United States Patent

[11] 3,598,376

[72] Inventor **Enrico Putin**
via P. Trevisan 2, Villaveria, Vicenza, Italy

[21] Appl. No. **853,406**
[22] Filed **Aug. 27, 1969**
[45] Patented **Aug. 10, 1971**
[32] Priority **Sept. 7, 1968**
[33] **Italy**
[31] **61626-A/68**

[54] **PLANT FOR DRYING, FIRING AND STACKING BRICKS**
8 Claims, 16 Drawing Figs.

[52] **U.S. Cl.** ..... 263/28, 25/142 M
[51] **Int. Cl.** F27b 9/00
[50] **Field of Search** ..... 263/28; 25/142 D, 142 M

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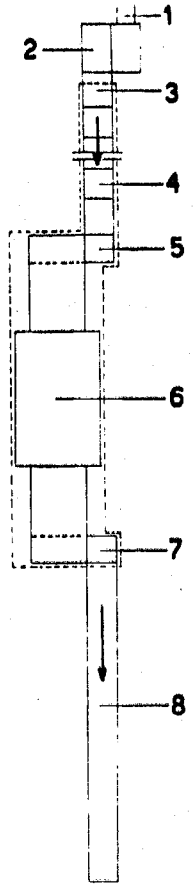
Primary Examiner—John J. Camby
Attorney—Richards and Geier

ABSTRACT: An automatic plant is provided for the continuous drying, firing and stacking of bricks and the like. The plant includes a tunnel. The drying of the material takes place in a first section of the plant in several stages with the bricks to be dried being spaced apart and subsequently reassembled. Then the bricks are moved through a next section in which they are superimposed and may be reassembled again. This movement takes place at a variable speed to compensate for any temporary stoppages in the working cycle. When the drying is completed the bricks enter into a firing kiln. From there, they move to a discharge surface upon which stacks of bricks are formed.



