No. 692,257. Patented Feb. 4, 1902.

B. E. ELDRED.

METHOD OF CALCINING LIME, &c.

(Application filed Feb. 18, 1901.)

(No Model.)

FIG. 2.

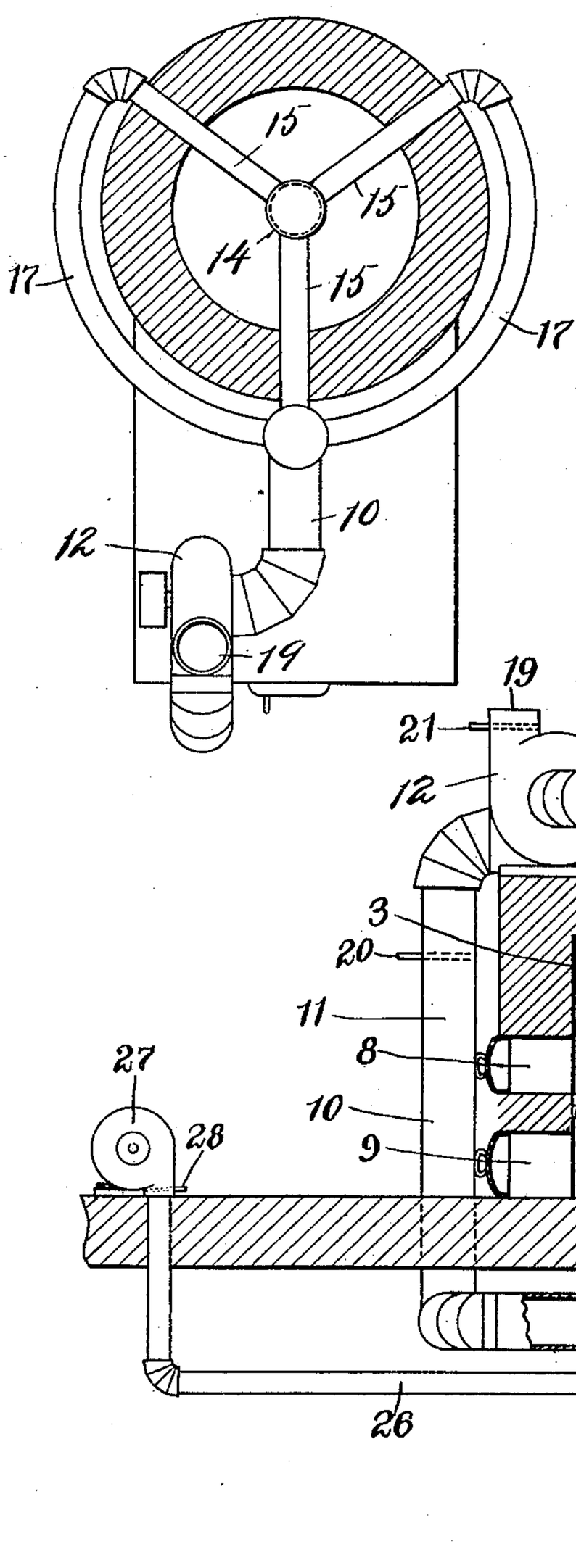
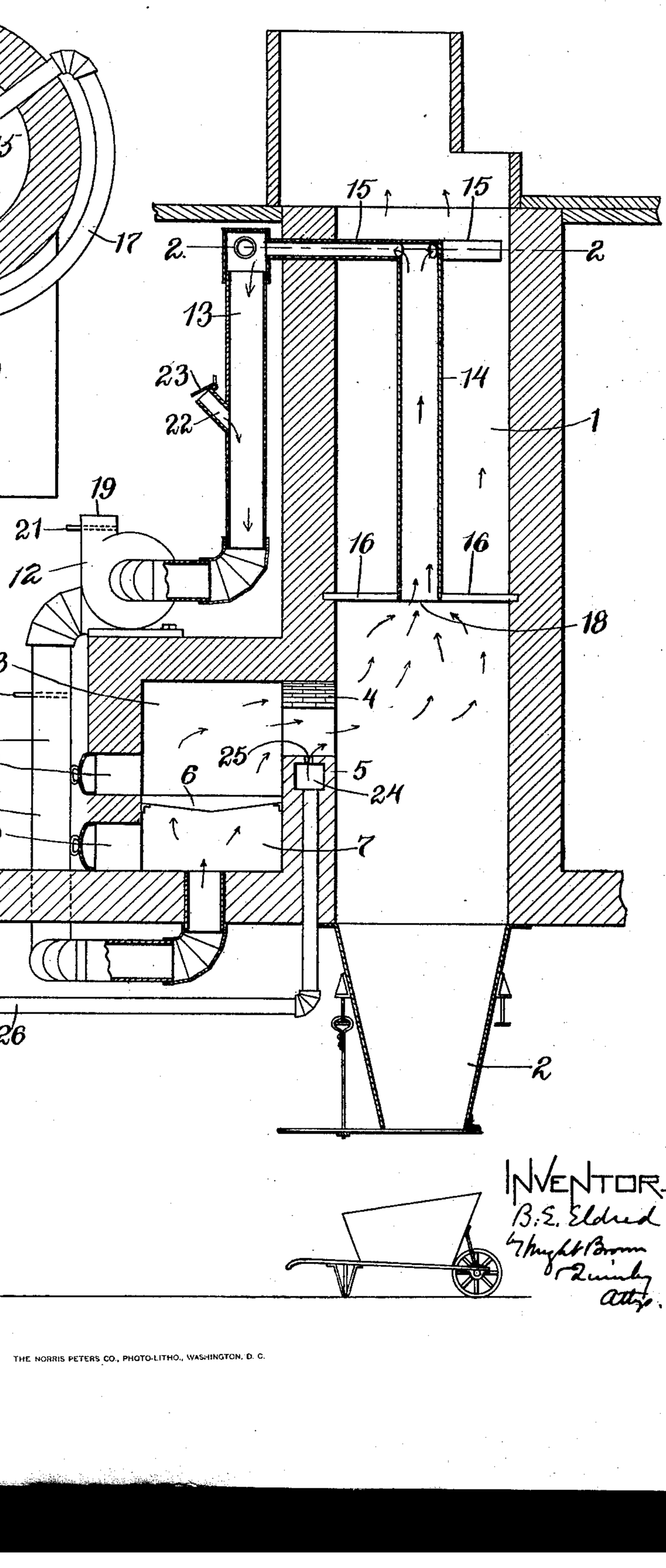


