F. A. SECORD.

PROCESS FOR DRYING ARTICLES AND APPARATUS FOR ACCOMPLISHING THE SAME.

APPLICATION FILED NOV. 17, 1915.

1,221,383.

Patented Apr. 3, 1917.

2 SHEETS—SHEET 1.

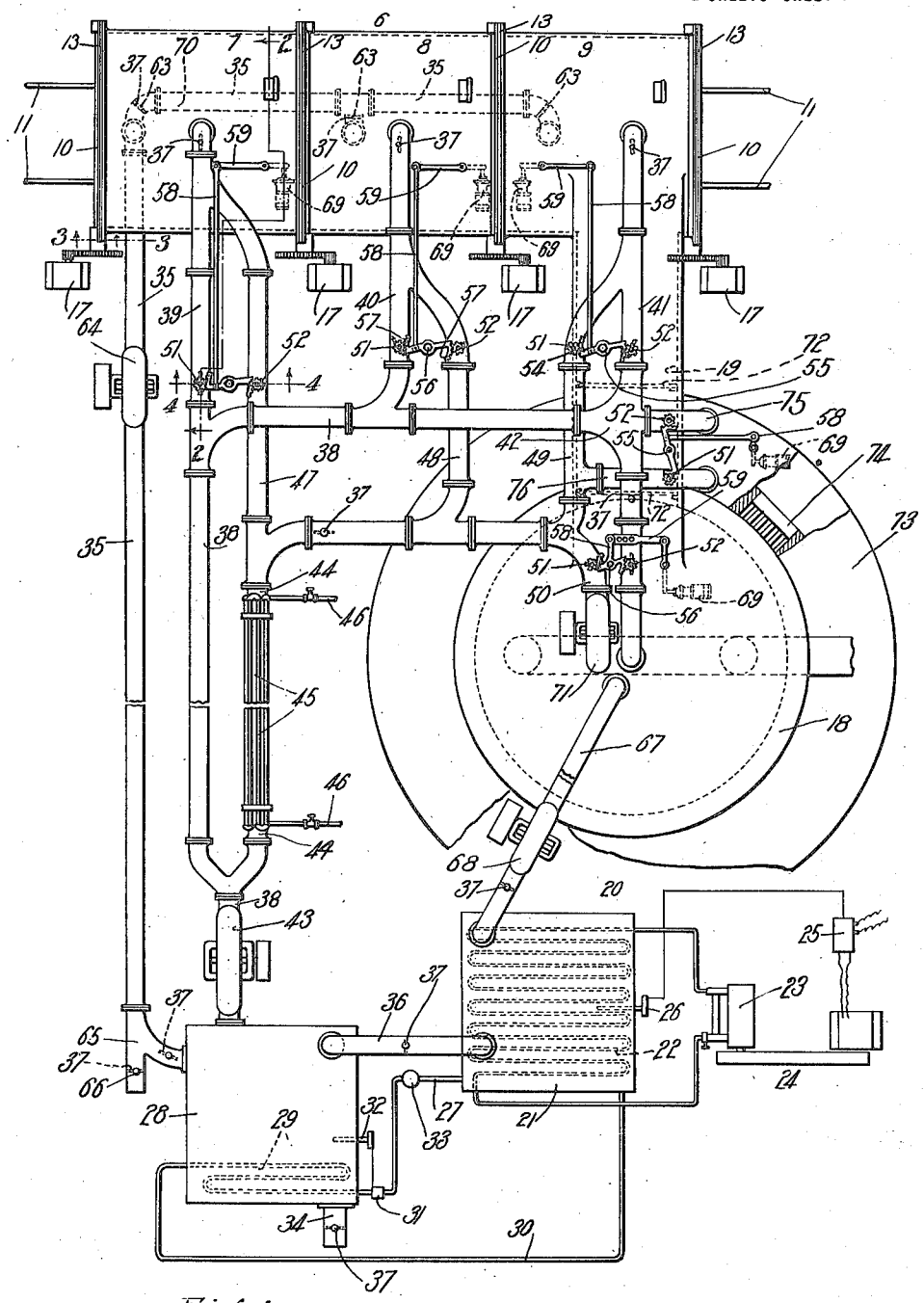


Fig. 1.

