No. 854,798. PATENTED MAY 28, 1907.

E. M. BUNCE.

APPARATUS FOR BURNING FUEL IN FURNACES.

APPLICATION FILED FEB. 2, 1907.

2 SHEETS—SHEET 1.

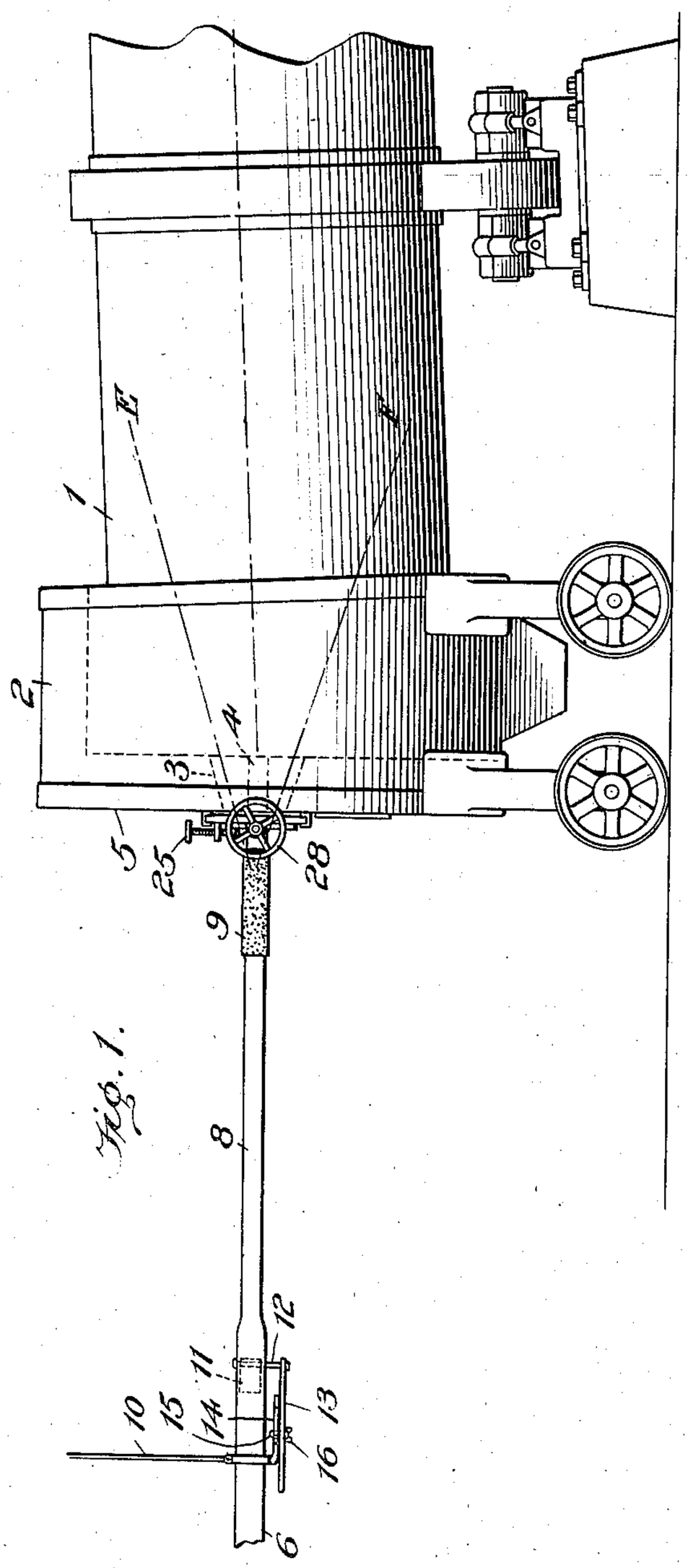

Fig. 1.