FIG. 1.



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METHOD OF CALCINING LIME, &c.

SPECIFICATION forming part of Letters Patent No. 692,257, dated February 4, 1902.

Application filed February 18, 1901. Serial No. 47,782. (No specimens.)

To all whom it may concern:

Be it known that I, BYRON E. ELDRED, of Brookline, in the county of Norfolk and State of Massachusetts, have invented certain new and useful Improvements in Methods of Calcining Lime, &c., of which the following is a specification.

The object of this invention is to control the temperature, volume, and duration of flame or combustion.

It consists in a method or process whereby in place of the ordinary pure-air draft which it is customary to supply to a fire the combustion of the fuel is conducted by means of an artificially-accelerated draft composed of air and a neutral gaseous diluent. I am thereby enabled to greatly retard the liberation of the heat units of the fuel and to produce a long flame of large volume.

An important application of my invention is in the burning or calcining of lime, in which art or industry it effects great economies in the cost of the process and improvement in the quality of the product, and I have hereinafter described my invention in connection with lime-burning, although I do not consider it as limited to this art.

The usual method of burning lime under the continuous process with external fires is by the use of wood as fuel. Wood has a comparatively low calorific power, yielding sufficient heat to effect the calcination of the lime-rock without overburning the lime; but its cost as a fuel is high in most localities as compared with that of coal and the available supply is constantly diminishing. The employment of coal in place of wood as fuel with ordinary methods of conducting combustion results in overburning of the lime. The calorific power of coal being much higher than that of wood, the intense heat developed by its combustion results in the formation of a slag by the melting of fusible impurities in the lime-rock, and there is obtained a product which will not slake thoroughly or only after a long period, often slaking to some extent after it has been made up into plaster or mortar and applied to buildings or elsewhere, producing the very undesirable effect known as "pitting." The combustion of an ordinary coal-fire in a kiln takes place mainly within the furnaces and is expended upon the furnace-walls rather than upon the lime-rock, causing rapid deterioration of linings and producing a short flame of small volume which is incapable of properly filling the cross-section of the kiln-body and burning the mass of rock uniformly throughout, but instead climbs the walls of the kiln where the draft is strongest and burns the lime at the sides more rapidly than at the center. Any artificial acceleration of a pure-air draft through a coal-fire merely tends to intensify the combustion and increase the rapidity with which the heat units are evolved, and such an expedient has never, so far as I am aware, been resorted to in a limekiln without increasing the evils which arise from an already too intense supply of heat. My invention enables me to use coal without overburning the lime and to obtain practically perfect combustion from very inferior grades of coal.

