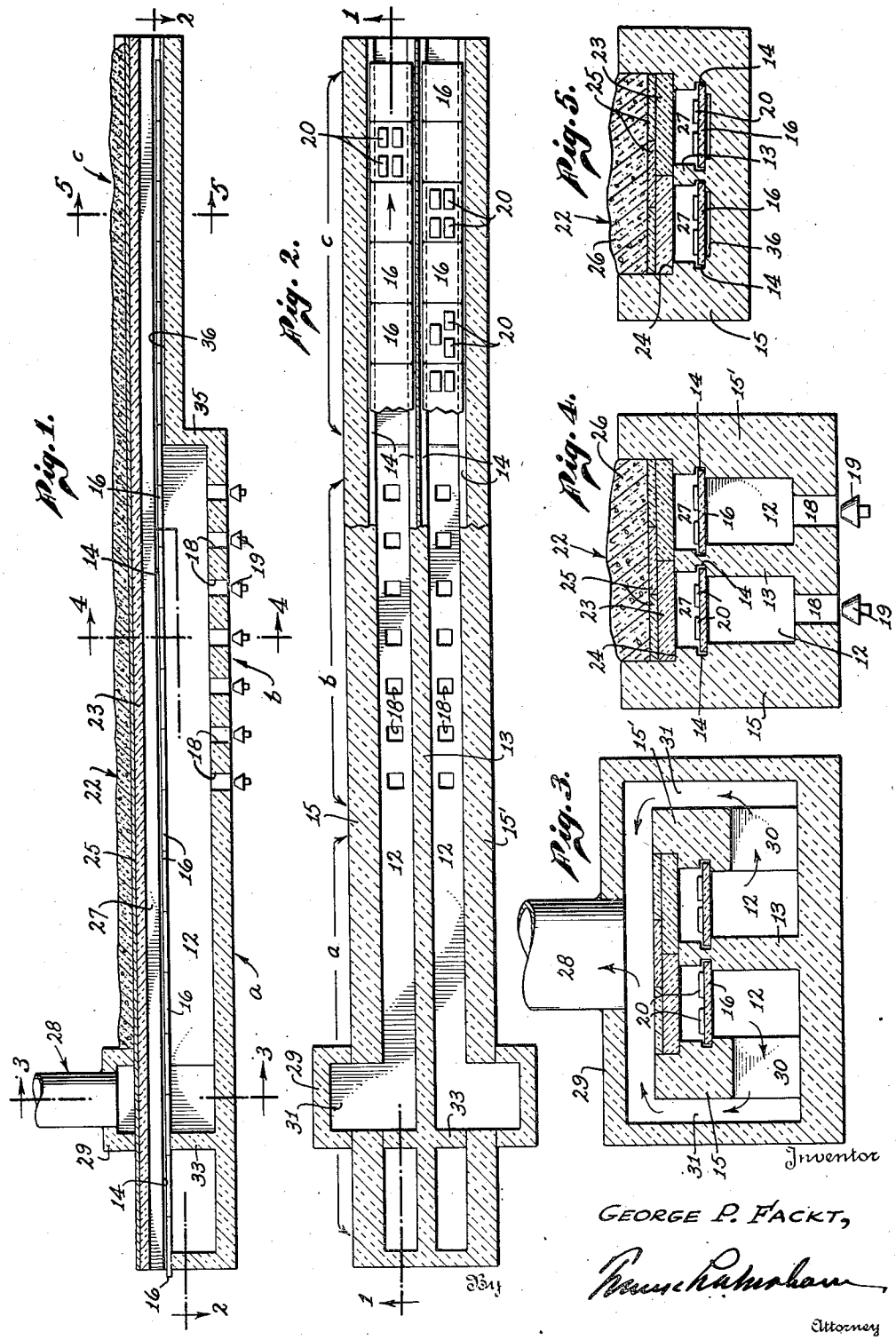
Sept. 24, 1940. G. P. FACKT 2,215,581

KILN

Filed Feb. 28, 1939 2 Sheets-Sheet 1



Sept. 24, 1940. G. P. FACKT 2,215,581

KILN

Filed Feb. 28, 1939 2 Sheets-Sheet 2

