No. 847,257. PATENTED MAR. 12, 1907.

C. A. MATCHAM.

ROTARY CEMENT KILN AND FUEL FEEDER THEREFOR.

APPLICATION FILED DEC. 31, 1906.

4 SHEETS—SHEET 1.

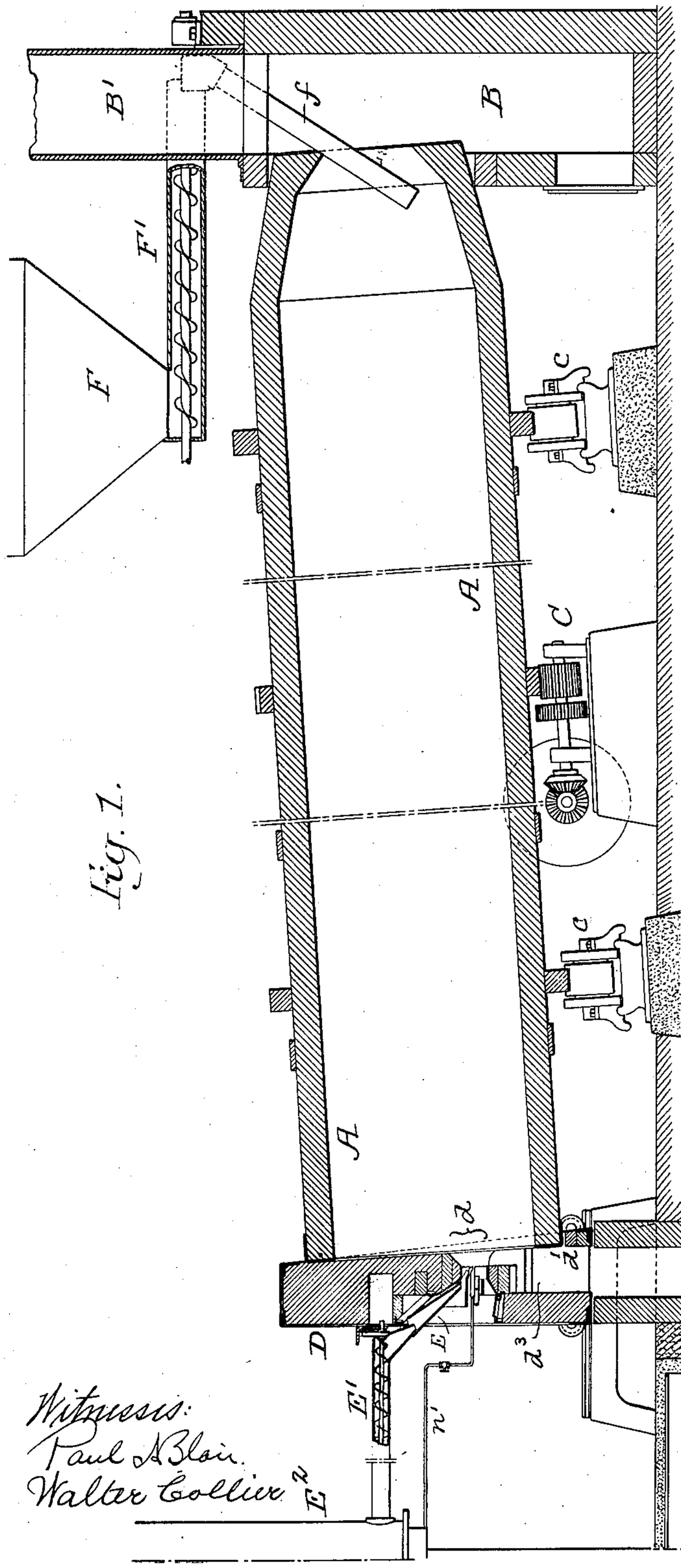

Fig. 1.

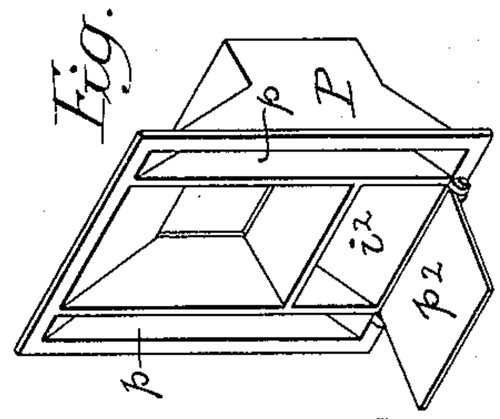

Fig. 6.

