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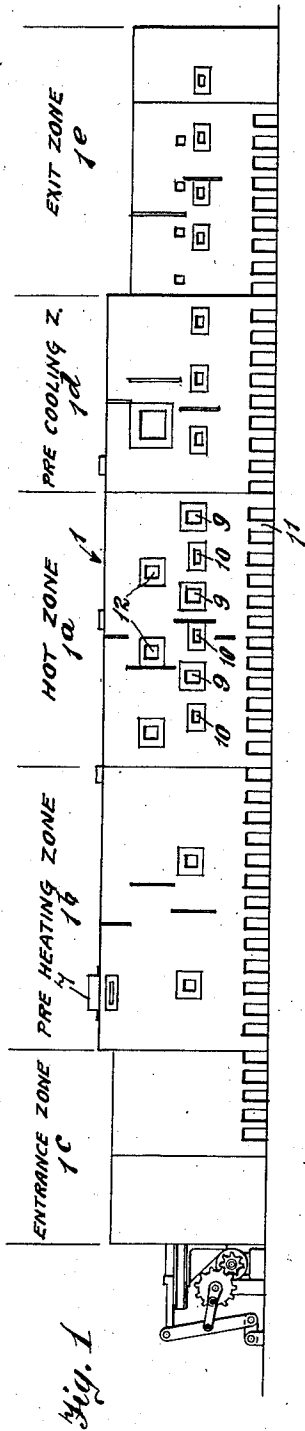
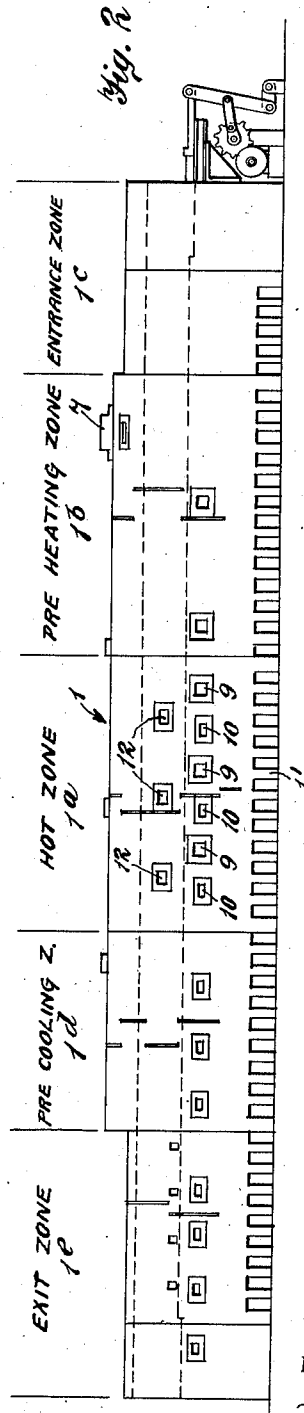
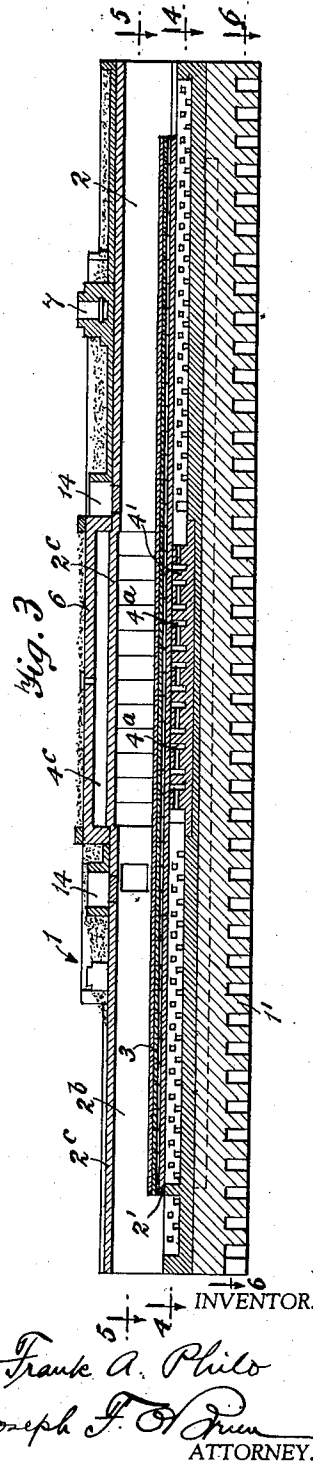
F. A. PHILO