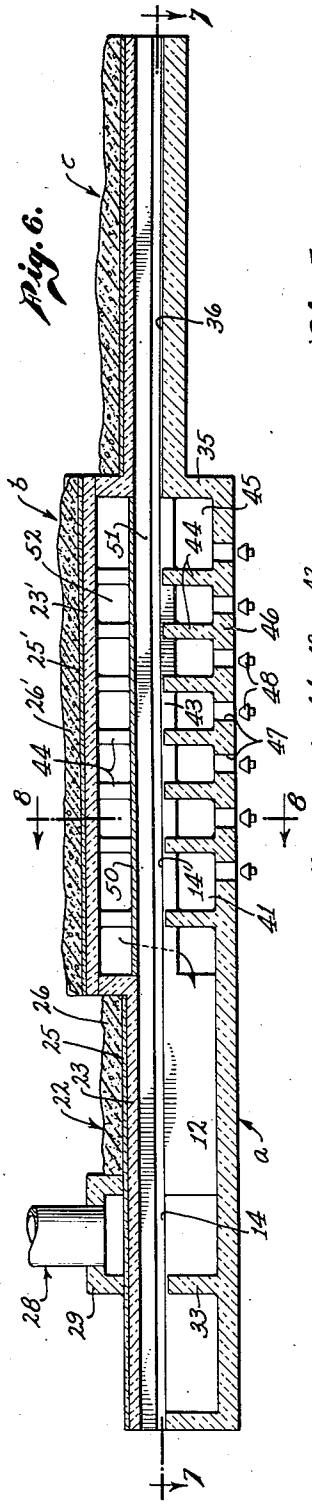


Fig. 6.

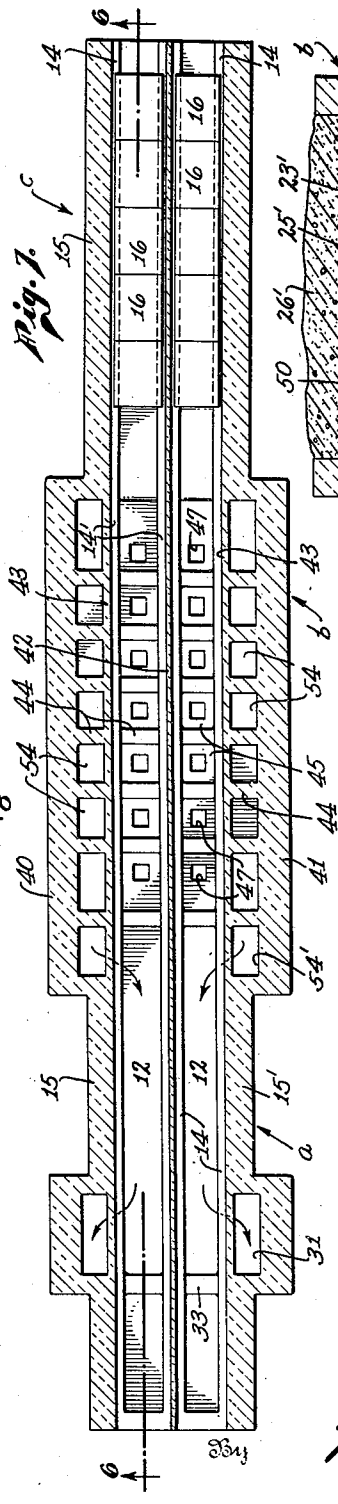


Fig. 7.

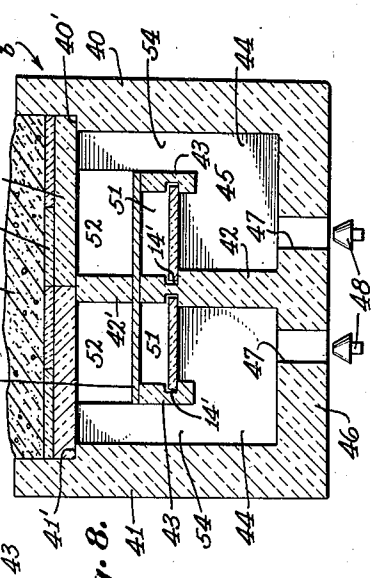


Fig. 8.

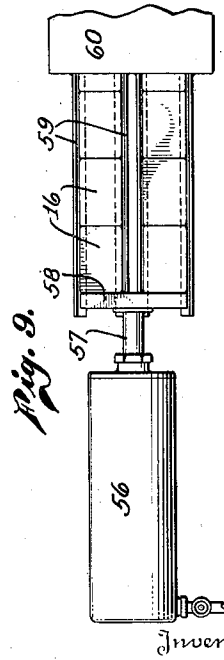


Fig. 9.