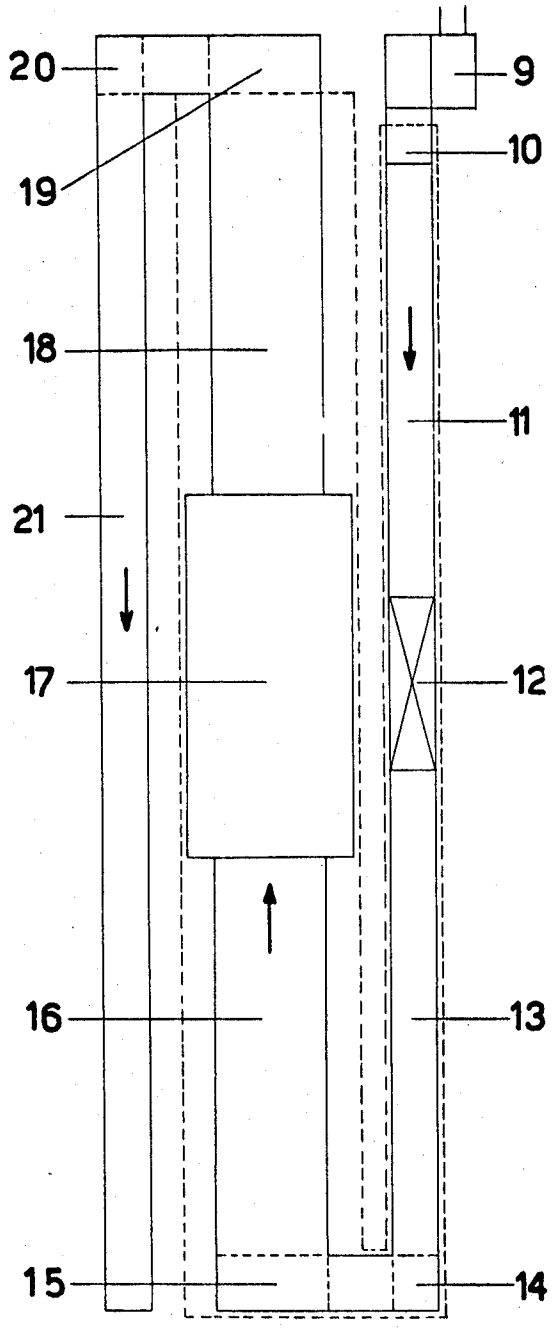


Fig. 2

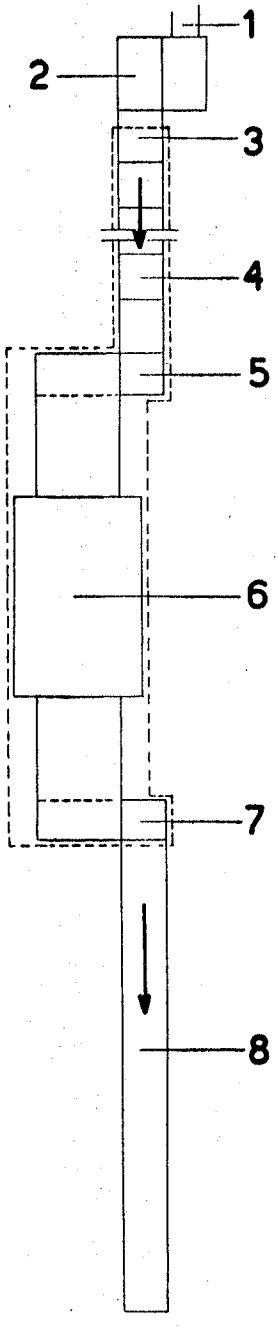


Fig. 1

INVENTOR:
E. Putin
By
Richards & Geier
ATTORNEYS

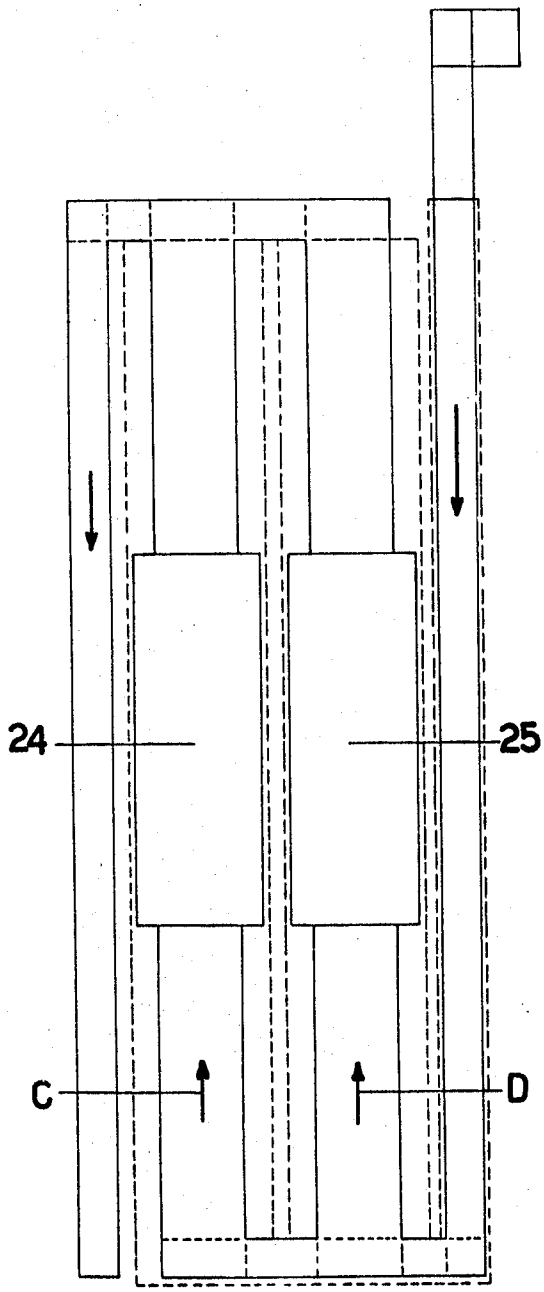


Fig.4

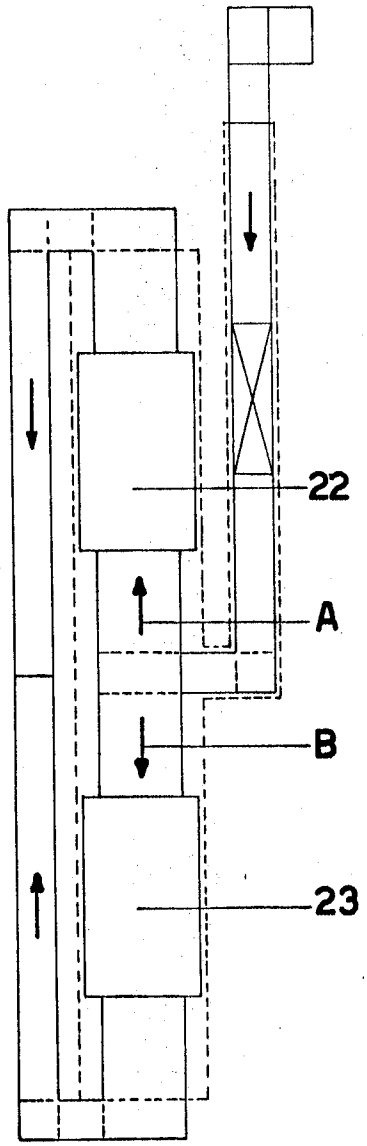


Fig. 3

INVENTOR:
E. Putin
BY
Richards & Geier
ATTORNEYS

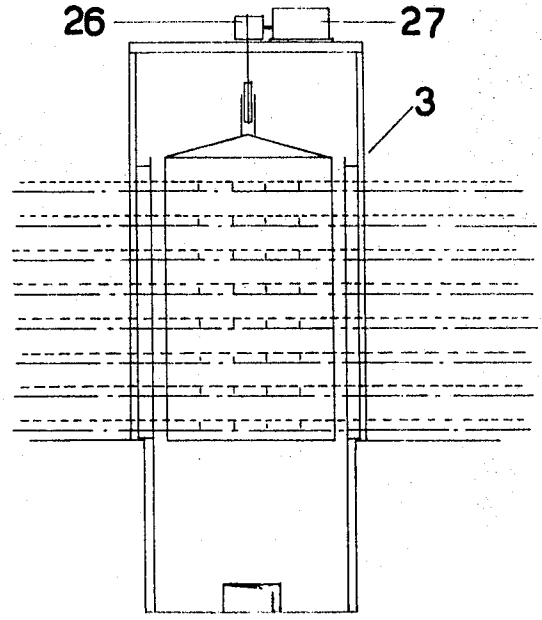


Fig. 5

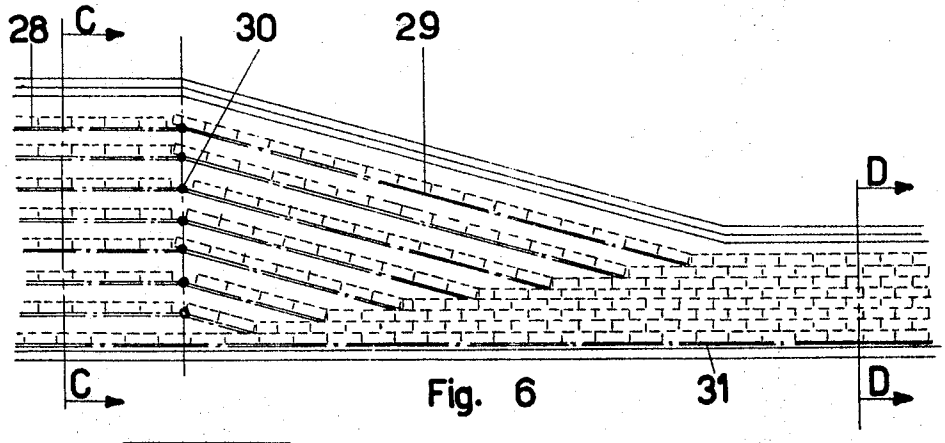


Fig. 6

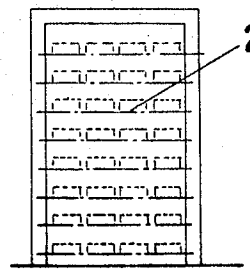


Fig. 7

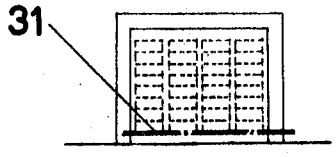


Fig. 8

INVENTOR:
E. Putin
BY
Richards & Geier
ATTORNEYS

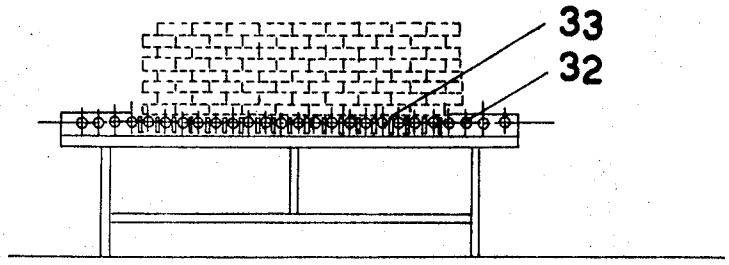


Fig. 9

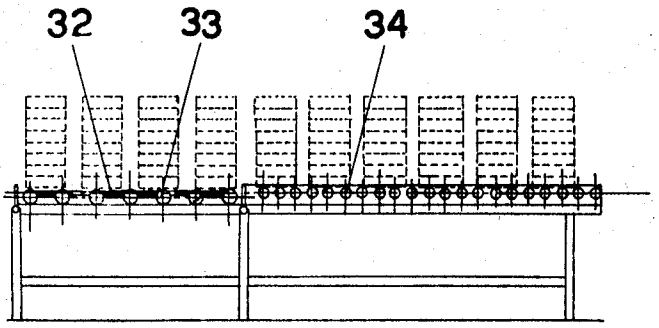


Fig.10

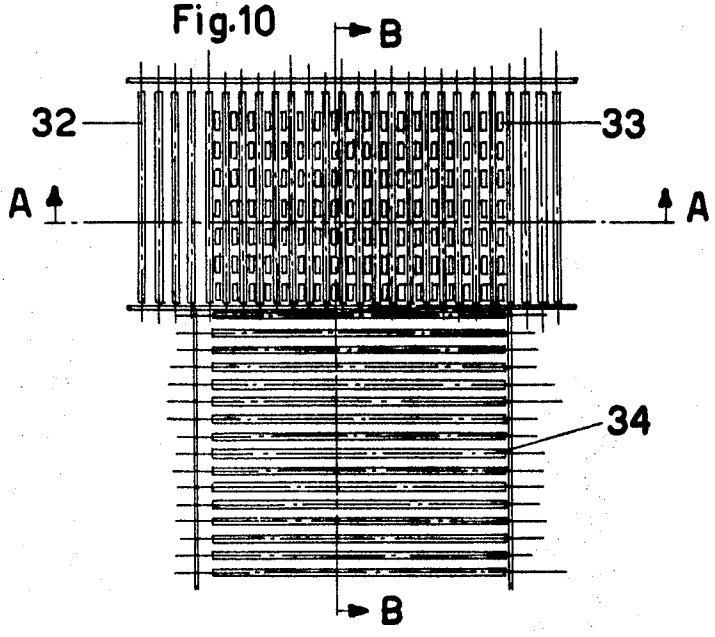


Fig.11

INVENTOR:
E. Putin
BY Richards & Geier
ATTORNEYS

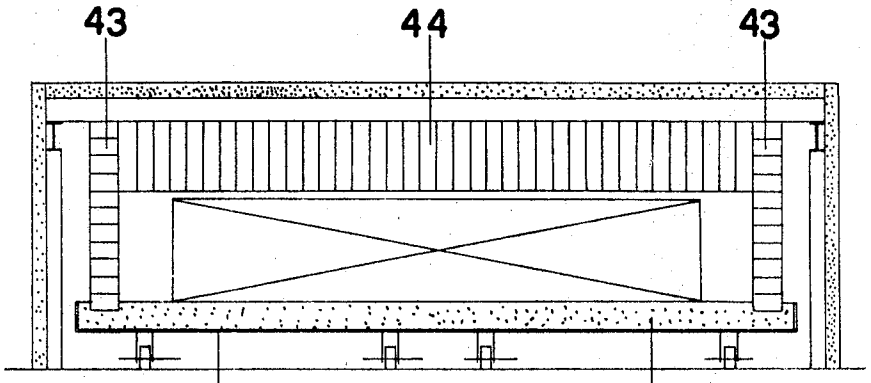


Fig. 12

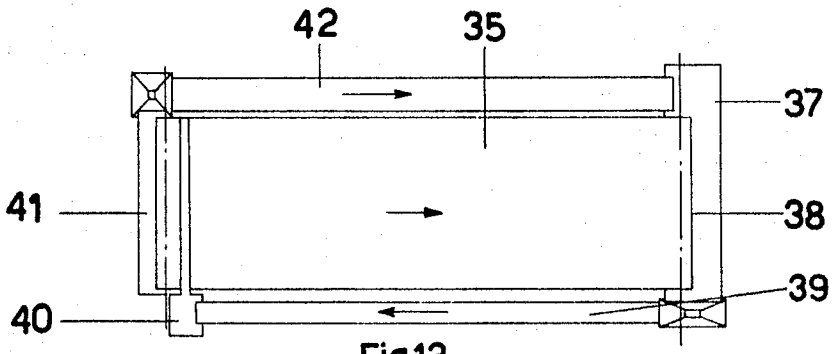


Fig.13

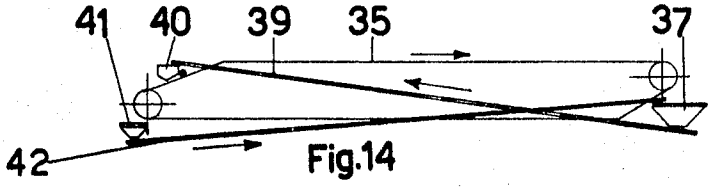


Fig.14

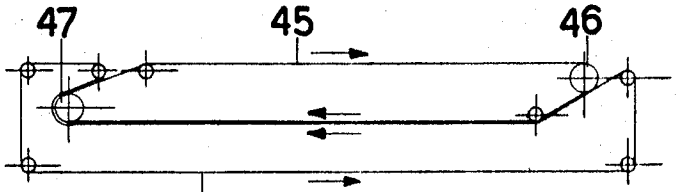


Fig.15

INVENTOR:
E. Putin
By
Richards & Geier
ATTORNEYS

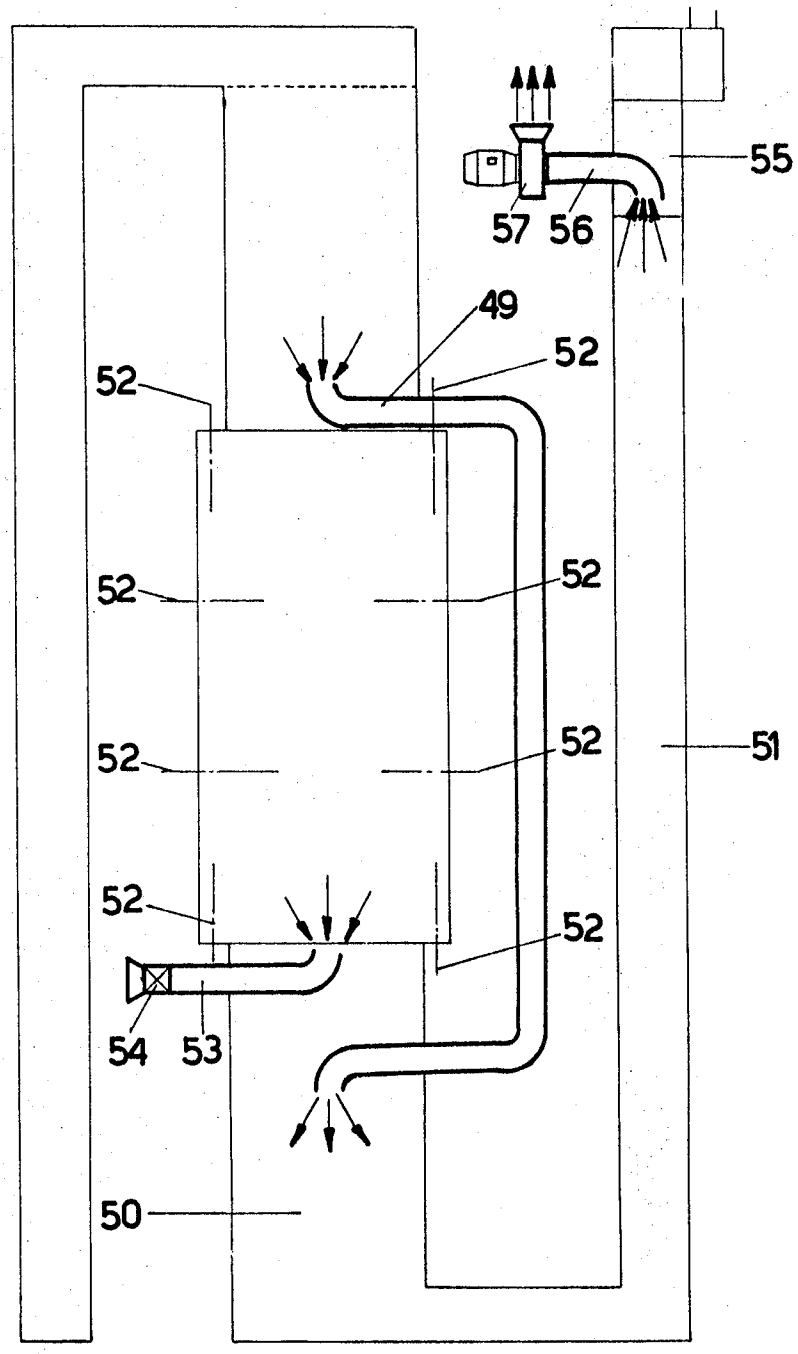


Fig. 16

INVENTOR:
E. Putin
BY
Richards & Geier