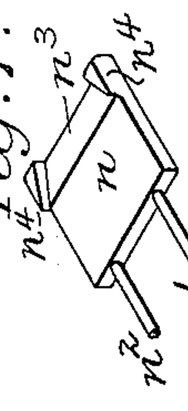

Fig. 7.

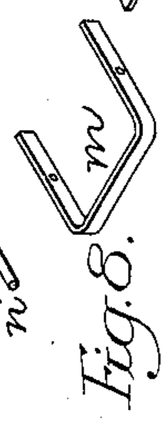

Fig. 8.

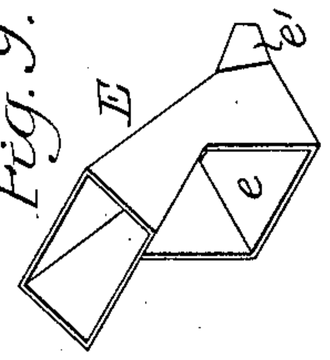

Fig. 9.

Witnesses:
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Walter Collier.

Inventor: Chas A. Matcham
by his Attorneys.
Howson & Howson

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4 SHEETS—SHEET 2.

Fig. 2.

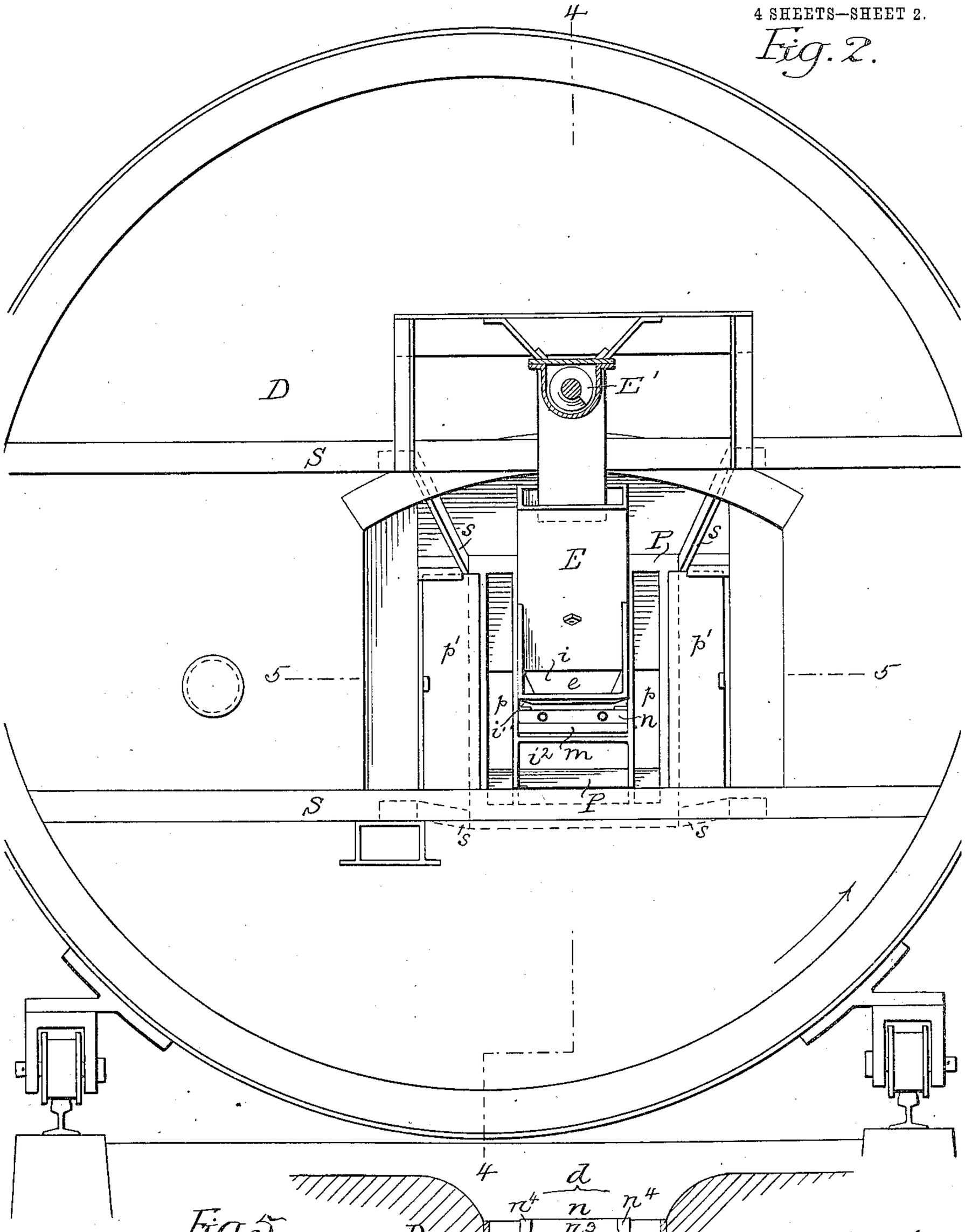

Fig. 5.

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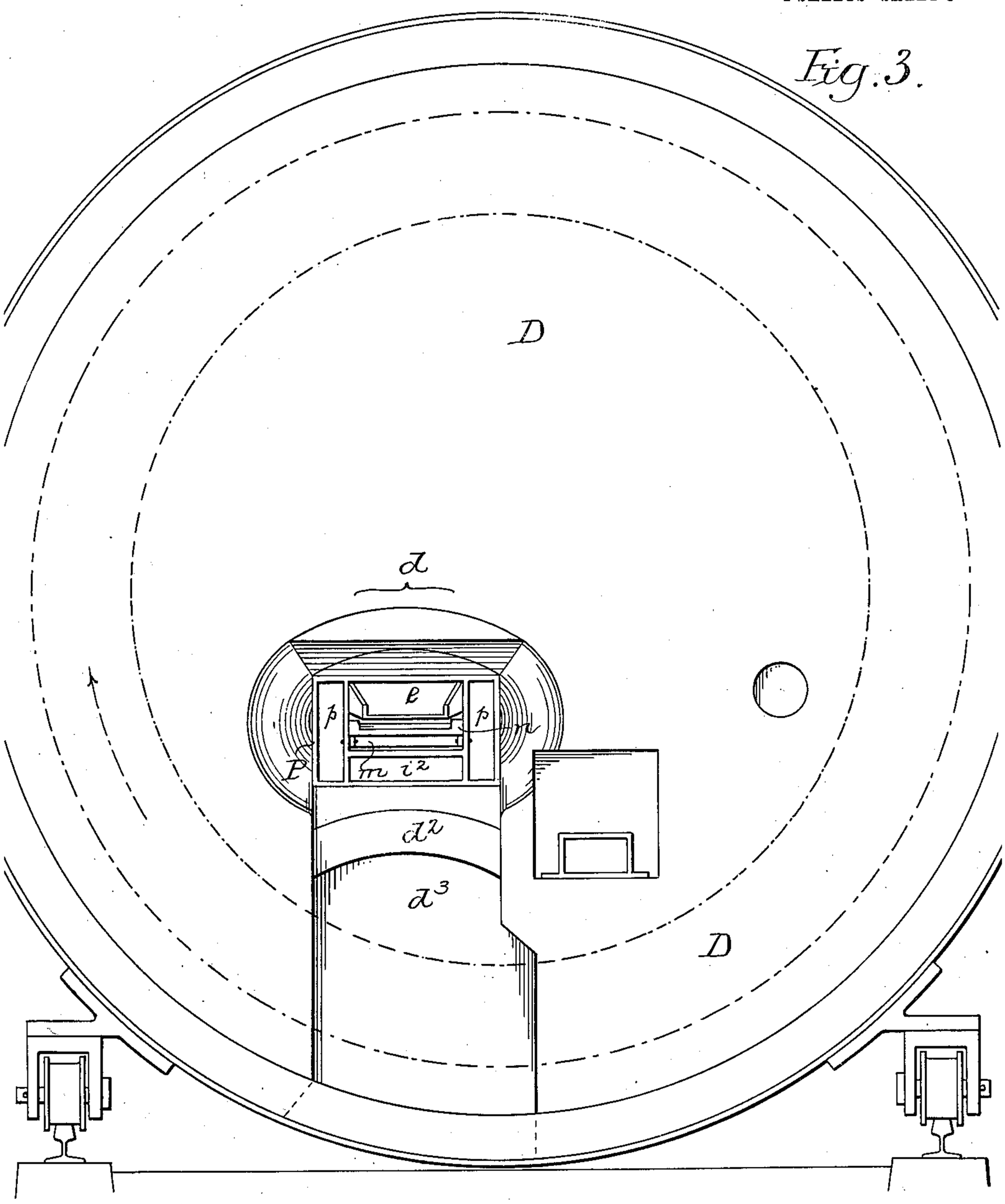
4 SHEETS—SHEET 3.

