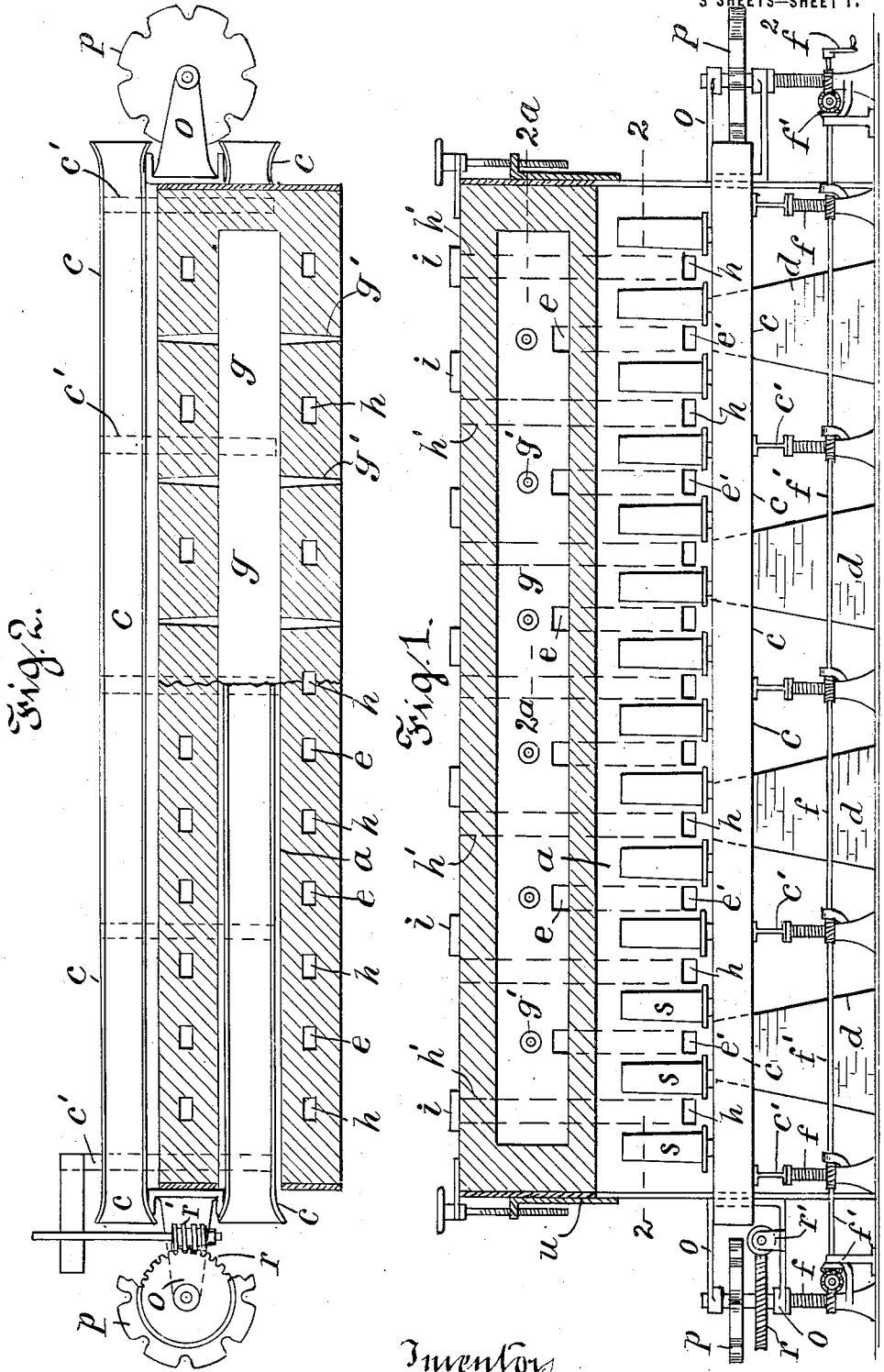


1,205,503.

Patented Nov. 21, 1916.