In applying my invention to the burning of lime with external coal-fires I pass through the fire as a draft-current or draft under artificial acceleration furnished by any suitable means, such as a fan-blower, a mixture of air and a neutral gaseous diluent. The latter may conveniently be derived from the kiln itself in the form of the gaseous products of the calcination of the lime and the combustion of the fuel. The gas driven off by heating the limestone is carbon dioxid or carbonic acid, (CO_2,) and the products of combustion are mainly free nitrogen and carbon dioxid, both of which are neutral as respects combustion—that is to say, they are non-combustible in oxygen and are non-supporters of combustion. They act as a diluent and carrier for the air. This artificially-accelerated draft when passed through the coal-bed on the grate maintains the combustion of the coal sufficiently to produce a rapid and abundant evolution of combustible gases; but on account of the dilution of the air in the draft by the kiln-gases, the expansion which it undergoes by being heated by these gases, and the speed of the draft combustion is incomplete within the furnace and a considerable quantity of fuel-gases escapes into the body of the kiln. Here the heating agent—namely, the flaming draft or current which passes off from the fuel-bed—may be supplied

with additional air to complete the combustion of the fuel-gases and obtain the maximum evolution of heat which they are capable of affording. The final evolution of heat from the fuel takes place within the body of lime-rock to a far greater extent than when the fires are supplied with a pure-air draft. In other words, the heat of the fuel is evolved at the point where it is needed and where it can do direct work in calcining the lime and is not uselessly expended in overheating the furnace-walls and overburning the lime at the mouth of the furnace. It naturally follows that this process effects great economy in fuel.

Of the accompanying drawings, Figure 1 represents a vertical section of a kiln for carrying my improved process into effect. Fig. 2 represents a horizontal section on the line 2 2 of Fig. 1.

The same reference characters indicate the same parts in both figures.

Referring to the drawings, 1 represents the cupola or calcining-chamber of the kiln, in which the material to be calcined is placed, the said cupola having an upper outlet to the atmosphere, and 2 represents a cooler at the lower end of the calcining-chamber. The broken stone or other fragmental material to be calcined is fed into the top of the cupola 1, and the burned lime is from time to time withdrawn from the cooler 2.

3 is a furnace, of which there may be more than one, communicating with the cupola 1 through an opening or arch 4 and having a bridge-wall 5, grate 6, and ash-pit 7 below the grate.

8 and 9 are the fire and ash-pit openings, provided with suitable doors.

10 is a draft pipe or conduit connecting at its upper end with a flue 14 in the cupola and at its lower end with the ash-pit 7 and having interposed in it a fan-blower 12. The part 13 of the conduit 10 above the fan 12 constitutes the suction-pipe of said fan and the part 11 below the fan constitutes a delivery-pipe therefor. A gate or valve 20 controls this delivery-pipe. The fan has also an auxiliary outlet or delivery pipe 19, controlled by a gate or valve 21, through which a portion of the kiln-gases may be disposed of without causing them to pass through the fire. At 22 the suction-pipe 13 is provided with an air-inlet, controlled by a valve 23. By adjusting this valve the relative proportion of air and kiln-gases in the draft may be exactly controlled. The flue 14 is placed vertically and centrally in the cupola with an inlet-orifice 18 at its lower end and is supported from the walls of the kiln by radial upper and lower arms 15 16. The upper arms 15 are hollow and in connection with outside pipes 17 17 form passages connecting the flue 14 with the upper end of draft-pipe 10. To prevent the flue from burning out, it may be constructed of refractory material or protected in any suitable manner. While the flue has a beneficial effect in drawing the flame into the center of the lime-rock, yet it is in no wise essential to the proper carrying out of my invention and may be omitted and the kiln-gases drawn from any convenient point in the cupola.

The bridge-wall 5 is provided with a conduit 24, having outlets 25 along the crest of the wall and connected by a conduit 26 with an auxiliary fan-blower 27, the blast from which is regulated by means of a gate or valve 28 in the conduit. A supply of air capable of being accurately regulated is thereby added to the heating agent or outdraft from the furnace 3, as this outdraft passes into the body of lime-rock in order to complete the combustion of the fuel-gases within said body of rock. The final air-supply may be added in any other suitable manner and at a different point or points, if desired, and, furthermore, I do not limit myself to supplying pure air to effect final combustion.