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Patented Sept. 24, 1940 2,215,581

UNITED STATES PATENT OFFICE

2,215,581

KILN

George P. Fackt, Palos Verdes Estates, Calif.

Application February 28, 1939, Serial No. 258,978

14 Claims. (Cl. 263—28)

My invention relates to tunnel muffle kiln structures of the type in which conveyor slabs or plates are placed end to end and pushed through the kiln, such slabs supporting the articles or product to be fired in the kiln without contacting said product with combustion gases.

In tunnel kilns of the class described as commonly constructed, the slabs or plates used for supporting the product are supported on a continuous stationary floor of fire brick or other refractory material under which there is a heat passageway or flue. The heat passages of the kiln are supplied with heat from oil or gas burners placed along the sides of the kiln with the flames directed laterally under the muffle and around the sides thereof. With this construction it is impracticable to employ more than two tunnels or muffle passages in the kiln and obtain an accurately controlled, sufficient heat transference throughout. If the burners were disposed beneath the muffles the stationary floor of the muffles would impede the passage of heat and materially slow up the firing of the product.

Among the objects of my present invention is the provision of a tunnel kiln of the class described of compact form in which the heat is applied more directly and evenly to the product being fired and in which the firing operation can be completed in much shorter time than with the kilns commonly used. It is also an object of this invention to provide a construction wherein any number of tunnels or muffle passages may be used successfully and still achieve the desired heat transference in each tunnel.

It is a particular object of this invention to provide a kiln of the tunnel type in which the slabs or plates carrying the product form a movable floor through the tunnel against the underside of which the heat from the burners is directed, the burners being arranged at intervals under the kiln and directed upwardly toward the underside of the slabs supporting the product to be fired.

In the ordinary tunnel kilns in which slabs or plates are used for supporting the product the line of plates may buckle upwards under the force necessary to push it through the kiln thereby upsetting the product thereon and causing choking of the kilns. It is also true that the floor upon which the plates ride in the ordinary construction becomes uneven and impedes the movement of the plates causing jambing and choking of the kiln and also causing breaking of the slabs where heavily loaded. It is a further object of my invention to overcome these disadvantages by forming tracks or guides for the side portions of the plates in the walls of the kiln. The upper part of the tracks or guides extend over the side portion adjacent the edges of the plates thereby preventing the plates from buckling or otherwise getting out of the desired horizontal plane.

Other objects and advantages will appear hereinafter from the following description and drawings.

Referring to the drawings which are entirely diagrammatic and for illustrative purposes only:

Fig. 1 is a longitudinal sectional elevation of a kiln embodying a form of my invention. The section is indicated on line 1—1 of Fig. 2.

Fig. 2 is a sectional plan view on line 2—2 of Fig. 1;

Fig. 3 is an enlarged cross sectional elevation on line 3—3 of Fig. 1 taken through the heating up zone;

Fig. 4 is an enlarged cross sectional elevation on line 4—4 of Fig. 1 taken through the hot zone;

Fig. 5 is an enlarged cross sectional elevation on line 5—5 of Fig. 1 taken through the cooling zone;

Fig. 6 is a longitudinal sectional elevation through a kiln illustrating another form of my invention. The section is indicated on line 6—6 of Fig. 7.

Fig. 7 is a sectional plan view on line 7—7 of Fig. 6;

Fig. 8 is an enlarged cross sectional elevation on line 8—8 of Fig. 6 taken through the hot zone of such kiln; and

Fig. 9 is a diagrammatic plan view of the feed end of the kiln showing a form of pusher for the slabs.

Referring particularly to Figs. 1 to 5 inclusive, the tunnel kiln shown is of the type in which two product receiving tunnels or passages are arranged side by side, it being understood, however, that either a single or a greater number of passages may be provided in the same structure. In the figures, *a* designates the feed end of the kiln or the heating-up zone, *b* designates the intermediate portion or hot zone, and *c* designates the delivery end or cooling zone.