Inventor

Frederick A. Secord,

By his attorney, Charles V. Goodwin

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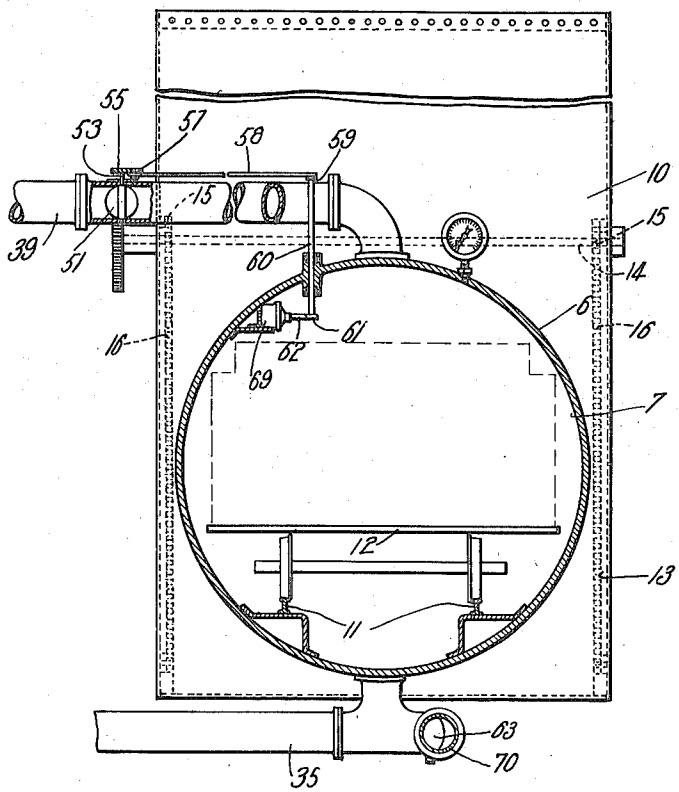


Fig. 2.

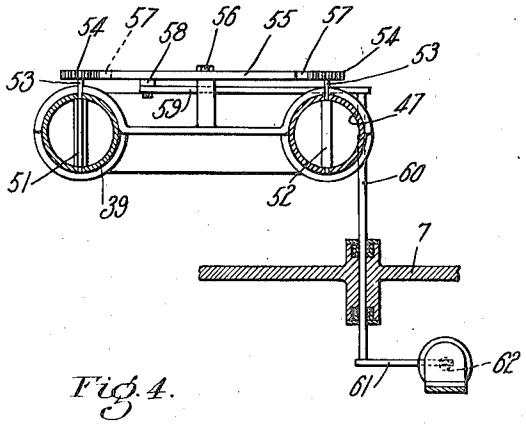


Fig. 4.

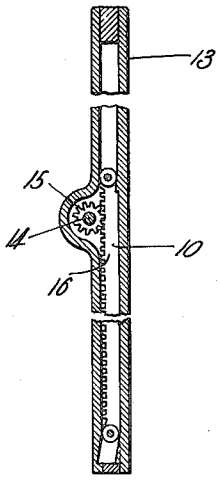


Fig. 3.

Inventor

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UNITED STATES PATENT OFFICE.

FREDERICK AVARD SECORD, OF ST. JOHN, NEW BRUNSWICK, CANADA, ASSIGNOR OF ONE-THIRD TO ALEXANDER PIERCE PATERSON AND ONE-THIRD TO CHARLES HENRY PETERS, OF ST. JOHN, NEW BRUNSWICK.

PROCESS FOR DRYING ARTICLES AND APPARATUS FOR ACCOMPLISHING THE SAME.

1,221,383. Specification of Letters Patent. Patented Apr. 3, 1917.

Application filed November 17, 1915. Serial No. 61,871.

To all whom it may concern:

Be it known that I, FREDERICK AVARD SECORD, a citizen of the United States, residing at St. John, in the county of St. John and Province of New Brunswick, Canada, have invented new and useful Improvements in Processes for Drying Articles and Apparatus for Accomplishing the Same, of which the following is a specification.