3 SHEETS—SHEET 1.



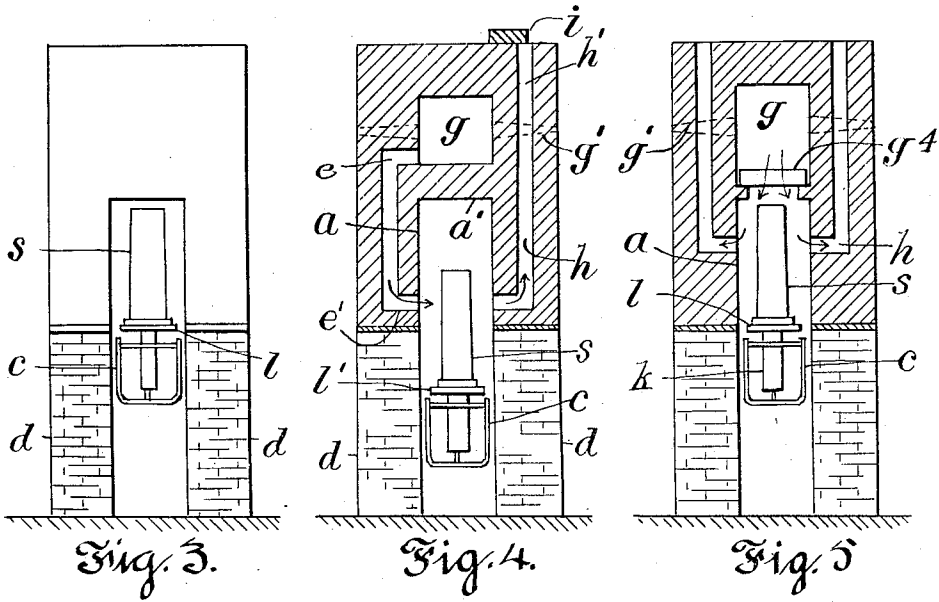
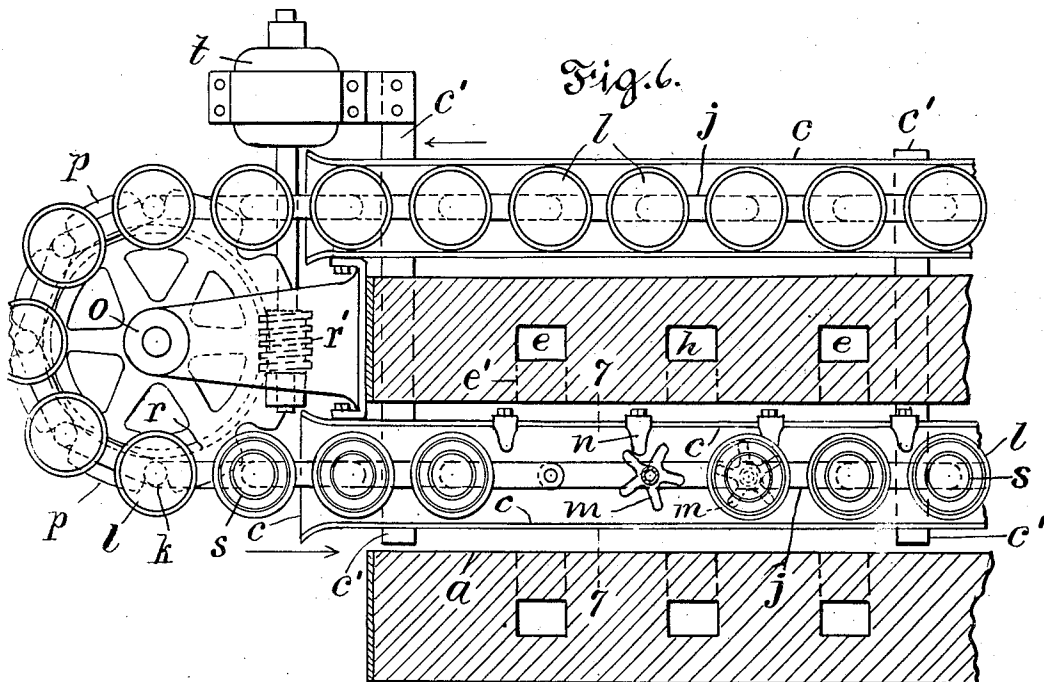
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C. D. BARNHART & W. H. JACOBI.
 CONTINUOUS HEATING FURNACE.
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 3 SHEETS—SHEET 2.