Extending throughout the kiln are two tunnels or passages generally indicated by reference numeral 12. These tunnels are relatively deep throughout the heating-up and hot zones and relatively shallow throughout the cooling zone. In the tunnels longitudinal recesses or guide channels 14 are formed in the side walls 15 and 15′ of the kiln and in the sides of a central wall 13 which are designed to receive and support the

heat-conductive refractory plates or slabs 16 arranged to be engaged by each other at their respective front and rear ends throughout the kiln thereby forming a movable floor and support for the product to be fired in the kiln.

It is understood that the product is placed on successive slabs inserted at the feed end of the kiln and any suitable mechanism for engaging the end of the last inserted slab is used for pushing the slabs progressively through the kiln. With the above described construction, due to the fact that only a very small proportion of the area of the undersurface of the slabs is in frictional contact with the recesses or guide channels 14 in the tunnels 12, it requires much less force to push the slabs through the kiln than in the ordinary kilns in which the slabs lie upon a floor in contact therewith throughout their entire lower surfaces. The construction embodying the recesses or guide channels 14 also serves to keep the end edges of the slabs in alignment and prevents successive slabs from buckling upward and overlapping as they are pushed through the kiln. In other words, the slabs forming a movable floor through the tunnels are kept in a horizontal plane at all times and cannot be pushed up on end.

In the hot zone B the kiln is provided with a plurality of openings 18 extending through the bottom of the kiln. Each such opening 18 is provided with a gas or oil burner 19 or other suitable heat producing means. The heat produced is directed upwardly against the bottom of the slabs.

In the forms shown the kiln is particularly designed for the purpose of firing tile, indicated at 20, on the slabs 16. Reference numeral 22 generally designates the top of each tunnel or passage 12 which is disposed comparatively close to the slabs forming the movable floor. This ceiling or top may be made in any suitable manner, however in the present instance, I have employed two slabs 23, one over each tunnel, supported on the wall 13 and on ledges 24 on the side walls 15 and 15' of the kiln. Upon the slabs 23 are thin slabs indicated at 25 upon which is placed any desired heat insulating material 26.

With the construction above outlined, it can be seen that the tunnels or passages 12 are divided or partitioned by slabs 16 thereby providing a heat treating tunnel chamber 27 in the upper regions of each of the tunnels 12. The products 20 to be fired are thus protected from direct contact with the products of combustion and hot gases while at the same time adequate heat transference is obtained from the source of heat to the heat treating chamber.

In the zone *a* near the end of the kiln there is provided a stack 28 mounted in the top of an enclosing wall housing 29. In the region of this housing the kiln walls 15 and 15' are reduced in height and provided with apertures 30 which permit passage of the hot gases from the lower portion of tunnels 12 outwardly and upwardly through flue passages 31 and upwardly through stack 28. A cross partition wall 33 is provided to prevent escape of the gases through the entrance end of the kiln.

At the cooling or discharge end *c* of the kiln the slab supporting structure and the ceiling construction is the same as throughout the remainder of the kiln except that as previously described the tunnels 12 are of less depth than throughout the remainder of the kiln, the floor or bottom wall of the kiln being higher throughout the cooling zone beyond a wall portion 35 at the end of the hot zone. As shown in Figs. 1 and 5 the tunnels 12 are sufficiently deep to provide a depressed portion under the slabs as indicated at 36. This permits the slabs throughout the cooling zone to be supported solely on the shoulders of the guide channels 14.

In the form of the invention shown in Figs. 6 to 8, the kiln construction is the same as that of Figs. 1 to 5 for that much of the kiln forming zones *a* and *c*. Thus Fig. 3 is the same as a section would appear taken through the stack and flue structure of Fig. 6, and Fig. 5 is a true section through the zone *c* of Fig. 6. The intermediate or hot zone *b* of the kiln of Figs. 6 to 8, however, is constructed differently than in the other form of the invention and will be described in detail below.

Referring particularly to Figs. 6 to 8, the intermediate or hot zone *b* has outer wall sections 40 and 41 extending laterally beyond the wall portions 15—15'. Parallel to the outer wall sections is a wall 42 forming a continuation of wall 13 and having longitudinal grooves or guides 14' which form a continuation of the grooves 14 of wall 13. Intermediate the wall 42 and each side wall there is provided what will be termed a rail wall 43 which is provided with a longitudinal groove 14' forming a continuation of the respective grooves 14 of the walls 15 and 15'. Extending transversely of the kiln are a plurality of partition walls 44 which interrupt the lower portion of tunnels 12 and form a plurality of chambers 45. The walls 44 extend to within a short distance of the bottom of slabs 16. These partitions also extend upwardly outside of and above the top of the rail wall portions to shoulders 40'—41' in the wall sections 40—41. The floor or lower wall 46 of the kiln is provided with an opening 47 in the region of each compartment or chamber 45. Each opening is provided with a suitable burner 48 or other heat producing means.

