bottom and normally open at the points of charging and discharging, of means for moving articles to be treated through said oven and over said points of charging and discharging, means along the path of travel of the articles through the oven for imparting baking heat thereto, and means for deflecting the air entering said oven through the points of charging and discharging from that part of the conveyer over said point.

24. In apparatus of the class described, the combination with a horizontally elongated oven having juxtaposed charging and discharging openings in its bottom, of an endless conveyer for carrying articles to be treated continuously in succession through said oven, arranged to carry said articles along the lower part of said oven, then along the upper part, and again along the lower part, heating means in the lower part of said oven, baffles over said openings directing the incoming air over said heating means, and separately controllable heating means along the upper path of travel of the articles carried by said conveyer.

25. In apparatus of the class described, an oven having an opening in its bottom for the passage therethrough of articles which

are treated in said oven, means for heating said oven, and means communicating with said oven below the top thereof for conducting away the volatile products of the baking operation.

26. In apparatus of the class described, a horizontally extended oven having an opening in its bottom for the passage there-through of articles which are treated in said oven, and means communicating with said oven at different levels and spaced along the sides thereof for conducting away the volatile products of the baking operation.

27. In apparatus of the class described, a horizontally extended oven having an open-

ing in its bottom for the passage there-through of articles which are treated in said oven, and means communicating with said oven at different levels along the sides thereof for conducting away the volatile products of the baking operation, the conducting means of greatest capacity communicating with said oven near its bottom.

Signed at Detroit, Michigan this 5th day of March 1917.

JOHN F. DODGE.
HARRY C. ALLEN.

Witnesses:

ALFRED H. KNIGHT,
REGINALD J. FRY.