ATTORNEYS

PLANT FOR DRYING, FIRING AND STACKING BRICKS

This invention pertains to a continuous automatic plant for the drying, firing, stacking and tying of bricks.

The problem of reducing the cost of manufacturing bricks has been tackled in various ways by brick manufacturers both in regard to the construction of the driers and in regard to the firing kilns. The latter have been constructed of the tunnel type with mobile transporting trucks for the brick material to be fired which advance slowly into the kiln, issuing therefrom with the fired bricks. Conventional plants using separate devices for the drying and firing of bricks, require preheating of the material in the course of the drying, successive cooling thereof and reheating at the firing site in the kiln.

All these separate steps increase the expense of treating the material entering and leaving the dryer and entering and leaving the kiln, and also increase the quantity of thermal power necessary for the successive heating treatment.

An object of the present invention is to eliminate these drawbacks of prior art plants.

Other objects of the present invention will become apparent in the course of the following specification.

The present invention provides a continuous automatic plant capable of any quantity of production for any quality of clay, providing a maximum yield in that it recovers for the drying process some of the heat from the firing kiln, but above all, retaining the thermal energy absorbed by the material in the process of drying, as preheating thereof before the firing.

The plant of the present invention comprises a tunnel, in the first part of which the drying of the material begins, followed by a period in which the material advances with a variable speed, as required, to complete the drying, said unit also acting as reservoir to compensate for any temporary stoppages in any part of the working cycle, and followed by the firing kiln itself, from which the material issues to be carried to a discharge surface on which stacks of bricks are prepared, thus constituting a completely automatic plant which requires practically no labor except for supervising the operation of the plant.

Another basic feature of the invention resides in that the brick material, suitably assembled according to the dimensions on a loading surface, is loaded by means of a multistage frame, which is vertically displaceable, into a superimposed displaceable surface disposed within the first part of the dryer to be subsequently assembled in groups of superimposed layers as soon as the dryer has given the material a sufficient degree of consistency, thus making it possible to appreciably reduce the cross section of the dryer and, consequently, to correspondingly increase the feed speed of the drying air, obtaining faster removal of the humidity in the second part of the dryer and consequently, reduction in the total length thereof, while in the first part the material is only heated and partly dried.

Still another feature of the present invention is that the material, at the end of the first drying phase, can be subsequently collected in groups of parallel rows so as to bring it to the operative width of the firing kiln if this width is not produced in the first assembling operation.