A top closure 50 extends over the space between rails 43 and cooperates therewith and with the slabs 16 and wall 42 to form a pair of firing tunnels or tunnel muffles 51. Above the closure 50 are a pair of longitudinal flues 52 through which the products of combustion may pass to the tunnels 12 of warming up zone *a* and subsequently out through stack 32. Over the flues 52 are slabs 23', and 25', and heat insulation 26' which are supported on shoulders 40'—41' and wall section 42'. Outwardly of the rails 43 the partition walls 44 extend upwardly to the top wall members 23' as previously described and cooperate with the rails to form the passages 54 through which the products of combustion or hot gases must pass before reaching the flues 52. After reaching flues 52 the hot gases flow toward stack 28, passing down the last pair of vertical passages 54' and into the lower portion of tunnels 12 in the zone *a*. In this form of the invention the firing chamber is more completely surrounded by the heating flames and gases than in the other form of the invention.

In both forms of my invention as illustrated it is to be understood that I preferably use some simple form of pusher for moving the floor of slabs through the kiln. In Fig. 9 there is diagrammatically illustrated a fluid operated pusher comprising a cylinder 56, piston rod 57, which terminates at its inner end in a piston (not shown) and at its outer end in a cross-head 58. The cross-head is adapted to engage the outermost slabs 16 which ride in angle-iron tracks 59 mounted exteriorly of the kiln 60 and in registration with the channels 14 in the kiln. Sev-

eral slabs may be placed on the tracks 59 and all pushed in at once by the hydraulic means. Any suitable source of pressure fluid may be used for supplying the cylinder 56.

Although the invention has been illustrated and described as taking two principal forms it is not intended to limit the invention to the exact forms shown but it is intended to cover such changes and modifications as come within the claims.

I claim as my invention:

1. In a kiln having a tunnel therein; a floor supported at its side portions in said tunnel; said kiln having openings through the bottom thereof; and heat producing means at each opening directed upwardly toward the exposed under face of said floor.

2. In a kiln having a tunnel therein; said tunnel having a longitudinal groove in its side walls; a floor consisting of a series of movable slabs having their side edge portions extending into said grooves; means for imparting movement to said floor; a series of burners; and means for directing heat from the burners directly against the exposed underside of said floor; said kiln having a flue passage communicating with the region of the tunnel below said floor for conducting the gaseous products of combustion out of said kiln in isolation from the region of said tunnel above said floor.

3. In a tunnel kiln, wall means forming a tunnel muffle in said kiln, the wall means forming the sides of said muffle each having a longitudinal groove therein interiorly of said muffle; a plurality of plates mounted in said grooves, said plates being movable in said grooves to form a movable floor for said muffle; wall means forming a plurality of chambers beneath said floor; and means for applying heat in the region of each chamber against the undersurface of said floor; said kiln having flue means communicating with the individual chambers beneath said floor for conducting the gaseous products of combustion out of said kiln in isolation from the interior of said muffle.

4. In a tunnel kiln, wall means forming a tunnel muffle in said kiln, the wall means forming the sides of said muffle each having a longitudinal groove therein interiorly of said muffle; a plurality of plates mounted in said grooves, said plates being movable in said grooves to form a movable floor for said muffle; wall means forming a plurality of chambers beneath said floor; the wall means forming the bottom of said chambers having an opening for each chamber; heat producing means in the region of each of said openings adapted to direct heat against the undersurface of said floor; wall means forming a longitudinal flue over said muffle and forming a plurality of upwardly extending passages communicating with said chambers and said flue.

5. In a tunnel kiln, wall means defining the top and sides of two elongated muffles, the sides of said muffles each being provided with an internal longitudinal groove; a movable floor in each muffle comprising a plurality of slabs mounted in said grooves; means for directing heat against the undersurface of the respective floors; and wall means forming passages whereby said heat is caused to flow outwardly of the floors of said muffles and vertically up the outer sides of said muffles and longitudinally over the top of said muffles.

