Dec. 20, 1932. C. A. COLEMAN 1,891,469

KILN

Filed Feb. 13, 1931 2 Sheets-Sheet 1

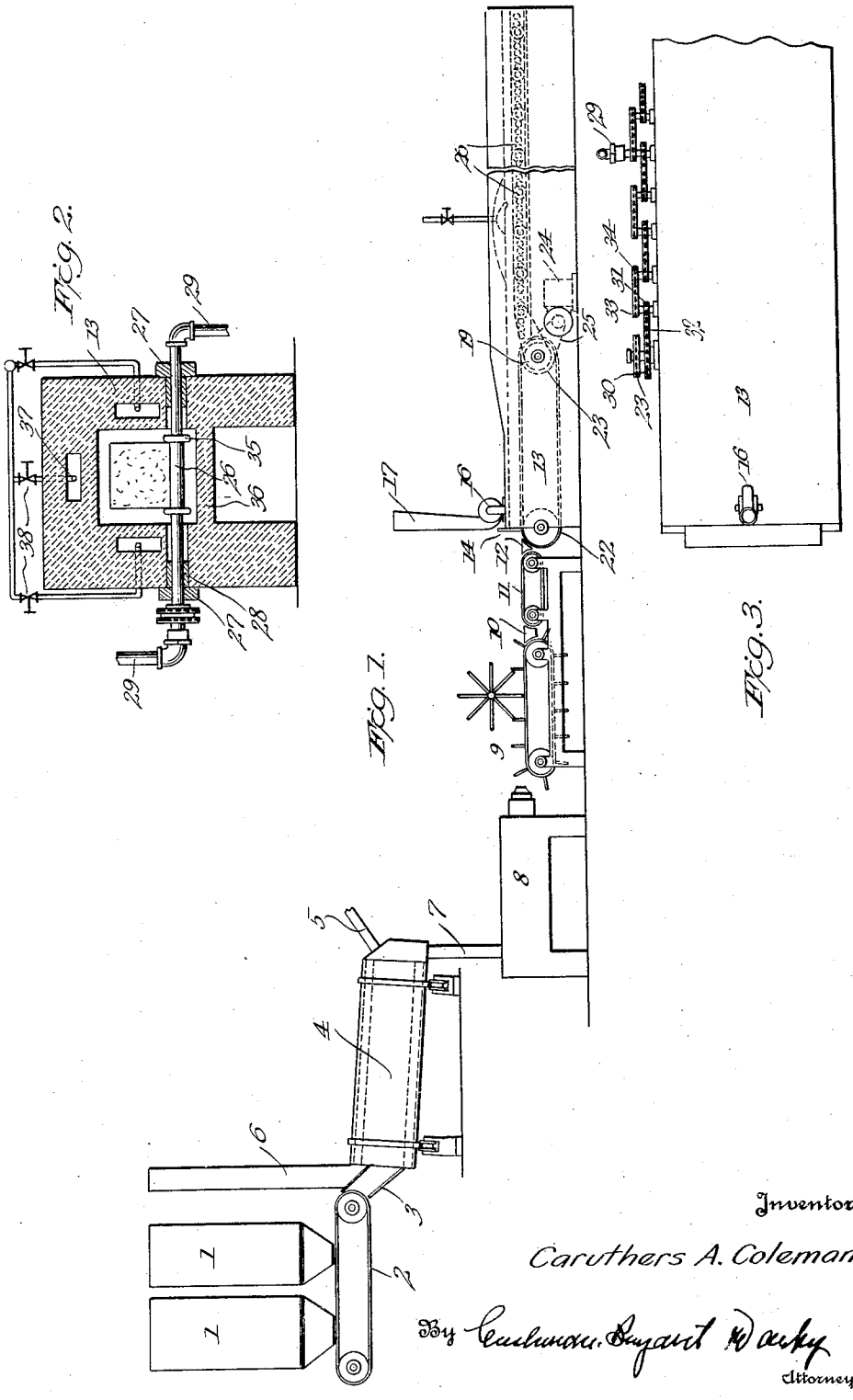

Fig. 1.

Fig. 2.

Fig. 3.