At the end of the firing phase and after traversing a path of suitable length for allowing cooling of the material and for forming a subsequent reserve of material, the material is subjected to further movements for the purpose of bringing it into groups of a width corresponding to that of the stacks to be formed for transportation.

The tying of the stacks is carried out by means which may be of conventional type and do not form a part of the present invention.

The plant according to the present invention comprises the following parts:

1. A loading device for receiving brick elements coming for example from a shaping machine, and a cutter, or from a moulding press or from any other processing system, in one or more parallel rows; a device which effects the spacing of the elements in groups to displace them subsequently to one side in parallel rows, for the purpose of forming groups of elements of dimensions corresponding to those of the loading surface of the frame.

2. A raisable frame formed of several stages on which the individual groups of brick elements are loaded, means being provided for the feeding of the material to these stages.

3. A tunnel dryer with multiple superimposed stages on which the groups of brick elements are fed, spaced apart in three dimensions, coming from the frame when the latter is loaded. The multiple superimposed stages are inclined from their ends with an adjustable angle of inclination for the purpose of causing the individual groups of bricks to descend and become disposed directly one upon the other, forming groups of bricks in parallel rows which become dried in the second part of the dryer and advance on a single displaceable surface.

4. A displaceable surface disposed in the tunnel dryer, provided with a transferring device which makes it possible to bring the groups of elements upon a parallel displaceable surface and assemble the elements in groups of parallel rows with a width equal to that of the firing kiln and thus making it possible to reduce the entire length of the plant, to complete the drying and at the same time to obtain considerable reserve of dried material which makes it possible to compensate for any stoppages in any part of the plant.

5. A firing kiln provided with a displaceable hearth covered with refractory material, in powder form if desired, according to various structures which will be described in greater detail hereinafter.

6. A displaceable surface located at the outlet of the furnace which transmits the bricks to a transferring device and separates them into one or more parallel rows in superimposed layers, to form stacks of bricks to be tied up and dispatched.

According to a further embodiment of the present invention the possibility is provided of feeding two or more firing kilns with only one dryer, or for feeding a firing kiln with two or more dryers. Any other combination of any number of dryers with any number of kilns, can be used to provide the greatest possible elasticity of operation.

Naturally, each of the parts of the above described plant may have different forms of construction while remaining within the scope of the present invention.

The invention will appear more clearly from the following detailed description when taken in connection with the accompanying drawings showing, by way of example only, preferred embodiments of the inventive idea.

In the drawings:

FIG. 1 is a schematic plan view of a linear arrangement of the plant;

FIG. 2 is a schematic plan view of an arrangement having parallel lines;

FIG. 3 is a schematic plan view of a plant having two kilns through which materials pass in opposite directions;

FIG. 4 is a schematic plan of a plant having two kilns through which material passes in the same direction;

FIG. 5 is a schematic side view of the elevator device for loading a dryer;

FIG. 6 is a schematic longitudinal section of the portion of dryer in which the elements are superimposed;

FIG. 7 is a schematic cross section along the line VII–VII of FIG. 6, of the portion of dryer comprising superimposed stages;

FIG. 8 is a schematic cross section taken along the line VIII–VIII of FIG. 6 of the portion of dryer in which the brick elements are directly disposed one upon the other;

FIG. 9 is a schematic partial section along the line IX–IX of FIG. 11 of the portion of the displaceable surface on which the lateral movement takes place for assembling bricks;

FIG. 10 is a schematic section along the line X–X of FIG. 11;

FIG. 11 is a plan view of a transfer device;

FIG. 12 is a cross section taken along a vertical plane of one embodiment of a firing kiln for the bricks;

FIG. 13 is a schematic plan view of one embodiment of the displaceable hearth of the firing kiln;

FIG. 14 is a schematic side view of the displaceable hearth of FIG. 13;

FIG. 15 is a schematic side view of another embodiment of a displaceable hearth.

FIG. 16 is a diagram showing the movement of the air within the firing kiln and the dryer.

In accordance with the embodiment of the present invention shown in FIG. 1, brick elements arrive in one or more parallel rows from a preceding processing operation to a spacing device 1 of conventional type, which divides the elements into groups, whereupon they are transposed laterally in parallel rows by means of a transfer device 2 to form groups of elements each having a dimension corresponding to the loading surface of the elevator 3 which loads a dryer 4. The brick elements issue from dryer 4 and are then carried to a transfer device 5 which assembles and laterally transposes the elements in groups of different and usually greater widths than previously and substantially corresponding to the width of a firing kiln 6.

The groups issuing from the kiln 6 are transposed by means of a second transfer device 7 into groups of a different dimension and corresponding to the stacks of bricks which are to be tied upon a conveyor 8 which is the end of the plant.

In a second embodiment of the present invention shown in FIG. 2, the brick elements, after initially being assembled and transposed laterally by spacing device 9, are loaded by the elevator device 10 onto the surfaces of the initial portion of the dryer 11, whereupon they descend onto the inclined surface 12 until they are disposed in superimposed layers in the end portion 13 of the dryer.