Fig. 3.



Witnesses:
Paul A Blair
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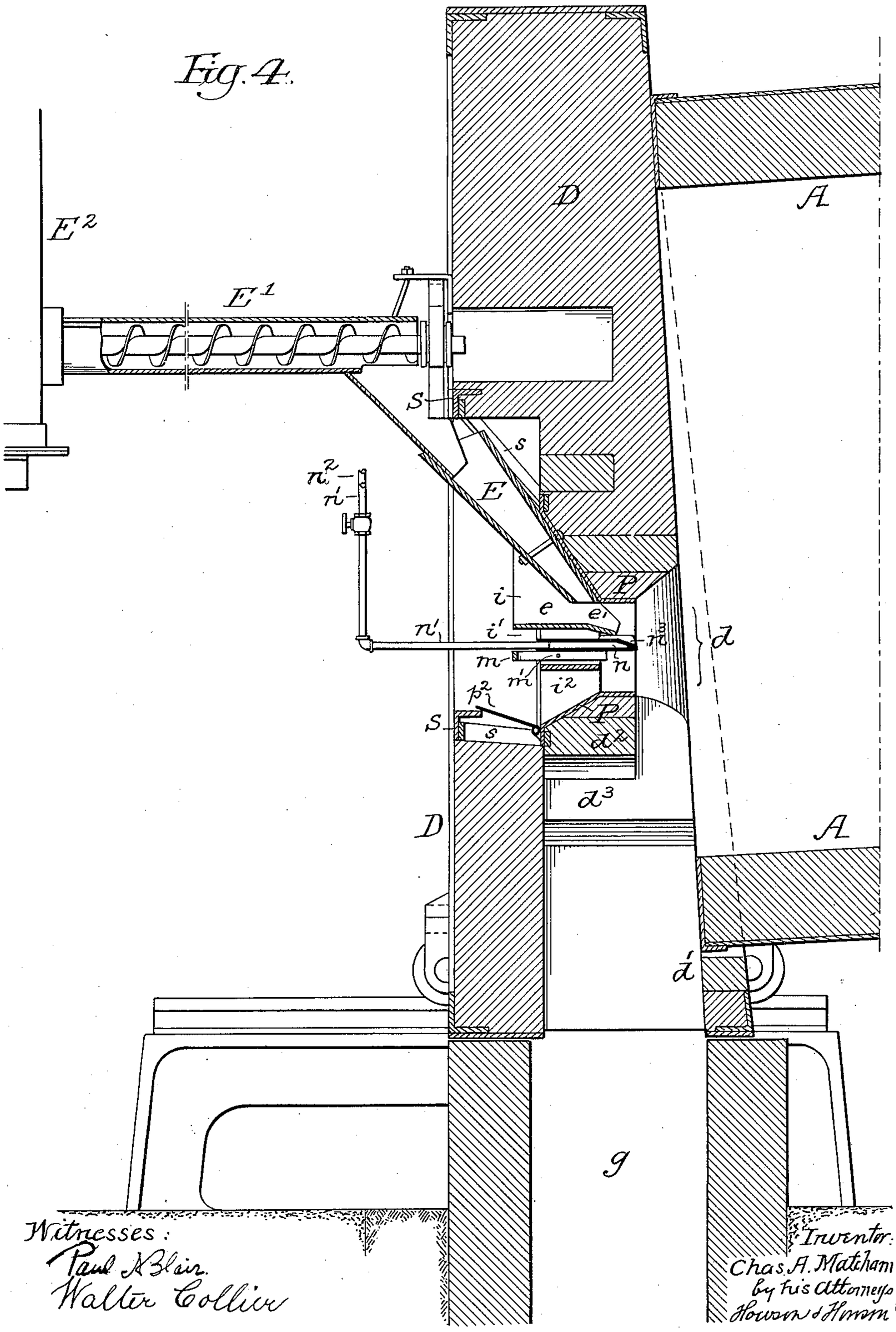
4 SHEETS—SHEET 4.

Fig. 4.



UNITED STATES PATENT OFFICE.

CHARLES A. MATCHAM, OF ALLENTOWN, PENNSYLVANIA.

ROTARY CEMENT-KILN AND FUEL-FEEDER THEREFOR.