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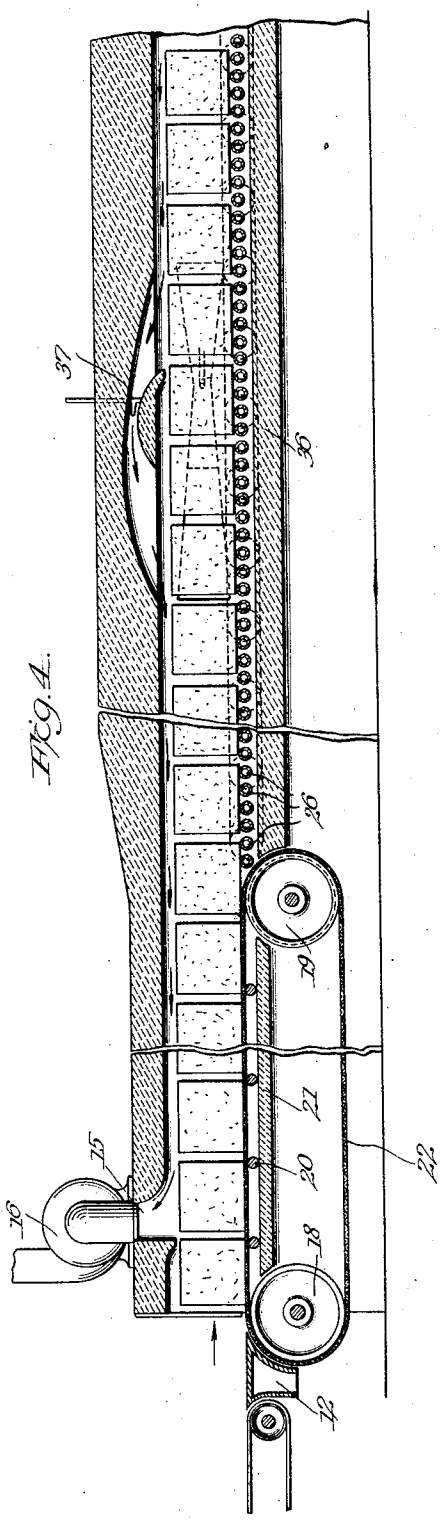

Fig. 4.

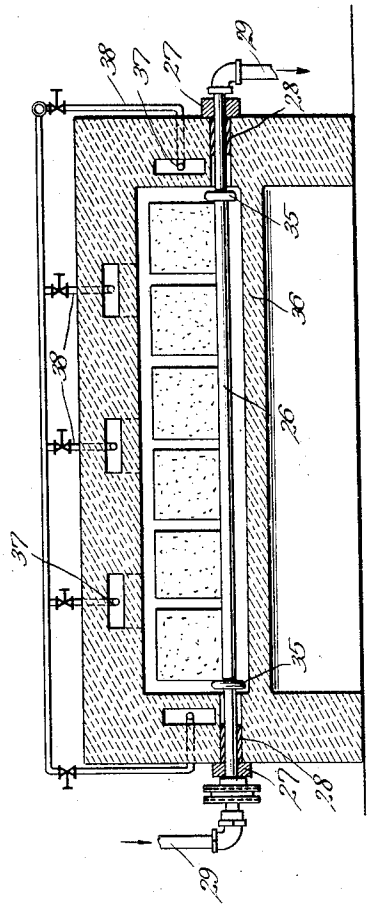

Fig. 5.

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UNITED STATES PATENT OFFICE

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KILN

Application filed February 13, 1931. Serial No. 515,615.

The invention relates to a kiln.

There are generally two methods used in connection with burning or baking clay products in tunnel kilns, namely a continuous operation and a periodic operation, continuous in the sense that the products are burned or baked as they pass through the kiln, and periodic in the sense that the products are allowed to remain in the kiln the required length of time to be burned or baked.

Heretofore in tunnel kilns it has been the practice to transport products through the kiln in a series of tiers loaded on cars riding on tracks or to carry them in a series of tiers on some type of conveyor. In so doing the products are allowed to pass the burners or furnace portion of the kiln or are allowed to remain adjacent the burners or furnace portion a designated period of time and then taken out and allowed to cool. This mode of burning or baking has proven very unsatisfactory since portions of the products do not receive the full effect of the heat. Some will be more burned or baked than others, the shrinkage will not be uniform, and in many instances they will be defective and of no value. The difficulty appears to be in subjecting a uniform and constant heat throughout the kiln so that all portions of the products will come in full contact therewith.

Prior to the burning or baking process the products must, of course, be dried, and subsequent to the said process, they must be cooled before being used.

By utilizing a truly continuous method of operation in a kiln, and a regenerative principle of maintaining a constant and proper temperature therein, I have overcome the heretofore mentioned difficulties with a relative large saving in cost of manufacture, with greater increased production.

One of the objects of my invention is to provide a kiln which is regenerative.

Another object of my invention is to provide a kiln which is absolutely continuous in its operation.

Another object of my invention is to provide a kiln in which the processes of drying, preheating, burning or baking, and cooling, are effected.