The elements are then assembled in groups of different width (usually greater), by a pair of transfer devices 14 and 15 and carried onto a displaceable surface 16, the width of which is equal to that of the firing kiln 17 and subsequently issue therefrom on the displaceable surface 18.

The use of the two displaceable surfaces 16 and 18 also has the advantage of permitting the formation of a reserve of material acting as a reservoir during the inevitable temporary interruptions of the process which occur in certain sections of the plant, so as to provide a regular feeding of the other stations for a certain time by simply adapting the traveling speed of the displaceable surfaces.

A further pair of transfer devices 19 and 20 redistributes the brick elements in groups of different width (normally less), corresponding to the width of the stack of brick elements to be made up and tied, for example, by means of straps, according to any conventional process, along the displaceable end surface 21 of the plant.

In the embodiments shown in FIGS. 3 and 4, two firing kilns 22, 23 and 24, 25, respectively, are provided in which the brick elements advance in opposite directions indicated by arrows A and B in FIG. 3 or in the same and parallel directions indicated by arrows C and D in FIG. 4.

In both embodiments, brick elements are fed from a single drying installation and are fed upon a single surface to be loaded with stacks of bricks as they issue therefrom.

Many other embodiments in the arrangement of the plant may be provided on the basis of particular requirements of the process without departing from the scope of the present invention.

Material is assembled to one side if desired by means of a transfer device of a type which will be described hereinafter, in a different number of rows and then fed to a displaceable surface, for example, by means of rollers, until a stage of the elevator 3 (FIG. 5) is loaded with each group, whereupon the elevator is automatically raised at the end of the loading operation of each stage, for example, by means of a winch 26, controlled by an electric motor 27, until the lower stage is opposite the displaceable loading surface.

Once the entire elevator 3 is loaded, the assembly of the material contained on its stages is made to move forward until it is disposed upon displaceable surfaces 28 (FIG. 6) of the first part of the tunnel dryer.

Both the displaceable stages of the elevator 3 and the displaceable surfaces 28 of the first section of the dryer may be provided with suitably driven rollers or belts.

Then the first phase of the drying commences and after traversing a path, the length of which depends on the feed speed of the material, in accordance with the type of clay employed and the type of brick, the material receives a degree of consistency sufficient to permit the superimposing of its elements.

For this purpose a superimposing device, shown schematically in FIG. 6 is provided; it comprises a series of multiple superimposed surfaces 29, pivoted at 30, which may assume an adjustable inclination according to the height of the brick elements and the number of rows which have to be superimposed.

The elements descend on the inclined surfaces 29 until they are disposed directly one upon the other forming groups of elements in parallel rows which move into the dryer, advancing on a single displaceable surface 31 (FIGS. 6 and 8).

Due to the reduced cross section of the dryer, the speed of the drying air is greater than in the first part of the dryer (FIG. 7) having stages 28, thus making it possible to obtain a more efficient heat exchange.

In the first part of the dryer, in which the speed of the air is reduced, the brick elements are separated from one another and their surfaces completely swept by the air which circulates in the dryer itself.

A pair of transfer devices such as shown in FIGS. 9, 10 and 11, subsequently carry the groups of brick elements upon a displaceable parallel surface for assembling the material into a complex of parallel rows having a width equal to that of the firing kiln.

The transfer device of a type which is used in many other parts of the plant, may comprise a first group of rollers 32 between which rollers 33 are disposed having axes perpendicular to the preceding raisable rollers which effect the transfer of an entire assembly of material onto the next series of rollers 34 extending in a direction perpendicular to the preceding ones.

This particular embodiment of the transfer device may be modified, for example, by replacing the rollers 33 with conveyor belts or movable pallets according to conventional means.

By using a pair of further transfer devices, for example, similar to that shown in FIGS. 9, 10 and 11, it is possible to displace the brick elements in parallel alignments, by effecting assemblies or separations into groups of different width, according to particular requirements. For example, the pair of transfer members used before the advance into the firing kiln assembles the brick elements into groups of a width equal to that of the kiln itself.

The kiln preferably has a width greater than that of the dryer, a feature which makes it possible to reduce the forward speed in the kiln and, consequently, the total length thereof.

The travelling section which precede and follow the firing kiln in this case preferably has the same greater width as that of the kiln for the purpose of enlarging the capacity of reserve material, as described above.

The displaceable surface may also be divided into individual portions separately controlled at various speeds, making it possible to obtain maximum adaptability in the operation of the plant.

The actual firing kiln may be constructed in various ways and a few embodiments of this assembly are shown, by way of example, in FIGS. 12 to 15. In one embodiment of the kiln, there is provided a displaceable hearth 35 (FIG. 12) formed, for example, of adjacent members loosely connected together and supported by rollers which rotate on a bearing surface.

The upper surface of the hearth 35 is covered with refractory material 36 such as a powder which is recovered at the end of the movement of the displaceable surface 35 for return to the initial portion thereof by suitable means.