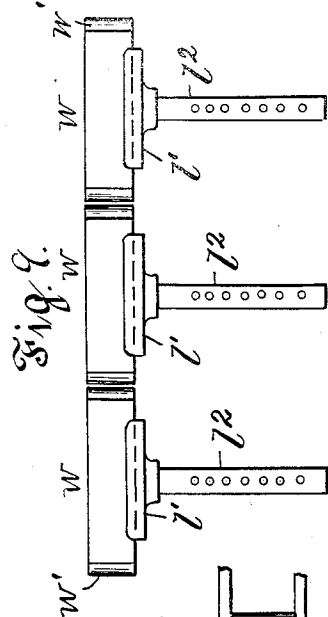
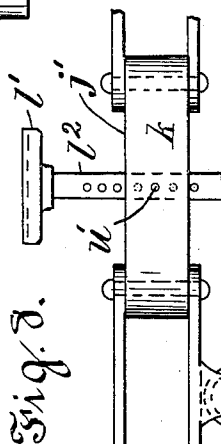
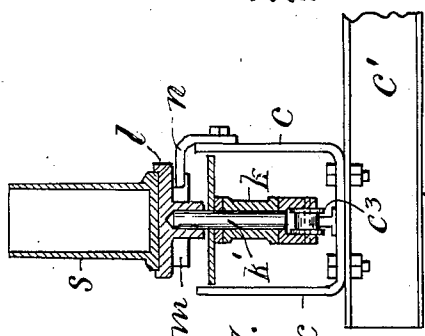
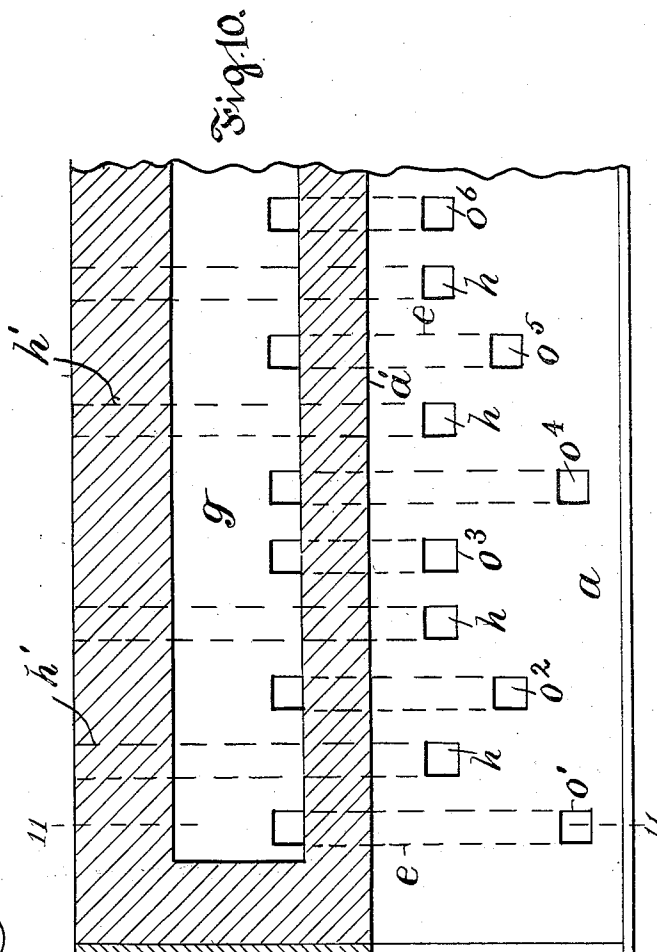
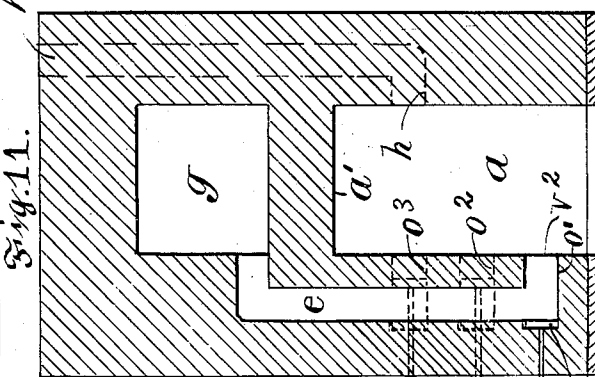
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3 SHEETS—SHEET 3.