No. 847,257. Specification of Letters Patent. Patented March 12, 1907.

Application filed December 31, 1906. Serial No. 350,215.

To all whom it may concern:

Be it known that I, CHARLES A. MATCHAM, a citizen of the United States, residing in Allentown, Pennsylvania, have invented certain Improvements in Rotary Cement-Kilns and Fuel-Feeders Therefor, of which the following is a specification.

My invention relates to certain improvements in rotary kilns for burning cement and means for feeding pulverized fuel to be drawn into the kiln by natural draft.

The object of my invention is to improve the combustion of the fuel within the furnace and to provide means for properly feeding a given quantity of pulverized fuel, and to allow a sufficient volume of air, which may be at normal temperature, to be drawn into the furnace with the fuel and a given volume of heated air to be drawn into the furnace at a point below the fuel-opening.

These objects I attain as hereinafter set forth, reference being had to the accompanying drawings, in which—

Figure 1 is a longitudinal sectional view of a cement-kiln, illustrating my invention. Fig. 2 is an enlarged end view of the front of the front hood. Fig. 3 is a similar view of the rear of the front hood. Fig. 4 is a vertical sectional view on the line 4 4, Fig. 2. Fig. 5 is a sectional plan view of the front hood on the line 5 5, Fig. 2; and Figs. 6, 7, 8, and 9 are detached perspective views of parts of the fuel-feeder.

A is the rotary kiln. B is the rear hood, communicating with the rear end of said kiln, on which is mounted a stack B′. The stack is of such a height and diameter as to cause the flame within the rotary kiln to burn by natural draft. B is the front hood, mounted in the usual manner and having wheels adapted to rails.

The rotary kiln A is carried by idler-wheels *c c* and driven by the usual geared mechanism C to cause it to slowly rotate.

F is the bin for the cement material. F′ is a conveyer leading from this bin to a chute *f*, through which the material is fed to the interior of the rotary kiln A.

G is the clinker-pit, having a passage *g* in direct line with the opening *d′* in the front hood D, so that the clinker as it is formed in the rotary kiln will pass from the kiln through the openings *d* and passage *g* into the clinker-pit G, from which it is removed by a conveyer or other suitable mechanism.

In the front hood D is a fuel-feed opening *d*, preferably arranged at one side of the vertical center line and slightly below the horizontal center line of the kiln, as clearly illustrated in Fig. 2, the rotary kiln turning in the direction indicated by the arrow, Fig. 2.

It will be understood that when the furnace is rotating in the direction of the arrow, Fig. 2, the material will accumulate on the right-hand side of the furnace. I therefore make the fuel-feed opening nearer that side of the furnace, so that the flame will come in contact with the material and will be some distance away from the interior walls of the kiln which are exposed on the opposite side of the furnace, although the position of this feed-opening may be varied without departing from the essential features of my invention.

It is preferable in a fuel-feeding device of the type shown to discharge the finely-powdered fuel into the kiln without being previously mixed with air to any great extent. Therefore I extend the inclined chute E into the front hood structure as near as possible to the inner wall of the said hood, as illustrated clearly in Fig. 4, and place directly under this chute a plate *e*, having a lip *e′* turned down to very nearly the angle of the chute, so that the finely-powdered coal will drop onto this plate and will slide into the furnace and be carried by the incoming air which passes through the air-space *i*, between the plate and the chute, and in order to extend this inclined lip I provide a plate *n*, which is mounted on a slideway *m*, pivoted at *m′*, and this plate can be moved longitudinally so as to be projected into the kiln or withdrawn therefrom. As this plate is subjected to considerable heat, I preferably make it hollow, as shown, and connect it with pipes *n′* and n^2, through which water is circulated. By pivoting the slideway *m* the plate *n* can be tilted to any angle desired and moved in or out, and if the plate is moved to the position shown in the drawings it will form a continuation of the lip *e′*, and some of the coal will pass down onto the inclined surface n^3 of the plate before passing into the kiln. I prefer to form flanges n^4 at each side of the inclined portion n^3 of the plate *n* to properly direct the fuel as it falls from the plate *n*.