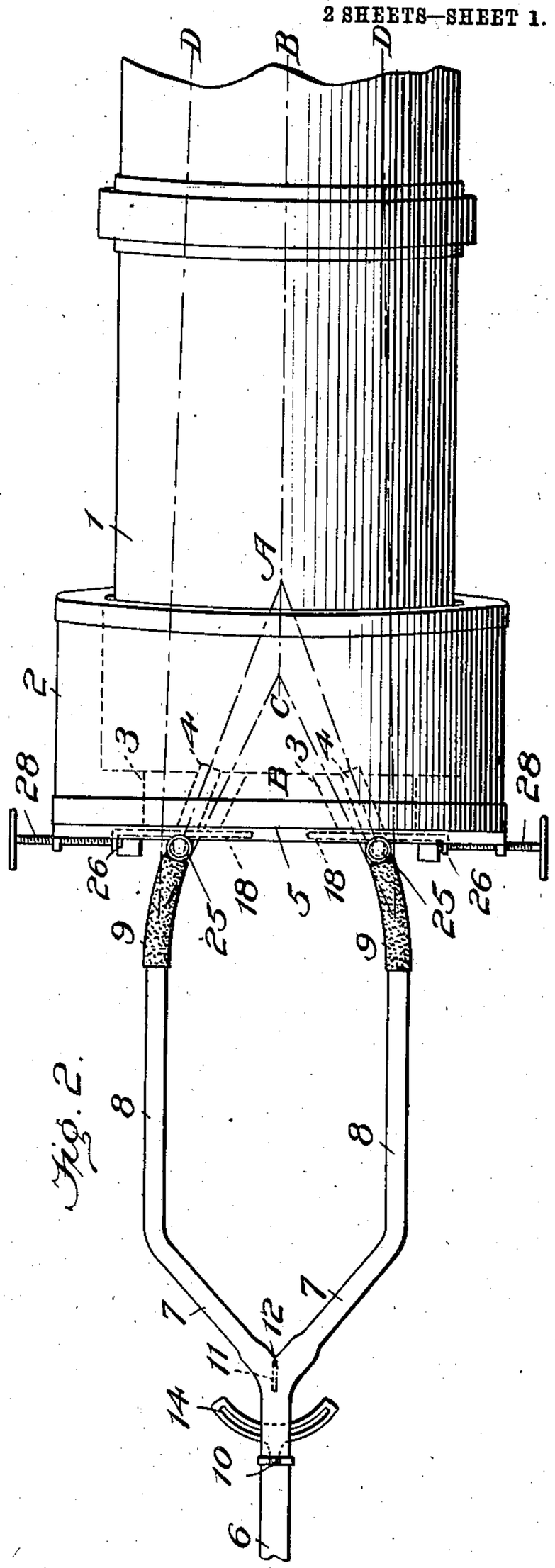

Fig. 2.

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Fig. 4.