2,132,831

TUNNEL KILN

Filed July 16, 1936

5 Sheets-Sheet 1



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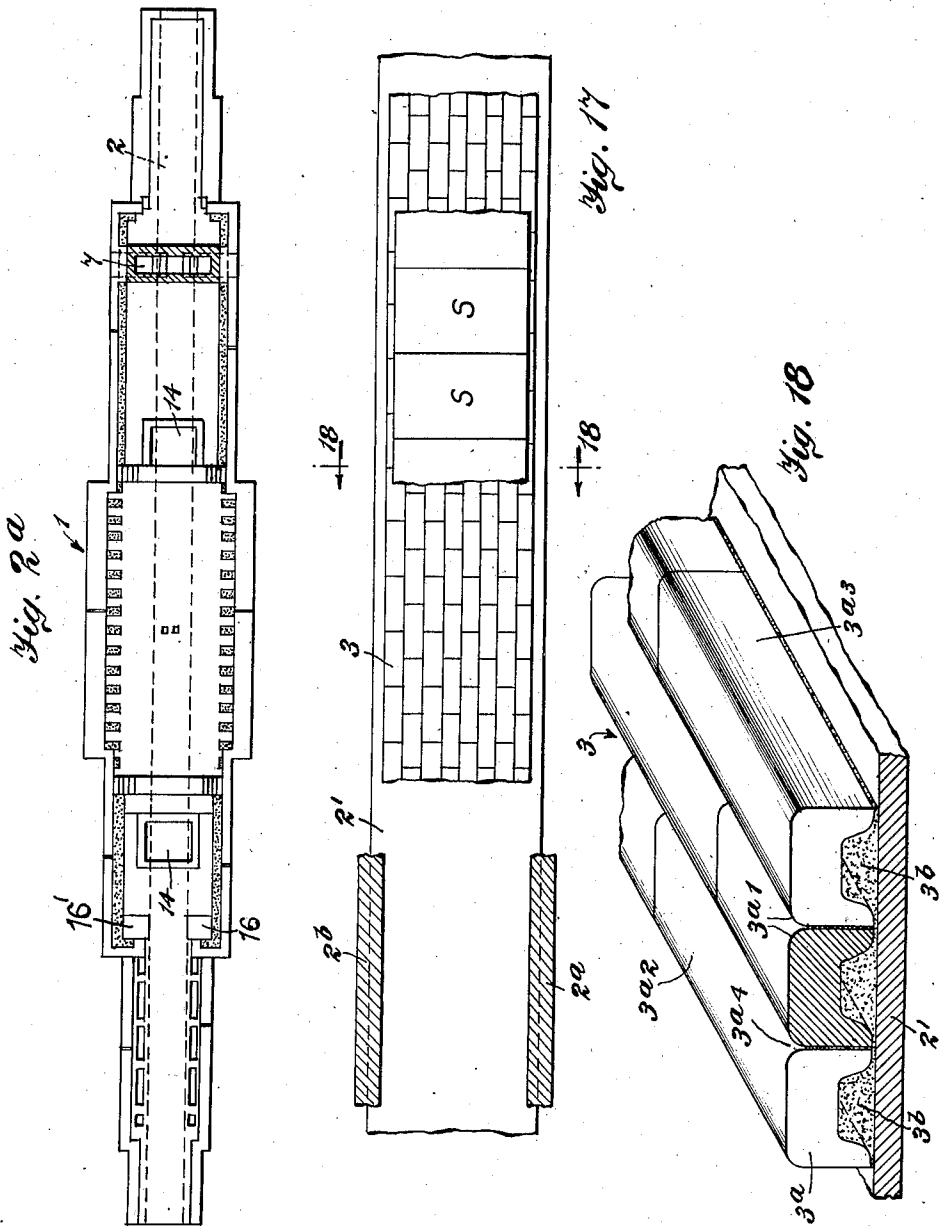
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2,132,831

TUNNEL KILN

Filed July 16, 1936

5 Sheets-Sheet 2



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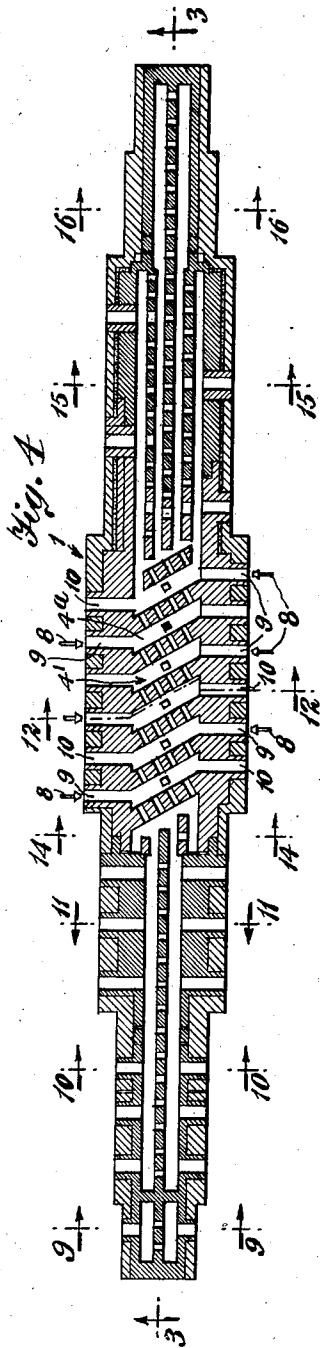
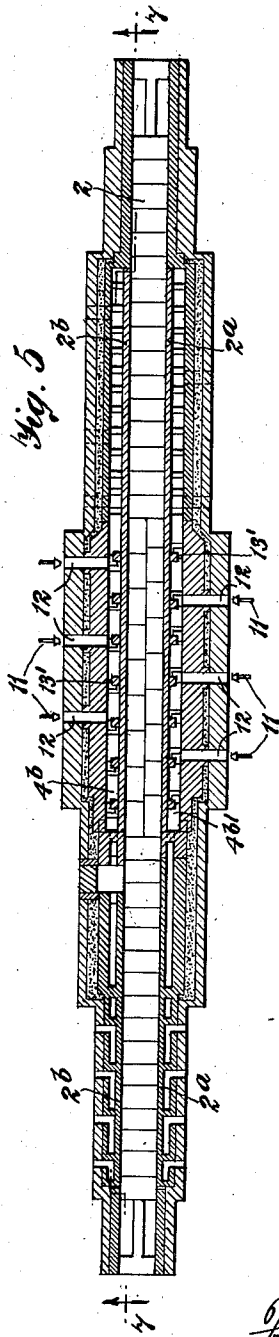
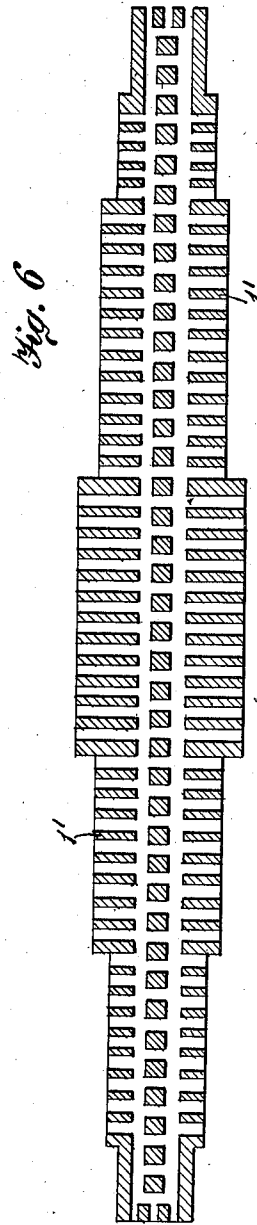
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TUNNEL KILN