During the operation of the kiln the door covering the ash-pit opening 9 is kept closed, so that a forced draft may be obtained through the body of fuel on the grate and the whole of the draft for the fire is supplied through the pipe 10. The fan 12 is run at such speed as to accelerate this draft to a considerable extent above the speed of the natural draft of the fire, and thereby to secure a vigorous expulsion of the flame and gases proceeding from the fuel-bed from the furnace into the cupola. I thereby insure a direct penetration of the heating agent to the central portions of the lime-rock in the kiln, which is unobtainable under a natural draft. Combustion itself takes place to a greatly-increased extent within the body of lime-rock, and the furnace is cooler than with a pure-air draft. One effect of the diluent kiln-gases is to attenuate the oxygen and the combustible gases evolved from the fuel-bed, so as to render it more difficult for each to find the other and combine. Combination eventually takes place, and combustion is very complete before the top of the cupola is reached, but having been retarded until the heating agent reaches the cupola it is effective to an increased degree. The visible effect of the diluted air-draft is a great increase in the volume of flame. Within the mass of lime-rock the body of diluent gases acts as an absorber and carrier of the heat of combustion, which distributes this heat uniformly throughout the mass and lowers the temperature of combustion. In a limekiln the body of rock within the zone of calcination is raised to a state of incandescence and acquires a temperature amply sufficient and in excess of the temperature which is required to ignite a mixture of air and fuel-gases. In other words, the body of lime-rock acts as a heat accumulator or storer. It will readily be seen that this is a condition conducive to perfect combustion and favorable to the existence of flame or combustion at a long distance from the seat of

initial combustion or the source of the heating agent. The presence of a heat-retainer or other means to maintain ignition is a condition which should also be supplied in order to obtain the best results in applying my invention to other arts or processes.

In carrying out my invention I employ a draft mixture of air and neutral gaseous diluent in the proportion of about three or four volumes of air to one volume of the gases; but this proportion may be varied without departing from the invention, depending upon the conditions under which the process is carried out.

The apparatus herein described is separately claimed in an application, Serial No. 47,781, filed concurrently herewith.

I claim—

1. The herein-described process which consists in conducting the combustion of fuel under an artificially-accelerated draft with air and a neutral gaseous diluent, the latter present in sufficient proportion to retard the combustion to a substantial extent, and subjecting the resulting heating agent to an igniting temperature to an extent sufficient to substantially complete its combustion.

2. The herein-described process which consists in conducting the combustion of fuel under an artificially-accelerated draft with air and a neutral gaseous diluent, the latter present in sufficient proportion to retard the combustion to a substantial extent, and applying the heating agent thus produced to a heat-accumulator capable of maintaining the ignition of said heating agent by its stored heat.

3. The herein-described process which consists in conducting the combustion of a bed of solid fuel by passing through the ignited bed an artificially-accelerated draft-current composed of air and a neutral gaseous diluent, the latter present in sufficient proportion to retard the combustion to a substantial extent, and subjecting the resulting heating agent to an igniting temperature to an extent sufficient to substantially complete its combustion.

4. The herein-described process which consists in conducting the combustion of fuel under an artificially-accelerated draft with air and a neutral gaseous diluent, the latter present in sufficient proportion to retard the combustion to a substantial extent, and adding air to the resulting heating agent and subjecting it to an igniting temperature to an extent sufficient to substantially complete its combustion.

5. The herein-described process which consists in conducting a substantially complete combustion of fuel with a draft-current composed of air and a neutral gaseous diluent comprising the products of said substantially complete combustion.

6. The herein-described process of calcining a fragmental mass of lime or cement forming material which consists in conducting the combustion of fuel from an external seat under an artificially-accelerated draft with air and a neutral gaseous diluent, the latter present in sufficient proportion to retard the combustion to a substantial extent, and propelling the resulting heating agent into the mass by the force of the accelerated draft-current.

7. The herein-described process of calcining a fragmental mass of lime or cement forming material by conducting the combustion of fuel from an external seat with an artificially-accelerated draft-current composed of air and a neutral gaseous diluent extracted from the calcining mass, and propelling the resulting heating agent into the mass by the force of the accelerated draft.

8. The herein-described process of calcining a fragmental mass of lime or cement forming material by conducting the combustion of fuel from an external seat with an artificially-accelerated draft-current composed of air and a neutral gaseous diluent, propelling the resulting heating agent into the mass by the force of the accelerated draft, and supplying the heating agent with air to complete its combustion within the mass.

9. The herein-described process which consists in conducting the combustion of fuel with a draft-current of air and a neutral diluent present in a predetermined proportion for the purpose and with the result of decreasing the rate of combustion and increasing the length of the flame.

In testimony whereof I have affixed my signature in presence of two witnesses.

BYRON E. ELDRED.

Witnesses:

R. M. PIERSON,

H. L. ROBBINS.