1,205,503.



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UNITED STATES PATENT OFFICE.

CLARENCE D. BARNHART, OF BROOKLYN, NEW YORK, AND WILLIAM H. JACOBI, OF EAST ORANGE, NEW JERSEY, ASSIGNORS TO W. S. ROCKWELL COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY.

CONTINUOUS HEATING-FURNACE.

1,205,503.

Specification of Letters Patent.

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Application filed December 17, 1915. Serial No. 67,340.

To all whom it may concern:

Be it known that we, CLARENCE D. BARNHART, residing at 550 Eastern Parkway, Brooklyn, borough of Queens and State of New York, and WILLIAM H. JACOBI, residing at 284 North Maple avenue, East Orange, county of Essex and State of New Jersey, both citizens of the United States, have invented certain new and useful Improvements in Continuous Heating-Furnaces, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

This invention relates to a means of treating a series of similar articles to heat the whole or a portion only of each article.

The invention is especially applicable to the heating of hollow shells or articles of steel, copper, or brass to anneal one end of the same to facilitate some subsequent mechanical treatment, as flanging, or drawing the tube of the article to a greater length. Such treatment is practised in the manufacture of cartridge cases by drawing the same into tubular form from a flat disk of brass. Such drawing operation is performed in a succession of steps each of which lengthens the tubular portion of the case and diminishes the thickness of such portion. Such drawing operation condenses the metal so that it is necessary to anneal it before it can be drawn again. In making such cases it is often necessary that the base should be unaffected by the heat, while the body or a portion thereof which is to be drawn is heated sufficiently to anneal it, or a portion of the open end only is heated to facilitate the tapering of such end. The means for heating a portion of such an article may be used in such operations as annealing, tempering, hardening, coloring, and in some cases drying or baking such portion of the article. Heretofore, the partial heating of such shells has been effected chiefly by directing gas-flames (which ordinarily have a temperature of about 2000 F.) against the portion to be heated while rotating the shell, and as the article at times requires no heat exceeding 900 F., great risk is incurred of injuring the metal, as the flame is so much hotter than the tem-

perature desired, and a slight over-exposure to such temperature results in burning or injuring the metal. Such injury is less likely to occur if the metal is very thin, as the heat is readily conducted through it, but where the thickness of the casing is considerable and the conduction is therefore slower, the outer portion of the metal may be burned before the inner portion attains the desired temperature. Such treatment is, in a sense, like the tempering of a safety razor blade in an electric arc. The use of skilled labor is also necessary by the use of flames in this manner, and the waste of heat and fuel is costly, and the operation is unavoidably tedious because it cannot be hastened in any manner nor performed automatically.

It is the object of the present invention to furnish a means of automatically subjecting the article to be heated, to a corresponding temperature, so that the inner and outer sides of the hollow articles may be exposed for any length of time to such temperature without danger or injury, and the entire operation performed by mechanism so as to avoid the use of skilled labor, and also to greatly increase the quantity of the product and secure a perfectly uniform quality in the same. This object is attained by so constructing a furnace with a heating-chamber that a heated zone may be maintained in the top of said chamber, and a series of the articles may be successively propelled through the chamber with the whole or a portion of each article projected into such heated zone.

If gas, oil or other fuel, which burns at a relatively high temperature, be used to secure the heat, the heated gases are suitably reduced in temperature and delivered to the heated zone at such a temperature as to wholly avoid the possibility of overheating the articles.