Filed July 16, 1936

5 Sheets-Sheet 3



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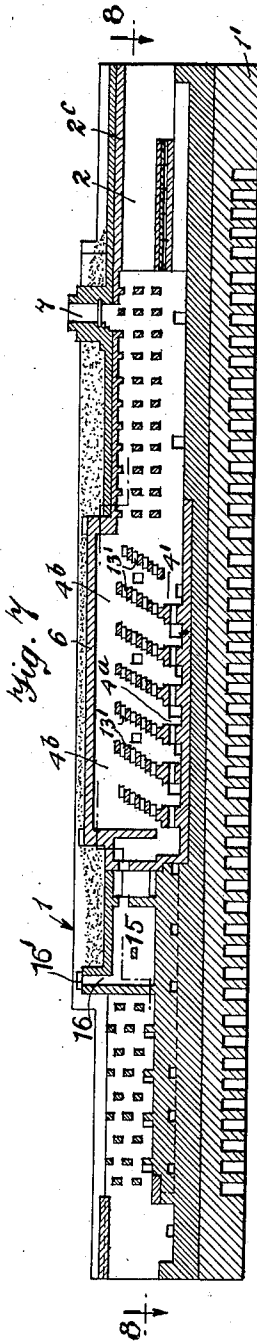
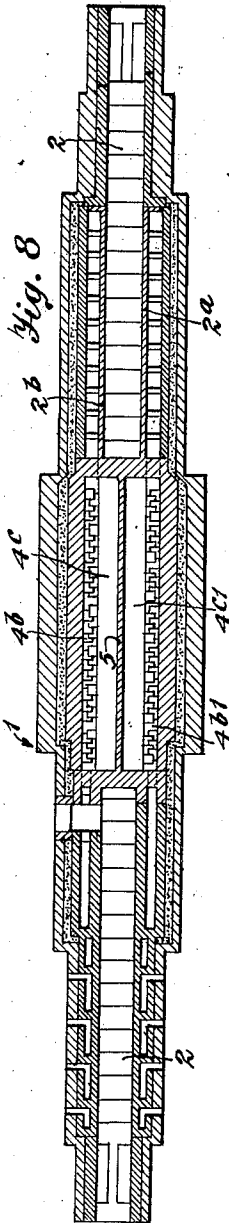
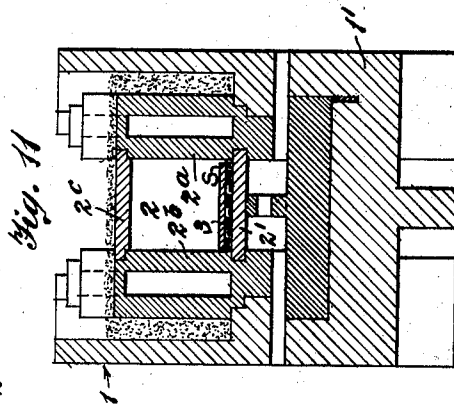
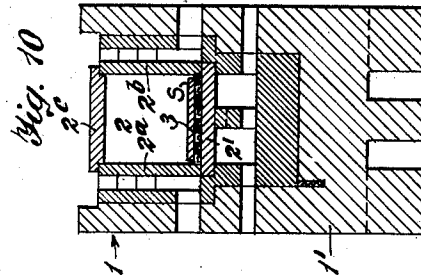
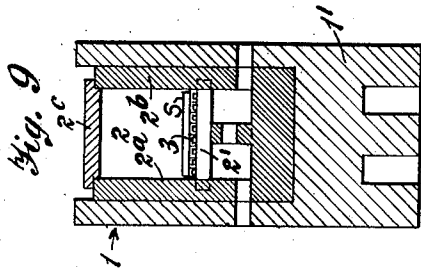
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2,132,831