This invention relates to improvements in processes for drying miscellaneous articles and more particularly, though not exclusively, to articles constructed of plastic material, such as brick, tile, pottery and the like, and for subsequently burning or baking said brick, tile and the like.

Furthermore, this invention relates to apparatus for accomplishing the same. The present system of drying brick, tile and the like consists in placing the wet clay from which said articles are constructed within suitable chambers and subjecting the same to excessively high temperatures varying from 120° to 300° F. and sometimes higher. These temperatures must be maintained for a considerable length of time in order to thoroughly dry said clay. To maintain such temperatures in any degree of uniformity involves considerable expense and time.

The application of so much heat to the clay, although previously considered essential, produces several objectionable results, for instance, intense heat contacting with the outer layers of the clay quickly evaporates the moisture from said outer layers and before the moisture from the interior of the clay has had a chance to spread or be conducted by capillary attraction or otherwise to the outer layers thereof, said outer layers have become quite dry, causing the material constituting the same to shrink and close the pores thereof.

The result of this drying and shrinking is to form a crust which retards the escape of the moisture within said clay and more especially when such escape must be accomplished by the conversion of the moisture therein into vapor. Such a state of affairs naturally prolongs the drying process of the clay and in fact renders the complete drying thereof impossible. The unequal shrinkage between the outer and inner layers of material constituting said clay develops severe internal stresses which produces cracks between said layers consequently destroying the finished tile or brick and resulting in a large percentage of loss to the manufacturer.

After the brick or tile has been dried as thoroughly as is possible with this system, it is placed within a suitable kiln where it is again subjected to a comparatively low temperature at first to insure the complete drying thereof before the final heat for baking is applied. This precaution is of particular importance, principally for the reason that to apply the final heat to material such as clay which is not thoroughly dry would immediately cause said clay to explode. In addition to the moisture which must inevitably remain within the clay after the drying process has been completed as far as possible, said clay in being transferred from the drying chamber to the kiln is more or less exposed to the atmosphere from which it very readily absorbs or accumulates more or less moisture during such transmission, and this moisture must also be removed before said final heat is applied.

After the burning or baking has been completed a considerable period of time must be consumed with the ordinary methods, in cooling the burnt product which cooling process must be uniform and gradual in order to prevent unequal shrinkage of the several layers of said clay.

The object of the present invention is to provide a process for drying and subsequently baking or burning articles of the nature set forth, whereby the forming of a crust, and exposure to the atmosphere during the drying process and the transference thereof from the drying apparatus to the kiln may be eliminated, and a considerable reduction in the length of time required to complete the drying, subsequent baking and final cooling of the clay, may be secured.

Another object of the invention is to provide instrumentalities adapted to produce and to maintain wide ranges of temperatures in order to accommodate the drying and baking of articles of different characters.

Still another object of the invention is to provide means for removing substantially

all moisture from the air which is to be used in the drying process and in tempering said air.

Another object of the invention is to provide instrumentalities constructed and arranged to supply predetermined quantities of salt and ammonia saturated air to the chambers within which the drying or burning of the clay takes place in order to produce a glaze upon the surface of the finished product.

The invention consists primarily in the improved process hereinafter set forth in the specification and claims, which consists in artificially reducing the temperature of the clay and in removing moisture from the surface of the clay after it has been thus artificially reduced by applying currents of air to the surface thereof.

The invention further consists in the improved process and in the combination and arrangement of parts of the apparatus whereby the above objects and other objects hereinafter appearing may be attained as set forth in the following specification and particularly pointed out in the claims.

Referring to the drawings:

Figure 1 is a somewhat diagrammatic view of an apparatus adapted to accomplish the several steps of the process embodying my invention.

Fig. 2 is a section taken on the line 2—2 of Fig. 1, illustrating the interior of the drying chamber.

Fig. 3 is a section taken on the line 3—3 of Fig. 1, illustrating the preferred form of gate for separating the several compartments of the drying casing from each other.

Fig. 4 is a section taken on the line 4—4 of Fig. 1, illustrating the dampers for controlling the temperature within the drying chamber and the means for operating the same.

Like numerals refer to like parts throughout the several views of the drawings.