I preferably provide an air-passage *i′* between the plate *e* and the plate *n*, which is sufficient to carry some of the particles of coal away from the edge of the lip *e′*, and I provide an enlarged opening i^2 under the

plate *n*, so as to insure the carrying of all the finely-powdered coal into the kiln. The chute E communicates with a fuel-feed conveyer E′, which in the present instance is a screw conveyer extending from a hopper E². The opening is incased by a frame P, Fig. 6, secured to the angle-beams S S by braces *s s*. The frame has air-passages *p p*, formed by vertical partitions at each side, as shown in Fig. 2, and the flow of air through these passages can be regulated by sliding dampers *p*′. A damper *p*² is pivoted to the frame P, and in adjusting this damper the flow of air through the passage *i*² can be regulated. It will be seen that air is drawn through the opening *d* with the fuel, practically surrounds the fuel, and as soon as the powdered fuel enters the rotary kiln it is immediately ignited, and the flame is drawn toward the stack end of the kiln in a large volume, having a sliding contact with the material being burned and with the exposed walls of the kiln.

In order that a large volume of heated air may pass into the kiln to be properly mixed with the fuel and air which is admitted through the feed-opening, I arch the front hood at *d*², in the present instance directly under the fuel-feed opening, and form an enlarged flue *d*³, which communicates at its lower end with the pit-passage *g* and at its upper end with the kiln. Thus a large volume of heated air is drawn into the kiln directly under the incoming powdered fuel and air, which may be at normal temperature, the heated air bodily supporting the fuel, and the two bodies of air are thoroughly intermixed with the fuel and produce an intense flame, which will properly reduce the cement material to clinker without the introduction of air under forced blast. By this construction I more conveniently burn the material to be calcined than heretofore, and I find that the fire-brick lining of the kiln is not burned or disintegrated to such an extent as when the fuel is introduced under a blast of air. The feed of the fuel is regular and produces an even flame, which will not underburn or overburn the material being calcined.

By my experiments I find that very good results can be obtained with a kiln eighty feet long, five feet eight inches internal diameter, having a stack ninety feet high and four feet internal diameter, using a burner as proportioned in the drawings, although the proportions of both kiln and burner may vary with the material under treatment and with the quality of the coal used.

The operation of the apparatus is as follows: The material is fed into the kiln in definite quantities through the chute *f* while the kiln is slowly rotated, and the fuel is fed in given amounts through the chute E, so as to fall in front of the air-inlet opening at the inner wall of the front hood. The natural draft at the stack end of the kiln will cause air to be drawn through the opening *d*, carrying with it the finely-divided fuel and at the same time causing a relatively large volume of heated air to pass from the pit through the flue *d*² to a point directly under the fuel-inlet opening *d*. A flame will thus be immediately produced, being drawn through the kiln so as to have a sliding contact with the material being treated and with the walls of the kiln.

While I prefer to use a high stack to produce a natural draft, other means may be used at the stack end of the kiln to produce an induced draft.

I have used in the claims the term "substantially horizontal kiln," meaning a kiln that is arranged at a slight inclination, so that the material will travel from the inlet end to the discharge end of the kiln over the lower surface of the kiln, while the products of combustion will have an uninterrupted flow from the fuel-feed opening to the stack.

The kiln can be operated in any suitable manner, so as to cause the material to flow through the kiln without departing from the essential feature of my invention.

I claim—

1. In an apparatus for burning cement, the combination of a substantially horizontal kiln, means for feeding cement material into one end of the kiln, there being an outlet for the discharge of said material at the opposite end of the kiln, means for feeding powdered fuel into the discharge end of the kiln, means at the inlet end of the kiln for creating a draft therethrough from the discharge end to the inlet end thereof sufficient to draw into the kiln the powdered fuel and a volume of air, said kiln being free from obstructions so that the flame is drawn in a substantially straight path through it in contact with the cement material but with a minimum disintegrating action upon the lining of the kiln, substantially as described.

2. In an apparatus for burning cement, the combination of a substantially horizontal kiln, means for feeding cement material into one end of the kiln, a passage through which the material is discharged at the opposite end of the kiln, means for feeding a stream of powdered fuel into the discharge end of the kiln, there being an opening in the discharge end of the kiln for the admission of air, and a relatively large opening for the passage of heated air into the kiln, with means for creating at the inlet end of the kiln a draft through the kiln from the discharge end to the inlet end thereof so that powdered fuel and a limited volume of air, and a relatively larger volume of heated air will be drawn into the kiln, the flame being drawn through the kiln in contact with the cement material, but with a minimum of disintegrating effect upon the lining of the kiln, substantially as described.