6. In a tunnel kiln, wall means defining the top and sides of two elongated muffles, the sides of said muffles each being provided with an internal longitudinal groove; a movable floor in each muffle comprising a plurality of slabs mounted in said grooves; wall means forming a plurality of chambers under each muffle; wall means forming a longitudinal flue over each muffle; wall means forming a plurality of upwardly extending passages at the sides of said muffles connecting the respective chambers with said flues; and means for directing heat against the undersurface of said floors.

7. In a tunnel kiln, wall means defining the top and sides of a plurality of elongated muffles, the sides of said muffles each being provided with an internal longitudinal groove; a movable floor in each muffle comprising a plurality of slabs mounted in said grooves; said kiln having a plurality of chambers under a portion of said floor and having upwardly extending passages leading from said chambers to longitudinal flues formed by the walls of said kiln over said muffles in the region of said chambers; said kiln having a longitudinal flue under said floor in a region of said kiln immediately beyond the region of said chambers and having a connecting passageway leading from each of said first mentioned flues to the respective last mentioned flues; and means for producing heat in the region of each of said chambers whereby hot gases are caused to flow against the undersurface of said floor, through said upwardly extending passages, through said first mentioned flues over said muffles, through said connecting passageways and through said last mentioned flues.

8. A kiln having a tunnel therein; a movable floor comprising a plurality of slabs slidably supported at their side edge portions in said tunnel adapted to support products to be fired, said floor dividing said tunnel into a heat treating tunnel chamber above said floor and a combustion tunnel chamber below said floor; and heat producing means communicating with said combustion tunnel chamber for directing heat upwardly against the undersurface of said floor; said kiln having flue means communicating with said combustion tunnel chamber for conducting the gaseous products of combustion out of said kiln in isolation from said upper heat treating tunnel chamber.

9. A kiln having a tunnel therein; a movable floor comprising a plurality of slabs arranged in abutting end to end relation; means formed in the side walls of said tunnel for supporting said slabs at their side edge portions and for preventing buckling of said slabs when said slabs are forced through said kiln; said floor being adapted to support products to be fired and serving to divide said tunnel into a heat treating tunnel chamber above said floor and a combustion tunnel chamber below said floor; and heat producing means communicating with said combustion tunnel chamber for directing heat upwardly against the undersurface of said floor; said kiln having flue means communicating with said combustion tunnel chamber for conducting the gaseous products of combustion out of said kiln in isolation from said heat treating tunnel chamber.

10. A kiln having a tunnel extending therethrough, said tunnel having a portion at one end of less depth than the remainder of the tunnel; a movable floor comprising a plurality of slabs slidably supported at their side edge portions in said tunnel adapted to support products to be fired, said floor dividing said tunnel into a heat

treating tunnel chamber above said floor, a combustion tunnel chamber below said floor in the region of the greatest depth of said tunnel, and a shallow tunnel chamber below said floor in the region of less depth of said tunnel; and heat producing means communicating with a part of said combustion tunnel chamber for directing heat upwardly against the undersurface of said floor; said kiln having flue means communicating with said combustion tunnel chamber at a point spaced from the portion of said tunnel of less depth for conducting gaseous products of combustion out of said kiln in isolation from said heat treating tunnel chamber.

11. In a kiln having a tunnel therein, a floor supported at an intermediate level in said tunnel for sliding travel therethrough and dividing said tunnel into an encased muffle above and a flue below whereby said floor forms an exposed ceiling for said flue; and heat producing means operative with and in said flue.

12. In a kiln having a tunnel therein, a floor supported at an intermediate level in said tunnel for sliding travel therethrough and dividing said tunnel into an encased muffle above and a flue below whereby said floor forms an exposed ceiling for said flue; and heat producing means including burners operating through openings in the bottom of said flue.

13. In a kiln having a tunnel therein, a floor formed of successive plates abutting end to end supported by tracks below and limiting guide means above for sliding travel through said tunnel, said floor dividing said tunnel into an encased muffle above and a flue below whereby said floor forms an exposed ceiling for said flue; and heat producing means operative with and in said flue.

14. In a tunnel kiln, wall means forming the top and sides of a tunnel muffle, a floor for said muffle cooperating with the top and sides to encase said muffle, means for supporting said floor for sliding travel through said kiln longitudinally of said muffle, said kiln having a chamber extending beneath said floor; and means for producing heat in said chamber.

GEORGE P. FACKT.