In the drawings, 6 represents a casing which is preferably subdivided into a plurality of compartments, in the present instance three are indicated at 7, 8 and 9 respectively.

The particular design and construction of the casing 6 may vary according to the location, capacity and pressures required. The preferred form, however, is cylindrical as illustrated, with several compartments being separated from each other by gates 10 while the opposite ends of the casing are adapted to be closed by gates of the same character, the preferred form of which will be hereinafter more fully described.

A track 11 extends through the several compartments of the casing 6 permitting a car or truck 12 to be moved entirely through said casing. To occupy as little space as possible the gates 10 are arranged to slide transversely of the casing 6 in inclosed casings 13.

A shaft 14 extends transversely of each gate and has secured thereon pinions 15 adapted to engage racks 16 on said gates which upon the rotation of said shaft cause said gates to be moved to open or close communication between adjacent compartments. The shafts 14 may be rotated in any desired manner but the preferred manner of operating them is by means of electric motors 17 each of which may be operated by the closing of a switch at a particular time during the operation of the apparatus.

The last compartment of the series of compartments in the casing 6 has direct communication with a suitable kiln as shown at 18 in which the articles which have been passed through the several compartments may be stacked for the purpose of burning or what is sometimes termed baking. A passageway 19 has been provided to connect the compartment 9 which in the present instance is the last compartment in the casing 6, with the interior of said kiln 18.

In order to successfully carry out the several steps of the process embodied in this invention, it is essential that instrumentalities be provided for maintaining the air in each one of the several compartments of said casing and likewise in the kiln 18 at a predetermined temperature, which temperature may vary from substantially below zero, to several hundred degrees above zero, according to the nature of the tile, brick, pottery or the like, which is to be dried and baked in the apparatus.

Furthermore, it is essential that means be provided for automatically regulating the temperatures as well as for maintaining temperatures at a predetermined point. The first step necessary is to provide an apparatus for cooling the air regardless of the temperature of the atmosphere.

To accomplish this result a refrigerating apparatus 20 has been provided and preferably consists of a brine tank 21 within which are arranged a series of coils 22 of pipe through which ammonia is adapted to be circulated from a tank 23 by electrically driven instrumentalities 24. The electrically driven instrumentalities 24 are controlled by a switch 25 which, in turn, is controlled by a thermostat of any of the well known types arranged within the brine tank 21 and adapted to be operated when the brine in said tank has reached a predetermined temperature, to operate the switch to open or close the electrical circuit controlling said electrically driven instrumentalities.

From the brine tank 21 there extends a pipe 27 which passes into a cooling chamber 28 also provided with a series of pipes 29. A return pipe 30 connects said series 29

with the tank 21. A valve 31 is arranged within the pipe 27 and is adapted to be operated by a thermostat 32 of any well known construction arranged within the cooling chamber 28 adapted to be operated, upon any variation of the temperature within said cooling chamber from a predetermined point, to increase or diminish the supply of cooled brine to said cooling chamber.

A pump 33 is arranged to provide the necessary circulation of said brine from the brine tank to the series of pipes 29 within the cooling chamber 28. A supply of air may be admitted to the cooling chamber 28 either from the atmosphere through an inlet pipe 34, from the casing through a pipe 35, or from the brine tank 21 through a pipe 36, each of said pipes being provided with suitable dampers 37. From the cooling chamber 28 means have been provided for conducting the cold air of the temperature determined by the thermostat 32 to each of the compartments 7, 8 and 9 of the casing 6 and to the kiln 18 through an air conductor 38 to which is connected branch pipes 39, 40 and 41 communicating with the compartments 7, 8 and 9 respectively and a branch pipe 42 extending to the kiln 18.

A blower 43 is installed in the conductor 38 preferably adjacent to the cooling chamber 28 so as to force the cold air from said cooling chamber into all of said compartments. Several methods may be employed for tempering the air which is conducted from the cooling chamber 28 to the several compartments of the casing 6 and also the kiln. The preferred method of accomplishing this result, however, is to provide another branch pipe 44, preferably connected with the pipe 38 adjacent to the blower 43. The pipe 44 passes through a plurality of coils 45 of heating pipe 46 connected with some suitable source of heat.