3. In an apparatus for burning cement.

the combination of a substantially horizontal kiln, means for feeding cement material into one end of the kiln, there being a passage for the discharge of said material at the opposite end of the kiln, means at the stack end of the kiln for creating a draft through the kiln from the discharge end to the stack end thereof, means for feeding powdered fuel into the kiln, there being an opening to admit a limited supply of air with the fuel, and a passage for the admission of a relatively larger volume of air, said passage being directly under the opening through which the incoming powdered fuel and air is introduced so that a combustible mixture will be immediately formed as the fuel enters the kiln, substantially as described.

4. The combination in a substantially horizontal kiln communicating at one end with a stack, of means for feeding material into the stack end of the kiln and discharging it at the opposite end of the kiln, means for feeding powdered fuel in a relatively dense mass directly into the discharge end of the kiln, there being a passage at the discharge end of the kiln through which a large volume of heated air is drawn in directly under the powdered fuel, so as to spread and support said fuel and carry it into the combustion zone of the furnace, substantially as described.

5. In an apparatus for burning cement, the combination of a substantially horizontal kiln, means for feeding cement material into one end of the kiln, said kiln having at its opposite end a passage through which the material is discharged, means for delivering pulverized fuel to a fuel-feed opening in the hood at the discharge end of the kiln, the hood having an opening for the passage of a limited quantity of air, there being a passage between the hood and the discharge end of the kiln for the admission of a relatively larger quantity of air, and means for creating at the inlet end of the kiln a draft through the kiln from the discharge end to the inlet end thereof, whereby the pulverized fuel and the air will be drawn into, and the flame drawn through the kiln in contact with the cement material but with a minimum disintegrating effect upon the lining of the kiln, substantially as described.

6. The combination in a kiln of the substantially horizontal type, of a front hood having a fuel-feed opening, means for feeding fuel into the kiln through said opening without previous admixture with air under pressure, and means for producing a draft to draw the fuel into the kiln, there being an enlarged flue formed in the hood under the fuel-feed opening and communicating with the clinker-pit, whereby a relatively large volume of heated air is drawn into the kiln simultaneously with the fuel, substantially as described.

7. The combination of the front hood of a cement-kiln having an opening, a fuel-feed chute extending into the opening, a plate under the fuel-feed chute having an extended lip turned down at such an angle that the pulverized fuel after lodging on the lip will pass off the same into the furnace, substantially as described.

8. The combination of a furnace provided with a front hood having a fuel-feed opening, with a chute for feeding pulverized fuel into the opening by gravity and without the aid of air under pressure, a fixed plate extending into the opening beyond the mouth of the chute, and a longitudinally-adjustable plate under the fixed plate capable of being projected beyond the edge of the fixed plate, substantially as described.

9. The combination with a cement-kiln of the substantially horizontal type, of a front hood having a fuel-feed opening therein, a frame built in the walls of the said front hood and terminating slightly back of the line of the inner wall thereof and a chute for feeding pulverized fuel by gravity through said opening, there being a relatively deep flue formed in the walls of the hood directly under the opening for the pulverized fuel, so as to permit of the passage of a relatively large body of heated air into the kiln directly under said fuel-feed opening, substantially as described.

10. The combination with a cement-kiln of the substantially horizontal type, of a front hood closing the outlet of the kiln and having a fuel-feed opening extending therethrough, a chute for feeding pulverized fuel into the said opening, and a plate upon which the powdered fuel is allowed to flow, said plate extending to such a point that the powdered fuel is discharged into the kiln before it is mixed with incoming air, there being a relatively deep flue formed in the front hood communicating with the clinker-pit and extending to a point directly under the fuel-feed opening, substantially as described.

11. The combination with a cement-kiln of the substantially horizontal type, of a front hood closing the end of the kiln and having a fuel-feed opening, a chute for feeding powdered fuel by gravity through said opening, there being air-passages at each side of the chute and another air-passage directly under the point of fuel-discharge for admitting air with the fuel into the kiln, with a deep flue formed in the walls of the front hood directly under the fuel-feed opening and communicating directly with the interior of the kiln and with the clinker-pit, substantially as described.

12. The combination with a cement-kiln, of a front hood having a fuel-feed opening, a chute, and a casing surrounding said fuel-feed opening and having two vertical partitions forming air-spaces at each side of the

chute, said chute being secured to the said casing and having an integral plate extending past its outlet for the reception of the powdered fuel passing down the chute, substantially as described.