The heating-chamber is formed with an open bottom and this feature, as well as the means used to dispose the heated gases within the top of the heating-chamber, and downward therein to a certain limit to form a zone of the desired depth, distinguishes our construction fully from any furnace in which the same temperature is desired throughout the entire chamber; to effect

which the heated gases are distributed to produce that particular result. The carrier or conveyer for moving the articles through the chamber would thus occupy a cooler zone in the chamber, and the carrier and heated zone can be so adjusted vertically in relation to one another that only the portion of each article which requires the heat may be projected upward into such zone.

19 The carriers, or the articles upon the carriers may be partially and intermittently rotated while moving through the chamber, so as to expose the same uniformly to the action of the heated zone.

15 The conveyer is preferably made endless, and carried around horizontally disposed pulleys at opposite sides of the furnace, so that one member of the conveyer may carry the articles through the furnace, while the other member is movable along the side of the furnace, which greatly facilitates the loading and unloading of the conveyer.

25 With a lesser number of operators, such a furnace can heat, anneal or otherwise treat a greater number of articles in the same period of time than could be treated by hand with gas-flames.

The invention will be understood by reference to the annexed drawing, in which—

30 Figure 1 is a longitudinal section through the center of the furnace with inlet-passages to the heating-chamber from a superposed combustion-chamber; Fig. 2 shows in the left-hand half a section on line 2—2 in Fig. 1 and in the right-hand half a section on line 2^a in Fig. 1; Fig. 3 is an end view of the furnace; Fig. 4 is a vertical section of the furnace-body taken on its left side through the inlet *e* and upon its right side through the flue *h*; Fig. 5 is a section of the body of the furnace with an alternative construction for the combustion and heating-chambers; Fig. 6 is a plan upon a larger scale of the left-hand end of Fig. 2; and Fig. 7 is a section on line 7—7 in Fig. 6; Fig. 8 shows an alternative means of adjusting the carriers vertically upon the conveyer-links; Fig. 9 shows a modified form of carrier; Fig. 10 and Fig. 11 show a means of adjusting the depth of the heated zone in relation to the carrier.

In Figs. 1 and 4, the furnace is shown with an elongated narrow heating-chamber *a*, which is open at the bottom to admit a conveyer which is supported in a trough *c*. The body of the furnace is supported upon piers *d* and the troughs *c* are supported adjustably upon jack-screws *f* connected by gearing *f'* so that all the screws may be rotated simultaneously by a crank *f*², and the trough with the conveyer, and driving-gear of the conveyer, may be adjusted vertically in relation to the heated zone. Above the heating-chamber is a combustion-chamber *g* supplied with gas-burn-

ers *g'*, and passages *e* lead the heated gases from the combustion-chamber to inlet-flues *e'* in the side-walls of the furnace at a suitable distance below its top *a'*, to form a heated zone between the inlet-flues *e'* and such top. Outlet-flues *h* are shown extended through the side-walls of the heating-chamber at the same level as the inlet-flues *e'* and are shown open to the atmosphere at *h'* upon the top of the furnace. Dampers *i* are shown applied over the outlet-flues of the heating-chamber.

It is evident that, with the construction shown, a heated zone may be maintained above the bottom edges of the inlet-flues *e'*, while the space below such heated zone is only heated in a slight degree, and would not therefore injure a conveyer having carriers to move the articles with more or less of their bodies projecting into the said zone.

The conveyer is shown as a chain formed with long links *j* at the junction of which bearings *k* and studs *k'* are sustained for rotatably supporting the carriers *l*, each carrier having a toothed wheel *m* thereon, the teeth of which are successively pushed by studs *n* upon one side of the trough *c* where it lies within the heating-chamber so as to gradually turn the carriers as they move through the chamber. This secures a uniform effect of the heat on the articles. The under side of the chain is furnished at intervals with grooved wheels *c*³ which run upon a rail in the bottom of the trough *c*, as shown in Figs. 7 and 8.

In Fig. 1, the trough *c* within the heating chamber with the conveyer is shown raised so that the carriers are near the level of the inlets, and the whole of the article *s* upon the carrier would thus be exposed to the heated zone; but in Fig. 4 the conveyer is shown lowered by turning the screws *f* so that only the upper third of the cartridge shell *s* is heated by projection into the heated zone. Such adjustable relation of the carriers to the heated zone permits the operator to adapt the furnace for heating more or less of an article, as may be required.