The pipe 44 is provided with branches 47, 48 and 49 which unite respectively with the branches 39, 40 and 41 of the cold air conductor 38 while another branch 50 is connected with the kiln 18. In order that the temperature of the air which is supplied to the several compartments may be regulated and maintained at the desired point, means have been provided for automatically regulating said temperature, said regulating means preferably consisting of a pair of dampers 51 and 52 arranged in the cold and hot air conductors slightly in advance of the point at which said conductors unite adjacent to their connection with the several compartments.

Each of said dampers is provided with a spindle 53 which projects through the conductor within which it is located and has secured to the outer end thereof a pinion 54. A rocker arm 55 pivoted at 56 between the two dampers 51 and 52 is provided with a segmentally arranged series of teeth 57 at opposite ends thereof which engage the pinions 54, and upon being rocked, cause the dampers 51 and 52 to be simultaneously operated with their spindles. The relative positions of said dampers with respect to each other is substantially at right angles so that when one is entirely closed the other will be wide open, whereby a current of air equal to the capacity of one conductor may always be passing therethrough.

The rocker arm 55 is connected by means of a link 58 preferably with a lever 59 attached to one end of a rocker shaft 60 which extends through the wall of the casing 6. To the opposite end of said shaft 60 is secured another lever 61 which, in turn, is operatively connected to the stem 62 of the thermostat of any of the well known forms adapted to be expanded or contracted by varying temperatures within the casing 6 and which may be set at a predetermined temperature so that the least variation of the temperature either upwardly or downwardly will operate the connecting instrumentalities between said thermostat and said dampers to permit the necessary proportions of hot and cold air to be mixed prior to its admittance into said casing and thereby maintain the temperature therein at the point determined.

The regulating instrumentalities for the several compartments and also the kiln are preferably substantially identical so that a description of one will suffice.

Another important step in the system of drying substances is to reduce the pressure of the air within one or all of the compartments of said casing 6 and in order that this may be accomplished the pipe 35 has been extended to each of the compartments 7, 8 and 9 and a damper 63, is provided adjacent to the connecting point of each of said branches with its respective compartment so that said compartments may be connected with or shut off from the pipe 35.

A blower 64 is connected with the pipe 35 for the purpose of exhausting the air from said compartments. A branch pipe 65 is supplied for discharging the air which is exhausted from the compartments 7, 8 and 9 to the atmosphere when desired, said pipe being provided with a damper 66. The kiln 18 is connected through an air conductor 67 with the brine tank 21 through which air may be forced in one direction or the other by a blower 68 connected therewith.

The preferred method of drying articles of the nature hereinbefore set forth in the apparatus described is as follows:

The material to be dried is placed upon the car 12 and moved into the first compartment 7 of the casing 6. The gates 10 at opposite ends of said compartment are then

closed. The atmospheric air within said compartment 7 is then preferably wholly or in part withdrawn by operating the blower 64 so as to remove substantially all moisture from said compartment. This air may, if desired, be forced through the pipe 35 and discharged through the discharge pipe 65 to the atmosphere. Preferably, however, this air is adapted to be turned into the cooling chamber 28 within which the temperature has been reduced to a predetermined degree, said degree being substantially 39.2° F. or lower.

By cooling the air in this manner any moisture which may have been contained therein before the same enters the cooling chamber 28 will be reduced to its maximum density and condense upon the walls of said casing, thus removing substantially all moisture from said air. The blower 43 is then operated to withdraw the dry air from said cooling chamber and force the same through the conductor 38 to the compartment 7. The air as it passes into the compartment 7 being at such a low temperature causes more or less moisture within the clay which is in said compartment to also condense upon the surface of said clay.

When the temperature of air has been reduced to substantially 39.2° F. said air will be as free from moisture as it will be possible to make it. In like manner, if the clay within the compartment 7 is exposed for a predetermined period to the same temperature the moisture within said clay will be brought to the surface thereof and there condensed. Air, the temperature of which has previously been reduced to substantially 39.2° F. and subsequently increased, is then passed through the compartment 7, and the moisture which has been condensed on the surface of the clay within the chamber referred to will be readily absorbed by said air and thus remove the condensation from said compartment and said clay.