Another object of my invention is to provide a kiln in which the various processes can be performed with comparatively great rapidity, and consequently the production will be immensely increased.

Another object of my invention is to provide a kiln which will deliver the products with a high uniform quality, and the practice of discarding a considerable amount of products due to lack of uniformity will be reduced to a minimum.

Another object of my invention is to provide a kiln, the use of which will materially reduce the cost of production.

Still another object of my invention is to provide a kiln which is simple in structure, durable, and cheap to construct, and in which the conveying apparatus is entirely enclosed.

With these and other objects and advantages in mind, attention is called to the drawings, in which:

Figure 1 is a side view of the kiln in combination with the various other apparatus used in the manufacture of clay products.

Figure 2 is a cross sectional view of the kiln taken on the line 2—2 of Figure 1.

Figure 3 is a plan view of a portion of the kiln.

Figure 4 is a longitudinal sectional view of the kiln.

Figure 5 is a cross sectional view of another form of the kiln of larger size.

Referring to the drawings in which like numbers indicate like parts, and particularly to Figure 1, 1 indicates hoppers in which the raw material or materials, such as powdered clay products of the desired varieties, are placed. The hoppers are regulated to deposit the necessary amount of raw materials upon an endless belt conveyor 2, which carries the same to a chute 3 leading into an apparatus 5 for maintaining and preliminarily heating the raw materials by means of steam injected through pipe 4 and exhausted through pipe 6.

Extending downwardly from the apparatus 4 is a pipe or chute 7 which delivers the materials to a suitable mixing and extruding apparatus 8. The extruded material is delivered to a cutting apparatus 9 of any well known type, such as the one shown, from

whence the now properly cut materials ride over the platform 10 onto the endless belt conveyor 11 driven by suitable power means, not shown. A platform 12 is provided at the other end of the conveyor 11 and the products pass over this into the regenerative kiln 13.

The regenerative kiln 13 is provided with a passage through its entire length and at its receiving end is closed by a door or gate 14. It is possible, of course, to provide this door or gate with an automatic opening and closing means, which is contemplated (but not shown) in the combination of apparatus to carry out my method of manufacturing clay products, said method being the subject of another application.

Adjacent the entrance and through the roof of the kiln is an opening 15, on top of which is mounted a suction fan 16 having an exhaust pipe 17. This fan is driven by suitable power means, not shown. It is possible, of course, to provide a fan at the outlet of the kiln which will drive the air therethrough, or at various points throughout the entire length of the kiln in order to maintain the proper draft of air.

Extending from the front end of the kiln to a designated point inside thereof is an endless belt conveyor comprising the pulleys 18 and 19, supporting rollers 20 mounted above the floor member 21, and around which runs the endless belt 22. The shaft of wheel 19 is supported by suitable bearings outside of the walls of the kiln, and is provided with a sprocket 23 which is in driving connection with the motor 24, by means of a chain 25.

The endless belt 22 is composed of a perforated substance, such as wire mesh or some other suitable material, the purpose of which will be later explained.

Positioned directly forward of the endless belt conveyor is a platform comprising a series of rollers 26. These rollers extend through the sides of the walls of the kiln and are supported in bearings 27 which, due to their outside position, may be kept properly lubricated. An insulating sleeve 28 is placed adjacent the bearings. The rollers are composed of metal or some other suitable refractory material, and as here shown, are hollow to allow circulation therethrough of a cooling agent to prevent the burning thereof, pipes 29 being provided for this purpose.

At spaced intervals there are placed power driven rollers. The first power driven roller adjacent the endless belt conveyor derives power therefrom by means of a sprocket wheel 30 on the shaft of the wheel 19, sprocket wheel 31 on the roller, and chain 32. The next power driven roller derives its power from the first power driven roller by means of the sprocket wheels 33 and chain 34. The remaining power driven rollers, except the last one, have thereon two sprocket wheels interconnected by chains. The number of power driven rollers and the intervals thereof depends upon the size of the products passing through the kiln, it being necessary, of course, to maintain the product in contact with one of said power driven rollers. It is obvious, of course, that means other than sprocket wheels and chains may be utilized to drive the rollers. Each roller is provided with guide flanges 35 between which the products move. A floor member 36 is positioned beneath the rollers.

At a proper place in the kiln are positioned, in suitable recesses, burners 37 having inlet pipes 38 leading thereto. In order to facilitate the burning or baking of all types of products, there are shown in the present disclosure top and side burners controlled by suitable valves so that one or all of the burners may be used, as required. From the foregoing description, it will be noted that the entire conveying apparatus is inside of the kiln and thereby maintains a constant temperature. Heretofore, where the conveying apparatus is partially outside of the boiler, great loss of heat is experienced.