TUNNEL KILN

Filed July 16, 1936

5 Sheets-Sheet 4



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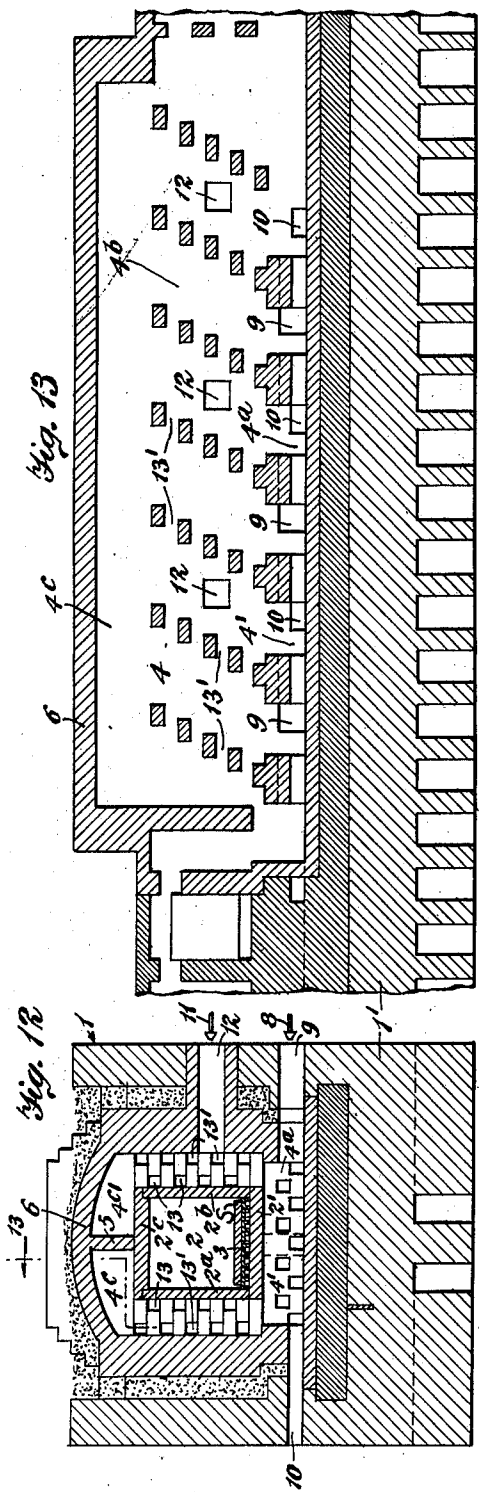
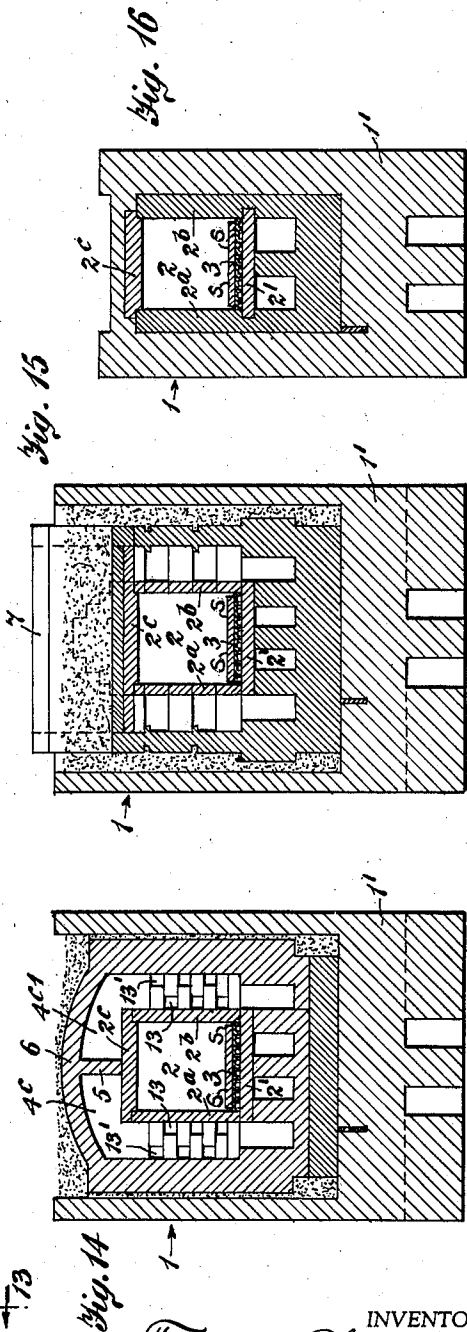
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TUNNEL KILN

Filed July 16, 1936

5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

2,132,831

TUNNEL KILN

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a corporation of California, and The Mosaic
Tile Company, a corporation of Ohio

Application July 16, 1936, Serial No. 90,902

17 Claims. (Cl. 25—144)

This invention relates to improvements in tunnel kilns.

One of the objects of this invention is to provide for a highly efficient application to a muffle or muffles of a greater range of temperatures than has heretofore been employed in conventional kilns of the type specified whereby wares requiring either high or low temperatures may be effectively fired and either glazed or unglazed ware, such as glost or biscuit tile, may be fired and matured on minimum time schedules for each type or class of ware and with equally good results.

Another feature of my invention is the provision in a muffle kiln of heat-applying means which will be capable of applying heat to fire wares at temperatures extending up to cone twelve, if desired.

Another object of my invention is to provide means to permit the application of the combustion gases while the said gases are at their peak or maximum temperature to an increased contact area and path of travel along the bottom and side walls of the muffle.

Another object of my invention is to utilize a more efficient method of applying the heat from the fuel-burners by dividing the muffle-contacting flue area into two sections preferably separated at the middle line of the top of the muffle by a longitudinal partition and thus forming at each side and top of the muffle separate or individual flues unconnected at the said top but extending separately along the sides and top of the muffle from the inlets thereof to the stack.

Another feature of my invention is the combination with such separate or individual flues of means for increasing the contact area and path of travel of the products of combustion along the bottom and sides of the muffle, and in the preferred form of my invention I provide for said products of combustion a horizontal bottom flue portion extending obliquely across the middle line of the muffle preferably in a direction toward the muffle entrance and opposite or counter to the direction of travel of the ware within the muffle, then I provide for said combustion products vertical side-flue members comprising separate flues extending obliquely across the middle lines of each of the opposite sides of the muffle preferably in the same direction and thereafter I provide for said combustion products separate top horizontally disposed flues extending in substantially straight longitudinal and parallel paths along the top of the muffle to the stack.

Another object of my invention is, in a kiln of the sliding-plate type, to provide a supplemental anti-friction surface, preferably comprising a stationary floor or track within the muffle

and having structural characteristics adapted to greatly reduce the friction which would normally be encountered in moving such plates through the conventional muffle.

Another object of my invention is to provide a track of the type specified which will have a tie or bond with the supporting member that will be strong and durable.