The air thus tempered is never heated to a temperature high enough to form a crust upon the surface of the clay, and therefore the pores of said clay will remain open until substantially every particle of moisture therein has been removed. The tempered air hereinbefore referred to may be admitted to the compartment 7 after cold air has been passed therethrough or, if desired, the cooling of the clay may take place in said compartment 7 and the removal of the moisture therein be accomplished in the next compartment of the series. The apparatus, however, is constructed so as to permit either system to be employed.

To accomplish the tempering of the air hereinbefore referred to, the coils of the pipe 45 are arranged along the branch pipe 44 said coils being heated and adapted to convey considerable heat to the air as it is conducted through the pipe 44. After the temperature which is most advantageous for the drying of clay or like articles has been determined, the thermostat or temperature regulating apparatus may be set and the valves or dampers 51 and 52 automatically operated thereby to maintain whatever temperature has been previously determined. When the clay within the compartment 7 has become sufficiently dried and ready for the kiln, the gate between said compartment 7 and the next compartment 8 may be opened and the car pushed along into said next compartment.

Previous to the admission of said clay to said compartment 8 the atmospheric air within said compartment should preferably be removed by means of the blower 64 connected therewith through the conductor 70, and replenished with absolutely dry air from the cooling chamber 28 which air is preferably tempered somewhat above that within the compartment 7.

The temperature within the compartment 8 may be automatically controlled and regulated by means of the thermostat 69 connected to the dampers 51 and 52 arranged within the branch pipes 40 and 48 which unite to supply air to the compartment 8. The next compartment 9 of the series of compartments is preferably heated to a temperature substantially above that of the compartment 8, but in substantially the same manner through the conductors 41 and 49.

The temperature in the compartment 9 is preferably the same as that within the kiln 18 which may be supplied with air of a predetermined temperature through the conductors 50 and 42 which are connected with the conductors 38 and 44. This arrangement of the conductors and air supplying instrumentalities permits the temperature of the kiln to be adjusted at will to accommodate the workmen who transfer the tile or clay from the casing 6 to said kiln. The several compartments with the exception of 7 are preferably for the purpose of gradually increasing the temperature of said clay during its transfer from the drying chamber to the kiln so as not to expose the clay to any sudden changes of temperature and also to eliminate any possibility of said clay absorbing any moisture after it has been dried and while being moved from the drying chamber to the kiln.

After the baking of the clay has been accomplished and before it is removed from the kiln, it must be cooled. To accomplish this result air heated to a predetermined temperature may be admitted through the conductors 42 and 52 from the air cooling and heating instrumentalities 28 and 45 respectively, until the clay is cool enough to be removed from said kiln. The tempera-

ture of the air entering said kiln through the conductors 42 and 50 may be gradually reduced by means of the dampers 51 and 52 arranged in the pipes 42 and 50.

It is sometimes desirable to utilize the heat from the kiln to assist in heating the dry air from the cooling chamber 28. To accomplish this result a blower 71 has been connected with the hot air conductor 50 so that the dry hot air from the kiln may be conducted into the several compartments of the casing 6.

It has been stated that one of the objects of the invention is to provide instrumentalities constructed and arranged to supply predetermined quantities of salt and ammonia saturated air to the chambers within which the drying or burning of the clay takes place in order to produce a glaze upon the finished product. To accomplish this result the brine tank 21 has been connected by means of an air conductor 36 with the cooling chamber 28. Another air conductor 67 connects said brine tank with the kiln 18, thus air may be drawn through said brine tank which, in passing therethrough, will absorb salt and ammonia vapors which may then be conveyed either to the kiln direct or to the several drying and tempering compartments through the cooling chamber 28 and conductors 38 and 44. The blower 68 facilitates the transfer of said salt and ammonia laden air from said brine tank to the kiln while the blower 43 is sufficient to convey the necessary proportions of salt air to the compartments 7, 8 and 9.

It will be obvious that with the apparatus hereinbefore set forth articles greatly differing in character and substance may be dried owing to the wide range of adjustment of said apparatus. Furthermore, the complete removal of moisture from the clay before the same is transferred to the kiln will be assured and the absorption of moisture by the clay as it is transferred from the drying compartments to the kiln will be absolutely prevented.