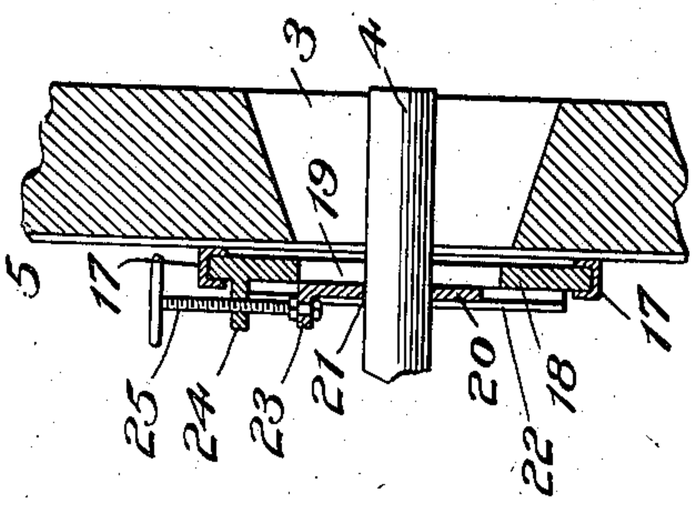
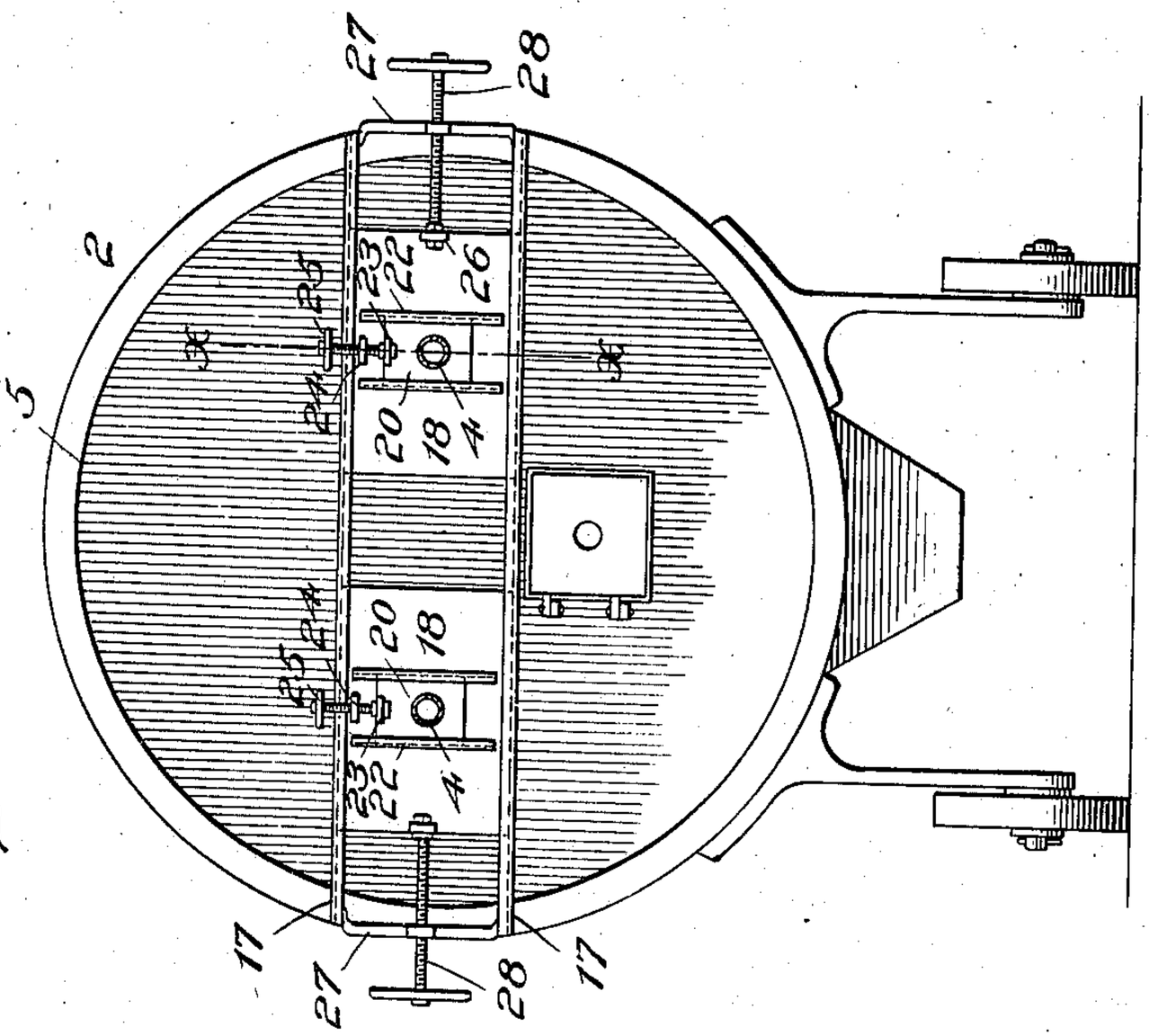


Fig. 3



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR BURNING FUEL IN FURNACES.

No. 854,798. Specification of Letters Patent. Patented May 28, 1907.

Application filed February 2, 1907. Serial No. 355,444.

To all whom it may concern:

Be it known that I, EARL M. BUNCE, a citizen of the United States, residing at Fenton, in the county of Genesee and State of Michigan, have invented new and useful Improvements in Apparatus for Burning Fuel in Furnaces, of which the following is a specification.

The object of my invention is the provision of an apparatus or means for burning fuel in suspension, such as pulverized coal when mixed with air, in a furnace, and especially in rotary kilns, whereby relatively complete combustion may be secured by thoroughly mixing the fuel with the air, and whereby when the apparatus is used in connection with a rotary or other kiln for burning Portland cement clinker the flame and the intensity of the heat may be localized at various points or places inwardly from the extreme lower end of the kiln, and said flame also be directed toward any portion of the internal surface of the kiln as well as axially thereof.

The invention consists in certain novelties of construction and combinations of parts hereinafter set forth and claimed.

The accompanying drawings illustrate an example of the physical embodiment of the invention constructed and arranged according to one of the several most desirable modes I have so far devised for the practical application of the principle.

Figure 1 is a side view in elevation of the apparatus showing its use in connection with a rotary kiln. Fig. 2 is a top plan view of Fig. 1. Fig. 3 is an enlarged end view. Fig. 4 is an enlarged sectional view on line *x*—*x* Fig. 3.