Another object of my invention is to provide, in a tunnel kiln of the type specified, an anti-friction surface and preferably a stationary supplemental floor or track having an anti-friction and anti-sticking surface which will enable ready sliding and will prevent the sticking of the movable slabs during sliding movement thereof through the muffle, thus preventing wrecks within the muffle resulting from such sticking of plates, it being understood that these movable plates or slabs are in continuous use; that they become fouled from glazed particles that drop off the tile during the firing of glazed ware thereon; that it is often necessary for the fireman to stop his propelling apparatus and to hold the plates stationary for a period of time to enable the reaching of a predetermined temperature, and that under these circumstances the fouled plate or slab has heretofore fastened itself to the floor bottom and when the plates are subsequently propelled has caused a wreck within the muffle.

Still another feature of my invention is the combination of a primary burner and a secondary burner communicating with each flue of the type specified at varying levels, the primary burner preferably being connected at the level of the horizontal bottom flue portion and the secondary burner communicating with the side flue portions of the flue intermediate the top and bottom of the muffle.

Still another feature of my invention is the provision of exhaust openings and air ports to provide additional heat control and cooling elements.

With these and other objects in view, the invention comprises the combination of members and arrangement of parts so combined as to co-act and co-operate with each other in the performance of the functions and the accomplishment of the results herein contemplated, and comprises in one of its adaptations the species or preferred form illustrated in the accompanying drawings, in which:—

Fig. 1 is a view in side elevation of one side of a kiln embodying my invention;

Fig. 2 is a similar side elevation of the opposite side of the kiln;

Fig. 2^a is a plan view of the said kiln;

Fig. 3 is a vertical longitudinal section on the line 3—3 of Fig. 4, looking in the direction of the arrows;

Fig. 4 is a horizontal section substantially on the line 4—4 of Fig. 3, looking in the direction of the arrows;

Fig. 5 is a horizontal section on the line 5—5 of Fig. 3, looking in the direction of the arrows;

Fig. 6 is a horizontal section on the line 6—6 of Fig. 3, looking in the direction of the arrows;

Fig. 7 is a vertical, longitudinal section on the line 7—7 of Fig. 5, looking in the direction of the arrows;

Fig. 8 is a horizontal section on the line 8—8 of Fig. 7, looking in the direction of the arrows;

Fig. 9 is an enlarged vertical, transverse section on the line 9—9 of Fig. 4, looking in the direction of the arrows;

Fig. 10 is an enlarged vertical, transverse section on the line 10—10 of Fig. 4, looking in the direction of the arrows;

Fig. 11 is an enlarged vertical, transverse section on the line 11—11 of Fig. 4, looking in the direction of the arrows;

Fig. 12 is an enlarged vertical, transverse section on the line 12—12 of Fig. 4, looking in the direction of the arrows;

Fig. 13 is an enlarged fragmentary vertical longitudinal section showing the hot-zone section of the kiln, the section being taken on the line 13—13 of Fig. 12;

Fig. 14 is an enlarged vertical, transverse section on the line 14—14 of Fig. 4, looking in the direction of the arrows;

Fig. 15 is an enlarged vertical, transverse section on the line 15—15 of Fig. 4, looking in the direction of the arrows;

Fig. 16 is an enlarged vertical, transverse section on the line 16—16 of Fig. 4, looking in the direction of the arrows;

Fig. 17 is a fragmentary detail view in plan of the bottom of the muffle showing the supporting floor, superposed plate-track and the movable plates or slabs, and

Fig. 18 is a section partly in perspective on the line 18—18 of Fig. 17.

Referring now to these drawings which illustrate a preferred embodiment of my invention, I indicates a kiln-body or shell preferably composed of conventional brick and built upon a foundation 1' of similar material, provision being made along the hot sections for expansion and contraction. The kiln preferably embodies a hot-zone section 1^a connected at one side with a pre-heating zone 1^b and an entrance zone 1^c while the other side of the hot zone communicates with a pre-cooling zone 1^d and an exit zone 1^e.

In the preferred form of my invention illustrated, a single muffle 2, preferably of substantially rectangular conformation and comprising a bottom 2', side walls 2^a, 2^b and a top 2^c, all built of conventional argon fire-brick slabs, is enclosed within said kiln body, extending axially thereof throughout its entire length. The muffle 2 is supported and has its bottom, side-walls and top suitably mounted in relation to supporting and enclosing structural parts, which are also preferably formed of conventional argon fire-brick, to provide a series of heat-applying and temperature-controlling flues, air-ports and checkered walls, as hereinafter more particularly specified.

In the preferred embodiment of my invention, the muffle 2 is provided with a flat supporting-bottom or floor 2' and I superimpose on this flat floor an internal floor or track 3 having an anti-

friction upper surface and composed of a single course of porcelain bricks 3^a each having substantially the conformation of a rectangular parallelepiped and provided with curved surfaces 3^b along the top longitudinal edges thereof merging with a flat top portion 3^{a2} and flat sides 3^{a3}.

These bricks 3^a are laid lengthwise in longitudinal alignment to form a series of adjacent rows laid over the entire floor slab and the joints between the aligned bricks in one row are staggered in relation to the bricks in the adjacent row, the top surface being thus composed of a series of rows of aligned bricks with longitudinal channels 3^{a4} formed by the rounded surfaces and the thickness of a layer of cement applied between the side walls of the bricks. These bricks are preferably provided in their bottom surfaces with longitudinal cutout channels 3^b disposed between the side-edges thereof for the purpose of providing a tie or bond between such bricks and the fire-brick bottom slab of the muffle that will be strong and durable, this tie being preferably formed of a suitable cement and fire clay.