Figs. 1, 4, 6 and 7 show the means for supporting and adjusting the troughs which carry the conveyer, such troughs being connected by cross-bars *c'* which, when elevated by the jack-screws, raise the troughs and conveyer uniformly. The end cross-bars carry upright bearings *o* for the horizontal guide-wheels *p* around which the loops of the conveyer turn at opposite ends of the furnace, and a jack-screw is provided beneath each of these bearings, and connected to the gearing *f'*.

One of the conveyer-wheels may be turned by suitable gearing, as the worm-wheel *r* and worm *r'*; which latter is shown in Fig. 6 driven by an electric motor *t* which is

movable with the adjustable parts. By a flexible electric connection, the motor may operate the conveyer when the same is raised and lowered to different levels.

5 That member of the conveyer which lies at one side of the conveyer-wheels traverses the heating-chamber, and the other member passes by the outer side of the heating-chamber, as shown in Figs. 2 and 6, which
10 fully exposes the carriers to the operators, for placing the articles thereon and removing them therefrom. A table would be placed adjacent to the outer member of the conveyer, on which the articles may be
15 placed for application to and removal from the carriers. As it may take several minutes for the articles or carriers to traverse the furnace, this arrangement affords ample opportunity for a very few operators to keep
20 the furnace charged, and to remove the articles discharged from the heating-chamber.

Where the greater part of each article is to be immersed in the heated zone, the inlet-flues e' for the heated zone may, as shown
25 in Figs. 1 and 4, enter the heating-chamber quite near its bottom, the zone between such inlets and the top a' of the chamber being then adapted to receive the greater portion
30 of the article, the conveyer having the same adaptability to support more or less of the article in such a zone, as when the zone is of less depth.

Instead of introducing heated gases from inlet-flues at the sides of the heating-chamber, as in Fig. 4, the gases may be introduced through the top of the heating-chamber, as in Fig. 5, where the bottom of the
35 combustion-chamber g is shown formed of fire-bricks g^4 laid with slight interspaces, to permit the products of combustion to enter directly into the top of the heating-chamber. The depth of the heated zone is then
40 determined by the location of the outlet-flues, which are shown much nearer to the top of the heating-chamber than in Fig. 4, thus forming a heated zone of much less
45 depth, than that in Fig. 4. Such construction is especially suitable where the furnace is used chiefly for heating only a small portion upon one end of the article, which
50 would be moved with the carrier at a suitable level to hold such end in the heated zone.

The heat may be prevented in some measure from escaping at the ends of the furnace, by gates or doors u movable downward upon
55 the ends of the furnace to any desired distance below the top line of the heating-chamber, as shown in Fig. 1. The lower
60 ends of such gates confine the heated gases within the furnace for such distance below the top of the chamber and thus partially prevent their escape.

Some means of varying the relation of the
65 carrier to the level of the heated zone is re-

quired, if the same furnace be used to treat a variety of articles which require heating to a greater or less depth from the upper end, and it is obviously immaterial whether
70 such variations be obtained by altering the depth of the heated zone, or adjusting the carriers vertically upon the conveyer.

Fig. 8 shows a means of adjusting the carriers vertically without changing the level
75 of the conveyer-links, the carrier l' having a stem l^2 fitted movably to a socket in the chain-link j' . The stem is furnished with a series of transverse holes and can be sustained at any desired height upon the conveyer by sliding the stem upwardly in the
80 socket and supporting it in its adjusted position by a pin w' .

In Fig. 9, carriers analogous to those in Fig. 1 are shown, constructed on the top to receive fire-bricks w of suitable length to
85 form, in practice, a continuous fire-brick floor in the heating-chamber. The chain and links are not shown in the adjoining Fig. 8 as the carrier l' and its stem l^2 have precisely the same relation as the carrier l'
90 and the stem l^2 of Fig. 9. The ends w' of the bricks fit nearly against one another and would be rounded off from the center of the carrier so as to avoid interference of the
95 bricks' corners when the carrier turns about the guide-wheels.