With the suction fan and burners in operation, the kiln functions as follows:

The suction fan draws cool air into the kiln at its open end, and a definite draft of air is thus created through the entire length of the passage thereof, which is finally exhausted by means heretofore described. As the products enter the kiln they come into contact with a draft of air heated to a sufficient temperature to present a perfect drying phase. Due to the perforated endless belt conveyor the heated air is allowed to reach all portions of the products and the speed thereof is so regulated to assure a thorough drying. As the products reach the end of the belt conveyor they will approach a preheating phase which becomes more pronounced upon their coming into contact with the draft of air nearer the burners. The rollers propel the products toward the burning or baking phase where they will receive the full effect of the heat, and as they pass the burners and continue to the outer portion of the kiln, contact is made with the cooler air, until by the time the end of the kiln is reached, they are completely cooled. During the cooling phase the regenerative properties of the kiln are greatly emphasized in that as the cool air passes over the heated products, it will in turn become heated by radiation therefrom, and as it is drawn rearwardly, become more heated. By the time the air reaches the burners its cooling effect will be lost and the temperature thereof increased proportionately by contact with the burners.

At the same time the perforated endless conveyor will maintain its temperature, as will the rollers, and the only loss of heat from the entire kiln will be from outside radiation,

which to a certain extent cannot be eliminated. Heretofore in tunnel kilns, where cars carrying the clay products are run through the kiln, a great amount of heat has been lost due to the cooling effect of the metal and the refractory tops thereof, and where the cars have themselves been preheated, additional apparatus is needed, more time consumed, and greater expense incurred. It therefore can be seen that the heat required during the phases of progress through the kiln as described, is constantly maintained and the amount of heat can be reduced at its source with a tremendous saving of cost.

It is difficult to divide the various phases of drying, preheating, burning or baking, and cooling into definite zones as they are actually so blended and so constant that no lines of demarkation can be drawn.

From the foregoing description of the kiln and operation thereof, it will be observed that a continuous process takes place, and therefore greater production, and that because of the regenerative functions of the kiln not only is a more constant and a perfect heat distribution in its various phases obtained, but also a definite saving in the cost of the products of combustion, and a greater uniformity in the quality of the products.

It is obvious that there are many changes which may be made in the structure of the kiln as well as various modifications, without departing from the spirit and scope of the appended claims.

I claim:

1. In a kiln, a passage therethrough, a burner therein, conveying means comprising a perforated endless conveyor and rollers in said passage, and means for maintaining constantly different phases of temperature throughout said passage.

2. In a kiln, a passage therethrough, a burner therein, conveying means comprising a perforated endless conveyor and rollers in said passage, said rollers having guide flanges thereon, and means for maintaining constantly different phases of temperature throughout said passage.

3. In a kiln, a passage therethrough, a burner therein, conveying means comprising a perforated endless conveyor and rollers in said passage, means to cool said rollers, and means for maintaining constantly different phases of temperature throughout said passage.

4. In a kiln, a passage therethrough, a burner therein, conveying means in said passage comprising a perforated endless conveyor and rollers, some of which are power driven, and means for maintaining constantly different phases of temperature throughout said passage.

5. In a kiln, a passage therethrough, a burner therein, an endless perforated conveyor in said passage, means to drive said endless conveyor, rollers in said passage, means to drive some of said rollers, and means for maintaining constantly different phases of temperature throughout said passage.

6. In a kiln, a passage therethrough, a burner therein, an endless perforated conveyor in said passage, means to drive said endless conveyor, rollers in said passage, a driving connection between said endless conveyor and one of said rollers, and means for maintaining constantly different phases of temperature throughout said passage.

7. In a kiln, a passage therethrough, a burner therein, an endless perforated conveyor in said passage, means to drive said endless conveyor, rollers in said passage, a driving connection between said endless conveyor and one of said rollers, some of said remaining rollers deriving driving power therefrom, and means for maintaining constantly different phases of temperature throughout said passage.

8. In a kiln, a passage therethrough, a burner therein, an endless perforated conveyor in said passage, means to drive said endless conveyor, rollers in said passage, said rollers being hollow and having a conduit at each end to allow the flow of a cooling agent therethrough, a driving connection between said endless conveyor and one of said rollers, some of said remaining rollers deriving driving power therefrom, and means for maintaining constantly different phases or temperature throughout said passage.

In testimony whereof I have hereunto set my hand.

CARUTHERS A. COLEMAN.