The internal floor or track thus formed will provide a stationary anti-friction slideway for the movable slabs S of refractory material which are charged or fed by suitable feeding mechanism through the muffle along or over this slideway. I find that with a floor or track of this type, I am enabled not only to reduce the friction between the movable slabs and their support, but it provides an anti-sticking surface which will enable ready sliding and will prevent the sticking of the movable slabs during sliding movement thereof through the muffle, thus preventing wrecks within the muffle resulting from such sticking of plates, it being understood that these movable plates or slabs are in continuous use; that they become fouled from glazed particles that drop off the tile during the firing of glazed ware thereon; that it is often necessary for the fireman to stop his propelling apparatus and to hold the plates stationary for a period of time to enable the reaching of a predetermined temperature, and that under these circumstances the fouled plate or slab has heretofore fastened itself to the floor bottom and when the plates are subsequently propelled has caused a wreck within the muffle.

In the said preferred embodiment of my invention, I provide for the hot-zone section a primary flue area 4 substantially U-shaped in cross section surrounding the bottom and sides of the muffle and divided at the top of the muffle by a vertically-disposed longitudinal partition 5. The base-portion 4' of the said U-shaped flue-area extends beneath and contacts with the bottom of the muffle and communicates with vertical side sections or branches 4^b, 4^{b'} which communicate at their upper ends with a pair of parallel horizontally-disposed top longitudinal flue sections 4^c, 4^{c'} individualized and separated from each other by the vertical partition 5 which extends throughout the hot zone along the vertical middle line of the kiln from the top of the muffle to the crown member 6 of said hot zone. Said separate and individual flues then connect and communicate with side flues extending longitudinally in the pre-heating zone along the sides of the muffle and discharge jointly into a stack 7 located near the entrance end of said pre-heating zone.

The flue area of the hot zone section is preferably divided at the parts adjacent to the bottom and sides of the muffle into a series of temperature-controlling flue passages or conduits.

These flue passages are formed by and positioned in the brick work surrounding said muffle, and in accordance with the preferred form of my invention illustrated, I provide a series of primary flue passages or conduits 4^a extending obliquely across the longitudinal middle line of the bottom thus increasing the longitudinal extent of these passages and providing for a longer contacting travel therein of the products of combustion at the hottest temperature thereof. The bottom flue passages are then divided to form a series of vertically-extending side branches 4^b and 4^{b'} on each side of the muffle. These vertically-extending side branches are separated by the muffle and extend obliquely of the longitudinal middle line of the sides of the muffle, thus again providing for increased length of said branch passages and for a longer travel of the products of combustion in contact with the sides of the muffle. The branch-passages discharge at their top ends into the said longitudinal top sections 4^c, 4^{c'} which, as aforesaid, are separated at the middle line of the top of the muffle by a vertically-disposed longitudinal partition 5. I thus provide at each side of the top of the muffle longitudinally disposed flue passages which are separate and independent from their connections with the side branches of the primary flue passages to the stack 7 located at the forward end of the pre-heating zone or section 1^b.

In the embodiment shown, there are a series of six primary flue passages and they are fed at the level of said bottom flue passages by a series of six primary burners designated by reference character 8 and located at opposite sides of the kiln body. The primary burners are connected with one end of said series of flue passages by a series of feed channels or conduits 9, and the ends of each of said primary passages opposite to a burner is provided with an air-intake channel 10, a series of six of such air-intake channels being provided in the embodiment shown for the purpose of controlling or raising the temperature in the upper part of the muffle.

The hot-zone flue area is also preferably fed by a series of secondary burners, and in the embodiment illustrated, a series of six secondary burners 11 are employed, three on each side of the kiln. The secondary burners on one side are connected by feed channels or conduits 12 to each vertical side branch passage fed by a primary burner on that side of the kiln, but because of the inclination of the branch passages, these secondary burners will be positioned to one side of the primary burners. Each primary flue passage and its vertical branch is thus fed by a pair of burners comprising a primary and secondary burner, and the entire series of primary and branch flue passages are fed by batteries composed of primary and secondary burners, the secondary burners being arranged at height levels and longitudinal positions which vary from the levels and positions of the primary burners.

Any suitable type of burner may be employed.

At the hot zone and in part of the pre-cooling zone the brick work adjacent to the bottom and sides of the muffle is built in what may be termed "a checkered pattern" so as to provide a series of alternate solid portions and openings in each course of brick and with the openings and solid brick portions in adjacent courses above and below staggered in relationship to each other. At the sides of the muffle these checkered brick courses provide a series of horizontal flue openings 13 positioned adjacent to each side of the muffle and additional flue openings 13' spaced

from the muffle side walls. In the passage-forming brick-work adjacent to the side walls of the muffle, the bricks of the adjacent courses overlap each other at their end sections to provide the aforesaid openings 13 and 13' which connect adjacent branch passages and when aligned form through passages. Partitions or piers are also formed for separating the members of the series of passages at the bottom and sides of the muffle while at the same time providing for equalization and stabilizing of the heat from the combustion gases passing through such flue sections.

It will be seen from the above that the oblique disposition of the primary flue passages and branches thereof through the hot zone will, in itself alone, increase the flue area for the application of heat from the primary and secondary burners to the muffle, and that the checkered walls and openings hereinabove described, when combined with such oblique flue-passages or channels, provide for a uniform distribution and application of the heat from the said burners to the muffle, and also that the location, disposition and arrangement of the flue passages hereinabove described will enable a highly efficient application to a muffle or muffles of a greater range of temperature than has heretofore been possible in prior art kilns of the type specified, and that I am enabled by this arrangement of flue passages, burners and openings to fire wares requiring either high or low temperature. For example, either glazed tile or biscuit tile may be effectively fired and matured in a kiln made in accordance with my invention hereinabove specified and may be so fired and matured on a minimum time schedule for each type or class of ware and with equally good results with respect to the various factors encountered in such work, such as cracking, crazing and the like.