Figs. 10 and 11 show a means of varying the vertical relation of the inlet-passages to the conveyer instead of varying the height
100 of the conveyer, as in the constructions previously described. Fig. 10 shows a longitudinal section of one end of a heating-chamber, and Fig. 11 a cross section of the same on line 11—11 in Fig. 10. Fig. 10
105 shows six inlets o' , o^2 , l^3 , o^4 , o^5 , o^6 formed with pairs at different levels, all connecting with the combustion-chamber g . Outlets h are formed between the inlets at a suitable level. Each of the inlet-openings in the wall
110 of the heating-chamber is provided with a movable plug v which, as shown in Fig. 11, is movable by a hand-rod v' , to be pushed forward to close the inlet, as indicated in dotted lines. Successive groups of inlets
115 like those shown in Fig. 10 are formed within the length of the heating-chamber, and the bottom limit of the heated zone may be determined or located at the level of any of these inlets by pushing the plugs v into
120 all the other inlets of a different level, thus discharging the heated gases into the chamber at the level desired for the bottom of the heated zone. The heated gases naturally
125 rise from such level and escape by the outlets h . It is thus evident that the furnace can be adapted for heating any portion of an article which is sustained upon the carrier in its passage through the furnace, as the relation of the carrier and the heated zone can be varied in the construction of the
130

carrier or in the construction of the heating-chamber.

The heat obviously cannot be wholly confined to the heated zone, as it is radiated and absorbed by the walls of the heating-chamber; but in our furnace the heat outside of the heated zone is not of the temperature required to operate upon the articles, and we are therefore able to determine the extent of operation upon the articles by projecting them more or less into the region of definite temperature. We have shown means which, in practice, operate to limit a heated zone to a certain region in the top of the heating-chamber.

From the above description it will be seen that the invention includes means for heating a zone in the upper part of a heating-chamber provided with a conveyer for successively carrying a series of articles through the chamber parallel with the heated zone, and any desired portion of such article projected uniformly into the heated zone throughout such movement. Also a special arrangement of an endless conveyer by which the loops at its ends turn horizontally around guide-wheels at opposite ends of the heating-chamber, and one member of the conveyer moves through the chamber while the other moves at the same level along the outer side of the chamber, where it can be readily loaded and unloaded.

The mounting of the endless conveyer upon horizontal guide-wheels having a substantially upright axis affords the greatest possible opportunity for loading and unloading the conveyer with the shortest possible length of conveyer, as one-half of the conveyer can be constantly exposed for loading and unloading. It also avoids the inversion of that portion of the chain which is not in the heating-chamber, as occurs when the loops of the chain are mounted upon vertical wheels having a horizontal axis. My arrangement thus avoids the necessity of fastening to the conveyer any carriers or other seats carried by the conveyers, as the same side of the conveyer-chain always remains uppermost and the carriers therefore retain their position entirely by gravity, and do not need any guards or casings to prevent them from dropping off the chain, as occurs when one-half of the chain is inverted. More than one-half of the whole length of the conveyer is therefore available for applying and removing the articles, and for cooling the same before they are removed from the carriers.

It will be seen in Figs. 7 and 8 that the conveyer chain and its attachments rest wholly upon the wheels c^3 which traverse the bottom of the trough and that the trough may be adjusted vertically, thus furnishing a means of varying the projection into the

heated zone of the articles carried by the conveyer.

Having thus set forth the nature of our invention what we claim herein is:

1. A furnace for heating, annealing, &c., having a heating-chamber extended horizontally and provided with means substantially as described for heating a horizontal zone less in depth than the said chamber within the top of the same, the chamber having an open bottom operating to disperse the gases below the heated zone, and an endless conveyer movable below the heated zone parallel with the same, and provided with carriers to receive the articles to be heated and transport them through the heating-chamber with a projection into the heated zone.