Referring to the several figures, the numeral 1 designates the lower portion or end of a rotary kiln which may be of any well known construction and be supported and revolved in any suitable way well known in the art; 2, a housing or hood of a well known type supported upon wheels and having an opening upon one vertical side which in this instance receives or matches the tubular end of the rotary kiln; 3, two openings in the rear wall of the hood and extending through the fire brick, indicated by dotted lines in Figs. 1 and 2, and full lines in Fig. 4, the surface bounding the opening being inclined inwardly as shown; 4, fuel discharge pipes with their ends located within the openings; 5, the face plate of the hood; 6, the main blast pipe connected with a blower and source of fuel supply; 7, 7, the two branches leading from the main blast pipe; 8, sections of pipe constituting continuations of the branches to the fuel discharge pipes; 9, flexible hose connecting the sections of pipe with the fuel discharge pipes, whereby universal joints are provided for the fuel discharge pipes; 10, a rod for supporting the end of the main pipe and the branch pipes; 11, a damper located within the main pipe at its junction with the branches; 12, the shaft to which the damper is secured; 13, a perforated lever arm; 14, a slotted semi-circular bearing supported by the main pipe; 15, a bolt passed through the slot in the circle and the lever; 16, a winged nut on the bolt; 17, 17, two channel iron sections upon the face plate 5 of the hood occupying parallel horizontal positions; 18, 18, two metallic plates with their edges loosely engaging the channels so they may be moved horizontally; 19, a central hole in each plate; 20, vertically movable plates; 21, holes in the plates 20 within which are loosely supported the fuel discharge pipes; 22, grooved bars or bearings which confine and guide the edges of the plates 20, as shown; 23, perforated lugs at the edges of plates 20; 24, lugs upon plates 18 with threaded holes; 25, threaded shafts and hand wheels, the threads of the shafts engaging the threaded holes in the lugs upon the horizontally movable plates, and the ends of the shafts having rotary bearings in the lugs 23 upon the vertically movable plates; 26, perforated lugs at the edges of the plates 18, 18, as shown; 27, brackets with threaded holes secured to the hood or housing; and 28, threaded shafts and hand wheels, the end of each shaft journaled in a lug 26, and the threads of the shafts engaging the threads of a hole in a bracket.

Any suitable type of blower and means for supplying fuel, such as pulverized coal, to the main blast pipe 6 may be employed, and such blowers and means being well known in the art I have not illustrated or described the same.

The mode of operation is as follows: Assuming the fuel discharge pipes 4, 4, to be in the relative positions shown by Fig. 2 and powdered fuel mixed with air to be projected

from the discharge pipes, the two currents or streams will meet at point or place A, where the fuel and air will become thoroughly commingled and the two currents change directions and become united to form a single current extending in a substantially straight line B—B, when the fuel and air issue from the discharge pipes under like pressure. The fuel being ignited an intense heat is localized at the place A and for some distance inwardly therefrom, the length of the flame depending upon the amount of fuel discharge and the air pressure. By turning the damper 11 in the main blast pipe 6 so that more fuel and air under pressure will be delivered from one of the discharge pipes than from the other, the flame will be shifted from the place A to a position at one side of a vertical plane passing through the line B—B. Obviously the flame can thus be shifted from side to side of the internal surface of the kiln as occasion may demand.

To change the place A of the most intense heat to a position nearer the lower end of the kiln, as at C, the threaded shafts 28 are revolved, and the plates 18, 18, with the discharge pipes 4, 4, moved toward each other so the air and fuel will be delivered and meet at the place C.

To localize the flame and most intense heat inwardly at any place on the line B—B from the lower end of the kiln the free ends of the discharge pipes 4, 4, are moved away from each other by the hand wheel mechanism and the currents or streams of air and fuel thus caused to meet at the desired place. When the discharge pipes 4, 4, coincide in direction with the lines D—D the place of most intense heat will be located far within the kiln at the meeting point or place of the two streams or currents of air and fuel.

As previously explained in connection with place A, the flame may be shifted from side to side of the internal surface of the kiln from the point or place wherever in the plane of the line B—B the two currents of fuel and air may be caused to unite or meet. By the manipulation of the hand wheels and shafts 25, 25, the free ends of the discharge pipes may be moved so that the common flame will be localized at the top internal surface or bottom internal surface of the kiln, near the lower end of the kiln, as indicated by dotted lines E and F, Fig. 1, or it may be located at the top and bottom internal surfaces at places some distance within the kiln.