It is possible, for example, to provide a hopper 37 at the end of the operative movement of the displaceable hearth 35

(FIGS. 13 and 14), the hopper being provided at its bottom with a rotating screw member 38 which causes the refractory material to drop onto a side conveyor belt 39 which returns it to another hopper also provided at the bottom with a shell-shaped member which provides a uniform feed of refractory material to the initial portion and over the entire width of the displaceable base hearth 35.

The upper material collected by the hopper 41 is transported by the conveyor belt 42 to the end hopper 37 for return to the cycle.

Sidewalls 43 (FIG. 12) dependent from the roof of the kiln 44 are in slight contact with the refractory material 36 superimposed on the displaceable hearth 35 of the kiln so as to ensure the lateral seal of the hot air.

In a still further embodiment of the kiln, shown schematically in FIG. 15, a displaceable hearth 45 is combined over its entire lower course, starting from the final return roller 46 and continuing behind the initial roller 47, with a second displaceable belt 48 which is suitably mounted on tension pulleys, supporting, during the return movement the assembly of refractory material disposed on the displaceable hearth 45 in its effective travel movement.

It is possible, for example, for the hearth of the kiln to be formed by rigid transverse members provided with a refractory coating of rigid material loosely mounted on the adjacent members so as to form a self-contained moving conveying carpet.

The carpet may be divided into separate portions movable at different speeds.

Hot air, preheated in the end portion of the tunnel which follows the kiln by the fired material issuing hot from the kiln itself, flows into a collector conduit (FIG. 16), is led to tunnel 50 and thence to a dryer 51 which precede the kiln.

A supplementary heat generator may be inserted at any point in the conduit 49 to integrate the thermal energy of the air. A fan may be also inserted in the conduit 49 to pressurize the circuit of the dryer itself.

The kiln is heated by burners 52 disposed on the walls and/or the vault of the kiln. The discharge gasses are collected by the conduit 53 and discharged into the atmosphere possibly with the use of a suction fan 54.

In this manner the discharge gases in the kiln resulting from the firing of the bricks and which are known to contain harmful substances, are prevented from polluting the unfired material which is in the drying phase and from damaging the dryer itself, thus ensuring perfect uniformity in the production of the bricks.

Air saturated with water vapor is discharged at the same rate as the inflow of material into the dryer and more particularly into the zone of the loader 55 by way of a conduit 56 which, with a possible insertion of a suction fan 57, carries it directly into the atmosphere.

The advantage of the plant of the present invention by the use of heated clay is particularly apparent in that it eliminates manipulation of the material and is without movements, and also in that the material advances in the dryer without any reductions in temperature, a feature which greatly assists the drying and ensures the absence of defects such as cracking, due to overrapid or unsuitable heating and drying of the brick material itself.

I claim:

1. An automatic plant for the continuous drying, firing and stacking of bricks and the like, comprising means loading clay bricks and having a vertically movable multistage frame, a drying tunnel having a plurality of sections, means in the first section of the drying tunnel receiving the loaded clay bricks and drying them in several stages while spacing them and reassembling them, means in a following section continuing the drying of the clay bricks, means superposing the bricks and having superposed adjustable downwardly inclined surfaces receiving separate series of bricks at their upper ends and placing the bricks one on top of the other at their lower ends, means reassembling the bricks and moving them at variable speeds, a firing kiln receiving the bricks and firing them, and discharging means receiving the fired bricks and stacking them.

2. A plant in accordance with claim 1, comprising transfer devices located in said drying tunnel for assembling the clay bricks into a plurality of parallel rows, the total width of said rows corresponding to that of the firing kiln, and other transfer devices located at the exit of said firing kiln for assembling fired bricks into stacks.

3. A plant in accordance with claim 1, wherein said firing kiln comprises a displaceable hearth, a layer of powdered refractory material upon said hearth, a discharge hopper located adjacent one end of said hearth and receiving said refractory material, a rotary screw member in said hopper, a conveyor belt receiving said refractory material, another hopper located adjacent the opposite end of said hearth and receiving said refractory material from said conveyor belt and another screw member receiving said refractory material from said conveyor belt and returning it to said hearth.

4. A plant in accordance with claim 3, comprising a third hopper collecting the upper refractory material and a second conveyor belt between the first-mentioned hopper and the third hopper.

5. A plant in accordance with claim 1, wherein said firing kiln comprises a displaceable hearth, a layer of powdered refractory material upon said hearth, rollers supporting said hearth for rotary movement, and a movable belt extending between said rollers and below said hearth for returning the powdered refractory material to the hearth.

6. A plant in accordance with claim 1, wherein said firing kiln comprises a displaceable hearth consisting of rigid transverse members having a loosely mounted rigid refractory coating forming a moving carpet.

7. A plant in accordance with claim 6, wherein said carpet consists of a plurality of separate portions movable at different speeds.

8. A plant in accordance with claim 1, comprising a plurality of drying tunnels and a plurality of firing kilns receiving clay bricks from said drying tunnels.