The time required for completing the entire drying and baking process will be greatly reduced as compared with that consumed with the systems now employed, for the reason that the exact temperature of the several compartments, best suited to the drying, baking and cooling may be maintained for any length of time, or changed at will to hasten or retard the same without regard to the condition or temperature of the atmosphere outside, which condition seriously affects the drying and baking systems now in common use.

In addition to regulating the temperature of the kiln 18 previous to the baking of the clay therein and during the cooling of said clay subsequently to said baking, it is also one of the advantages of this invention to supply dry tempered air of a predetermined temperature to the several furnaces of the kiln which will result in a considerable saving in time over the present methods employed.

To render this possible, the kiln 18, which is preferably circular, is surrounded by a chamber 73 which embraces all of the furnaces of said kiln, one of which is illustrated in section at 74, and as this is, in substantially all respects, similar to the other furnaces connected with said kiln, but one has been shown. The chamber 73 has communication with the passageway 19 but is adapted to be shut off from said passageway by suitable gates 72.

Tempered air, which has previously been reduced to a temperature substantially 39.2° F. is adapted to be conducted to the chamber 73 through a branch pipe 75 connected with the cold air conductor 38 and a hot air pipe 76 connected with the hot air conductors 44 and 49. With this arrangement of the conductors, a great saving of time and expense will result, owing to the removal of the moisture from the air before it is admitted to the furnaces and also to the tempered condition of said air.

Having thus described my invention what I claim and desire by Letters Patent to secure is:

1. A process for drying clay which consists in placing said clay within a closed casing and then in circulating through said casing and in contact with said clay currents of air having a temperature artificially reduced to substantially 39.2° F. until the temperature of said clay is thus artificially reduced and then continuing the circulation of currents of air in contact with said clay until the moisture at the surface of said clay is removed.

2. A process for drying clay which consists, first in artificially reducing the temperature of said clay and second in removing moisture from the surface of said clay by applying currents of air to the surface thereof.

3. A process for drying clay which consists in placing the material to be dried within a closed casing, then in passing through said casing and in contact with said clay currents of air having a temperature artificially reduced to substantially 39.2° F. until the temperature of said clay is thus artificially reduced and then in artificially increasing substantially the temperature of said currents of air, whereby moisture is removed from the surface of said clay and from said casing.

4. A process for drying clay which consists first in artificially reducing the temperature of said clay by applying currents of air of lower temperature than that of said clay to the surface thereof, and second in remov-

ing moisture from said clay by applying currents of air to the surface thereof.

5. A process for drying clay which consists first in artificially reducing the temperature of said clay by applying currents of air of lower temperature than that of said clay to the surface thereof and second in removing moisture from said clay by applying currents of air of increasing temperature to the surface thereof.

6. An apparatus for drying and baking clay having, in combination, a kiln and a drying casing, each adapted to contain clay, means for reducing the temperature of air, means for circulating said air through said casing and said kiln and in contact with said clay, said circulating means including a pair of conductors, means for heating the air in one of said conductors and instrumentalities for automatically regulating the amount of air passing through said conductors and into said casing and kiln, whereby the temperature of the air circulating through said casing and kiln may be regulated.

7. In an apparatus for drying clay, a casing for said clay, a pair of conductors connected with said casing, instrumentalities constructed and arranged to remove substantially all moisture from the air passing through said conductors, heating instrumentalities arranged adjacent to one of said conductors, means for forcing the moisture-less air through said pair of conductors into said casing and instrumentalities constructed and arranged to automatically mix air from said heating instrumentalities with the air in the other conductor whereby said air may be heated to the desired temperature.

8. In an aparatus for drying clay a series of casings, means adapted to open and close communication between the several casings of said series, means for conveying the material to be dried successively through said series of casings, means for conducting air to each of the casings in said series, instrumentalities constructed and arranged to remove substantially all of the moisture from the air passing into said casings, instrumentalities constructed and arranged to heat portions of said air, and means for independently regulating the temperature of the air entering each of said casings.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

FREDERICK AVARD SECORD.

Witnesses:
SYDNEY E. TAFT,
HATTIE E. STRATTON.