2. A furnace for heating, annealing, &c., having a combustion-chamber for supplying heated gases and a heating-chamber extended horizontally and open at the bottom and having inlet-flues connected with the combustion-chamber, the inlet-flues introducing the heated gases at the same level at different points through the side-walls of the heating-chamber and operating to form a heated zone above the level of such inlets, and the open bottom of the chamber operating to disperse the heated gases below the said inlet-flues and to form a cooler zone below the said inlets, and an endless conveyer movable below the said heated zone parallel with the same and carrying articles with more or less of their upper portions penetrating the heated zone.

3. A furnace for heating, annealing, &c., having a heating-chamber extended horizontally and having a depth materially greater than its width, means for heating a horizontal zone less in depth than the said chamber within the top of said chamber, such means consisting of a combustion-chamber delivering heated gases to the heating-chamber by means of inlet-flues in the side-walls of the chamber at the bottom limit of the said zone, and outlet-flues discharging the gases not lower than the said limit, and means for conveying a series of articles horizontally through the chamber with their upper ends extended into the said heated zone.

4. A furnace for heating, annealing, &c., having a heating-chamber extended horizontally and open at the bottom, means for heating a horizontal zone less in depth than the chamber within the top of the same, such means consisting of a combustion-chamber delivering heated gases to the heating-chamber by means of inlet-flues in the side-wall of said chamber at the level required to limit the depth of the said zone, and a conveyer having carriers for carrying a series of articles horizontally through the

chamber and the carriers adjustable vertically upon the conveyer to vary the penetration of the articles into the said zone.

5 A furnace for heating, annealing, &c., comprising a heating-chamber, means for heating a zone within the said chamber, comprising several series of inlets for introducing heated gases into the chamber at different levels to vary the bottom limit of
10 the zone, outlets to discharge the heated gases not lower than the said limit and means movable below the heated zone for conveying a series of similar articles through the chamber parallel with the said
15 zone, and penetrating into the same.

6. A furnace for heating, annealing, &c., comprising a heating-chamber, means for heating the heating-chamber from above to form a heated zone in the upper part of the
20 heating-chamber, and means movable in the heating-chamber under the said zone for conveying a series of articles through the heating-chamber with a penetration into the heated zone.

25 7. A furnace for heating, annealing, &c., comprising a heating-chamber, means for heating the same, and a conveyer having a series of carriers, and guide-wheels with substantially upright axles at the ends of
30 such conveyer, one member of the conveyer carrying a series of articles upon the carriers through the said chamber, and the other member being movable at one side of the said heating-chamber and carrying articles
35 upon the carriers in readiness to enter the chamber.

8. A furnace for heating, annealing, &c., a series of similar articles, comprising a heating-chamber open at both ends, means
40 for heating a horizontal zone in the said chamber, an endless conveyer having one member movable through the said chamber and the other movable along the outer side of said chamber to facilitate the loading and
45 unloading of the conveyer, and carriers

upon the conveyer arranged and operated to sustain the articles to be heated with their upper portion projected into the heated zone.

9. A furnace for heating, annealing, &c., 50 comprising a heating-chamber, means for heating a horizontal zone in the top of said chamber, an endless conveyer having an inner member movable through the said chamber parallel with the heated zone, and the 55 other member movable at the same level at one side of said chamber, and non-invertible carriers upon the conveyer arranged and operated to receive the articles upon the outer member, and transport the articles to 60 be heated through the heating-chamber with a projection into the heated zone.

10. A furnace for heating, annealing, &c., comprising a heating-chamber, an endless conveyer-chain having an inner member 65 movable through the said chamber and an outer member movable at the same level along the outer side of said chamber, carriers supported rotatably upon the chain 70 for carry the articles to be heated, and means for intermittently rotating the carriers in their movement through the chamber.

11. A furnace for heating, annealing, &c., comprising a horizontally extended heating-chamber with a heated zone maintained in 75 the upper part of the same, an endless conveyer-chain having one member movable through the said chamber and the other member movable along the outer side of said chamber, a trough fitted beneath each of said 80 members, rolls upon the conveyer-chain resting upon the trough, means for rigidly connecting the trough beneath both of the members, and means for raising and lowering the trough to vary the relation of the 85 conveyer to the heated zone.

In testimony whereof we have hereunto set our hands.

CLARENCE D. BARNHART.
WILLIAM H. JACOBI.