In the embodiment of my invention illustrated, I provide means for controlling and varying the temperature in order to provide varying temperatures for varying products being fired, and as illustrated I provide in the pre-cooling zone flue passages provided with a series of air-ports, it being understood that some kinds or types of ware will require rapid cooling, whereupon these air-ports can be opened by removing the loose brick in the openings to reduce the temperature and provide for a more rapid cooling of the ware, while with other types or kinds of ware, the ports can be kept closed to provide for a slower cooling of the ware being fired.

The flue passages 15 can also exhaust into openings 16 covered by removable caps 16' at the top of the kiln in order to provide, if necessary, additional heat control for varying types of ware being fired. (See Figs. 7 and 2^a.)

I also build in the side wall of the kiln body, at the hot, pre-heating, pre-cooling and cooling zones, a plurality of vertically-disposed mineral-wool expansion-joints so as to permit end-wise expansion without cracking of such walls.

In the preferred embodiment illustrated, the foundation section of the kiln is composed of a series of courses of common bricks while the flue-embodying portions above the foundation preferably comprise courses of common fire brick and argon fire brick, the type of brick being changed according to the heat conditions encountered. At the cooling, pre-cooling, hot zone and pre-heating zone, I preferably apply expansion joints in the two top courses of common bricks employed in the foundation. Also at the

top of the kiln over the entrance, pre-heating and pre-cooling zones I preferably provide elongated beds of diatomaceous earth, and also preferably provide at the hot zone alternate wall

5 buttresses and wells of diatomaceous earth.
Man-holes 14 at the top of the pre-heating and pre-cooling zones adjacent to the hot zone are provided and at the entrances of such man-holes, the top plates or slabs of the muffle are
10 removably mounted to permit access to the muffle at these places.

It will be seen that in the foundation and base construction illustrated, I have provided a positive and firm support for the muffle slabs by
15 means of center piers, and by the obliquely-disposed checkered brick work members which define the flue passages, and this supporting structure for the muffle will avoid possibility of sagging of the bottom plates or slabs of the muffle.

20 In the brick-work structure at the cooling and precooling zones which embodies a pair of longitudinal flues beneath the muffle bottom, the central portion of said bottom is supported by a center pier vertically aligned with a central
25 foundation pier formed by providing a pair of vertically-extending longitudinal channels in said foundation courses of brick.

At the communicating portion between the pre-cooling zone and the hot zone the longitudinal
30 flues beneath the muffle-bottom are narrowed and increased in number, and the passages at the muffle-side are provided with checkered courses of bricks, while in the hot-zone, the side passages are provided with checkered brick work
35 and the diagonal or oblique partitions between the bottom flue series are also composed of checkered brick work. These various flue passages and the communicating openings in the checkered brick work, as hereinabove specified,
40 serve to provide for an even distribution or circulation and an equalization or stabilizing of heat within the flue passages and make it possible to produce uniformity of the application of heat to the muffle.

45 Suitable vents and a damper in the stack are also provided for the purpose of more effectively controlling the draft and the intensity, distribution and uniformity of the heat.

While the primary and secondary burners
50 hereinabove described provide heat for the hot zone, I preferably provide in the pre-heating section a series of four burners, two suitably being located at each side of the kiln and communicating with the longitudinal flues extending through
55 said pre-heating section and the pair of burners on one side of the kiln being arranged in staggered relationship to the pair on the opposite side.

Having described my invention, I claim:

60 1. A tunnel kiln embodying, in combination, a muffle, means for passing ware there-through, a U-shaped heat-applying flue-area comprising a horizontal base-portion having passages in contact with the muffle bottom, opposite vertical
65 branch-portions having passages in contact with the sides of the muffle, and separate top horizontal portions in contact with the top of the muffle, said passages in the branch-portions extending in a direction oblique to the middle line
70 of the muffle sides, and means for supplying heat to said flue area.

2. A tunnel kiln embodying, in combination, a muffle, means for passing ware there-through, a U-shaped heat-applying flue-area comprising a
75 horizontal base-portion having passages in con-

tact with the muffle bottom, opposite vertical branch-portions having passages in contact with the sides of the muffle, and separate top horizontal portions in contact with the top of the muffle, said passages in the base and branch-
5 portions extending in directions oblique to the walls of the muffle with which they contact, and means for supplying heat to said flue area.

3. A tunnel kiln, embodying in combination, a muffle, means for passing ware there-through, a
10 U-shaped heat-applying flue-area comprising a horizontal base-portion having passages in contact with the muffle bottom, opposite vertical branch-portions having passages in contact with the sides of the muffle and separate top hori-
15 zontal portions in contact with the top of the muffle, said passages in the base and branch-portions extending in directions oblique to the walls of the muffle with which they contact and said top portion comprising a pair of longitudi-
20 nally extending flue passages communicating with said branch passages at the upper ends thereof, and means for supplying heat to said flue area.

4. A tunnel kiln, embodying in combination, a
25 muffle, means for passing ware therethrough, and a U-shaped heat-applying flue-area comprising a horizontal base-portion in contact with the muffle bottom, opposite vertical branch-portions in contact with the sides of the muffle and
30 separate top portions extending horizontally and longitudinally in contact with the top of the muffle, primary burners connected with said flue area at the level of said base portion and secondary burners connected with said flue area be-
35 tween the ends of said branch portions.

5. A tunnel kiln, embodying in combination, a muffle, means for passing ware therethrough, a heat-applying flue comprising a series of pas-
40 sages contacting with a wall of said muffle and extending obliquely across the longitudinal middle-line of said wall, means for supplying heat to a plurality of said passages, and additional flue sections for permitting movement of hot
45 gases therethrough.

6. A tunnel kiln, embodying in combination, a muffle, means for passing ware therethrough, a heat-applying flue having a base portion provided with a series of base passages disposed at
50 the bottom of said muffle and extending obliquely across the longitudinal middle line of said muffle bottom, means for supplying heat to a plurality of said passages, and said base passages having a series of additional flue passages communicat-
55 ing therewith for permitting movement of hot gases therethrough.