13. The combination of the end of a cement-kiln or other furnace having a hood provided with a fuel-feed opening, a casing surrounding the hood having two vertical partitions forming a central fuel-feed opening and side air-passages, a chute secured to the casing and having an integral plate with an inclined lip, a longitudinally-adjustable water-cooled plate directly under said lipped plate, the parts being so proportioned that air will be admitted under the plate as well as at each side thereof, substantially as described.

14. The combination of the front hood of a cement-kiln having a fuel-feed opening, a casing surrounding said opening and having two vertical partitions forming a central fuel-feed opening and side air-passages, a chute secured to the casing, a plate under the chute having an inclined lip, a longitudinally-adjustable plate under the first-mentioned plate, and a rocking frame on which the adjustable plate is mounted, substantially as described.

15. The combination of the end of a cement-kiln or other furnace having a fuel-feed opening, with a fuel-feed chute, a plate under the chute, and an adjustable plate under the first-mentioned plate having a beveled portion and side flanges at each side of the beveled portion, substantially as described.

16. The combination with a cement-kiln or other furnace having a fuel-feed opening in its front wall, of a casing in said opening, and extending to a point near the inner face of the wall, said wall being flared from this point, a chute, two plates under the chute, of which one is adjustable, there being an air-passage at each side of the chute, and a central air-passage under the plates, with means for regulating the flow of air through said passages, substantially as described.

17. The combination in a cement-kiln of the substantially horizontal type, of a front hood having a feed-opening, a casing surrounding the feed-opening and extending to a point near the inner face of the said hood, said inner face of the hood below the fuel-feed opening being cut away to form a relatively deep flue directly under the fuel-feed opening for the admission of the heated air from the clinker-pit, said opening communicating directly with the interior of the kiln, with a feed-chute for the fuel discharged through said feed-opening into the kiln, substantially as described.

18. The combination in a cement-kiln, of a front hood closing one end of the kiln and having a fuel-feed opening, a casing surrounding said fuel-feed opening and having two vertical partitions forming side air-passages and a central fuel-feed passage, a chute secured to the said casing and arranged to discharge fuel into the fuel-feed opening, an adjustable plate under the said chute, there being an air-passage under the said plate, and a relatively deep flue under the fuel-feed opening, said flue being formed in the hood and communicating with the clinker-pit and being connected to the fuel-feed opening at a point back of the line of the inner face of the hood, substantially as described.

19. The combination of the front hood of a cement-kiln having a fuel-feed opening therein, with a frame mounted in the said opening, two transverse beams in the hood, one mounted above and the other below the fuel-feed opening, braces connecting the upper portion of the frame to the upper beam and other braces connecting the lower portion of the frame with the lower beam, substantially as described.

20. The combination of the front hood of a cement-kiln having a fuel-feed opening, with a frame mounted in said opening, two transverse beams secured to the hood one above and the other below the fuel-feed opening, a brace connecting the upper end of the frame with the upper beam, and another brace connecting the lower end of the frame with the lower beam, a fuel-feed hopper secured to the frame, and a plate under the hopper, provided with an air-passage at each side of the hopper, there being an air-passage below the hopper, substantially as described.

21. The combination in a rotary cement-kiln, of a front hood having a fuel-feed opening and a rear hood, a stack communicating with the rear hood, means for feeding material into the kiln, there being a discharge-opening for the material at the front hood, a clinker-pit with which the discharge-opening communicates, a chute for powdered fuel extending into the fuel-feed opening, means for feeding a continuous stream of powdered fuel to said chute so that it will flow down the chute by gravity, there being passages for the admission of a limited volume of air, and the passage for the discharge of the material from the kiln being of relatively large cross-sectional area and formed in the hood directly under the fuel-feed opening, whereby a relatively large proportion of heated air is drawn into the kiln through said flue from the pit simultaneously with the fuel and the limited volume of air drawn in through the fuel-feed opening by the natural draft of the kiln, substantially as described.

22. In an apparatus for burning cement the combination of a substantially horizontal kiln, means for feeding cement material into one end of the kiln, there being an outlet for the discharge of said material and a fuel-feed opening at the opposite end of the kiln, a stack communicating with the inlet end of the

kiln, said stack being of such a height as to create a draft through the kiln from the discharge end to the inlet end thereof, and constituting the sole means for drawing in the fuel and sufficient air to support combustion, said kiln being free from obstructions so that the flame is drawn in a substantially straight path through it in contact with the cement material, but with a minimum of disintegrating action upon the lining of the kiln, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

CHARLES A. MATCHAM.

Witnesses:

HENRY HOWSON,

JOS. H. KLEIN.