7. A tunnel kiln, embodying in combination, a muffle, means for passing ware therethrough, a heat-applying flue having a base portion provided with a series of base passages disposed at
60 the bottom of said muffle and extending obliquely across the longitudinal middle line of said muffle bottom, means for supplying heat to the said base passages, a series of vertical branch-flue passages disposed obliquely across the longitudi-
65 nal middle line of the muffle side walls, contacting with said muffle side walls and communicating at one end with said base passages and at the other end with additional flue sections at the top of the muffle for permitting movement of
70 hot gases through said side wall and bottom sections.

8. A tunnel kiln, embodying in combination, a muffle, means for passing ware therethrough, a heat-applying flue having a base portion pro- 75

vided with a series of base passages disposed at the bottom of said muffle and extending obliquely across the longitudinal middle line of said muffle bottom, means for supplying heat to said base passages, a series of vertical branch-flue passages disposed obliquely across the longitudinal middle line of the muffle side walls, contacting with said muffle side walls and communicating at one end with said base passages and at the other end with additional flue sections at the top of the muffle for permitting movement of hot gases through said side wall and bottom sections, and means for applying additional heat to said branch passages.

9. A tunnel kiln embodying, in combination, a muffle, means for passing ware therethrough, a U-shaped heat-applying flue-area comprising a horizontal base-portion having passages in contact with the muffle bottom, opposite vertical branch-portions having passages in contact with the sides of the muffle, and separate top horizontal portions in contact with the top of the muffle, said passages having walls formed of brick partition members of checkered pattern to provide therethrough alternately-positioned openings and closed portions, and means for supplying heat to said flue area.

10. A tunnel kiln embodying, in combination, a muffle, means for passing ware therethrough, a heat-applying flue comprising a series of passages contacting with a wall of said muffle and extending obliquely across the longitudinal middle-line of said wall, said series of passages being separated from each other by walls formed of brick partition members of checkered pattern to provide therethrough alternately-positioned openings between adjacent flue passages and closed wall portions, means for supplying heat to a plurality of said passages, and additional flue sections for permitting movement of hot gases therethrough.

11. A tunnel kiln, embodying, in combination, a muffle, means for passing ware therethrough, a heat-applying flue having a base portion provided with a series of base passages disposed at the bottom of said muffle and extending obliquely across the longitudinal middle line of said muffle bottom, means for supplying heat to said base passages, a series of vertical branch-flue passages disposed obliquely across the longitudinal middle line of the muffle side walls, contacting with said muffle side walls and communicating at one end with said base passages and at the other end with additional flue sections at the top of the muffle for permitting movement of hot gases through said side wall and bottom sections, said series of passages in the horizontal base flue section and in the vertical branch-flue passages being separated from each other by walls formed of brick partition members of checkered pattern to provide therethrough alternately-positioned openings between adjacent flue passages and closed wall portions.

12. A tunnel kiln, embodying in combination, a muffle, means for passing ware therethrough, a heat-applying flue having a base portion provided with a series of base passages disposed at the bottom of said muffle and extending obliquely across the longitudinal middle line of said muffle bottom, means for supplying heat to said base passages, a series of vertical branch-flue passages disposed obliquely across the longitudinal middle line of the muffle side walls, con-

tacting with said muffle side walls and communicating at one end with said base passages and at the other end with additional flue sections at the top of the muffle for permitting movement of hot gases through said side wall and bottom sections, and means for applying additional heat to said branch passages, said series of passages in the horizontal base flue section and in the vertical branch-flue passages being separated from each other by walls formed of brick partition members of checkered pattern to provide therethrough alternately-positioned openings between adjacent flue passages and closed wall portions.

13. A tunnel kiln, embodying in combination, a muffle, means for passing ware therethrough, a heat-applying flue having a base portion provided with a series of base passages disposed at the bottom of said muffle and extending obliquely across the longitudinal middle line of said muffle bottom, means for supplying heat to one end of said base passages and supplying air to the opposite end of said base passages, a series of vertical branch-flue passages disposed obliquely across the longitudinal middle line of the muffle side walls, contacting with said muffle side walls and communicating at one end with said base passages and at the other end with additional flue sections at the top of the muffle for permitting movement of hot gases through said side wall and bottom sections.

14. In a kiln, a muffle having a floor comprising a course of blocks having upper edge portions rounded to provide an anti-friction surface, sliding ware-carrier plates movable along said floor, and means for applying heat to said muffle.

15. In a kiln, a muffle having a floor comprising a course of blocks having upper edge portions rounded and laid lengthwise end to end in rows to cause the block surfaces to produce a series of longitudinally-disposed continuous rows with channels formed by the rounded edges therebetween and to provide an anti-friction surface, sliding ware-carrier plates movable along said floor, and means for applying heat to said muffle.

16. In a kiln, a muffle having a floor comprising a course of blocks having upper edge portions rounded and laid lengthwise end to end in rows to cause the block surfaces to produce a series of longitudinally-disposed continuous rows with channels formed by the rounded edges therebetween and to provide an anti-friction surface, sliding ware-carrier plates movable along said floor, and means for applying heat to said muffle, said blocks having on their rear surfaces cut out bonding channels firmly bonded to the bottom wall of said muffle.

17. In a kiln, a muffle having a floor comprising a course of blocks having the general conformation of rectangular parallelepipeds provided with flat top surfaces having rounded portions at the edges on opposite sides of said flat surfaces, said blocks being laid lengthwise end to end in rows to cause the block surfaces to produce a series of longitudinally-disposed continuous rows with channels formed by the rounded edges therebetween and to provide an anti-friction surface, sliding ware-carrier plates movable along said floor, and means for applying heat to said muffle.

FRANK A. PHILO.