It will be observed that each discharge pipe 4 forms at the end where it connects with the hose 9 a universal joint, and that the opposite end is free to move through practically the circumference of a circle so that the current of fuel and air may be directed toward any portion of the internal surface of the kiln or axially thereof. Under some conditions it may be desirable to use a single discharge pipe thus connected at one end so as to form a universal joint, but two such pipes are preferably employed and the currents of fuel and air or flames united to form one current or flame, inasmuch as by bringing the currents of fuel and air together the same are more thoroughly mixed and more complete combustion with a greater heat results. Again, by bringing the two flames or currents of air and fuel together at an angle the heat may be localized near the lower end of the kiln and in this and other locations there is less tendency for the flame and heat to swiftly pass through the kiln to the stack before the heat has been transmitted to the material under treatment.

In all cases the hole or holes or openings in the housing should be large enough to allow the pipe or pipes to discharge the air and fuel to the desired place within the kiln.

The advantages secured by the use of my improved apparatus in connection with burning raw materials into Portland cement clinker are obvious. With devices now in use the length of the clinkering zone is very limited and the raw material frequently passes to the zone without being thoroughly burned, under which circumstances the kiln must be stopped and the unburned material driven back. By the use of my apparatus the clinkering zone can be brought to the lower end of the kiln or the heat elsewhere localized and the flame directed upon the material not thoroughly burned. In fact, the point or zone of clinkering is under the control of the operator at all times. Furthermore, the formation of "rings" may be prevented or the same readily burned off when formed as the flame can be directed to any point within the lower potion of the kiln and the heat there intensified.

From the foregoing description taken in connection with the drawings, it is clear that I have produced an apparatus whereby a plurality of streams of fuel and air may be united and thoroughly commingled and more perfect combustion secured when said streams of fuel and air are ignited, and whereby the resultant flame may be moved from place to place within a furnace or rotary kiln, and the heat localized for any desired purpose.

While I have shown and described only one example of the apparatus or means whereby the principle is physically embodied, I do not intend to limit the scope of the invention to such specific means, as equivalent means may be employed to perform the same or analogous functions, for instance, a different type of flexible joint may be selected, the pipes 4 be curved, other means be used to move the free ends of the discharge pipes, either simultaneously or successively to different positions in the arcs of circles,

and two main supply or blast pipes each having a damper be substituted for the main blast pipe with branches as herein illustrated.

What I claim is:

1. The combination with a furnace, of two fuel discharge pipes each jointed at one end and freely movable at the other end, means for supplying air and fuel to the pipes, and means for supporting them in different positions so that the air and fuel discharged therefrom may be caused to successively meet at an angle at a plurality of points or places within the furnace.

2. The combination with a furnace, of two fuel discharge pipes each jointed at one end and freely movable at the other end; means for supplying air and fuel to the pipes; and means for adjusting the said pipes to different angular positions in a horizontal plane so that the two streams of air and fuel may be caused to meet at different points or places within the furnace.

3. The combination with a furnace, of two fuel discharge pipes angularly disposed each to the other; means for pivoting the same so the free ends may move; means for supplying fuel and air to the pipes; and means for adjusting the pipes vertically so the flame may be directed upwardly or downwardly within the furnace.

4. The combination with a furnace, of two fuel discharge pipes each jointed at one end and freely movable at the other end; means for supplying air and fuel to the pipes; and means for adjusting the pipes both vertically and horizontally so the two streams of fuel and air delivered from the pipes may meet at a plurality of points or places within the furnace and form one stream.

5. The combination with a rotary or other kiln, of two fuel discharge pipes each jointed to move in vertical and horizontal planes at the free end; means for adjusting the pipes to angular positions so the streams of air and fuel will meet, change their directions, become thoroughly commingled and form one stream; and means for supplying fuel and air to the same.

6. The combination with a rotary or other kiln, of two fuel discharge pipes each universally jointed at one end to another pipe and the other end freely movable, and said pipes angularly disposed each to the other so the streams of fuel and air will meet to form one stream; means for supplying air and fuel to the pipes; and means for delivering more fuel to one of the pipes than to the other.

7. The combination with a rotary kiln, of two freely jointed and movable fuel discharge pipes angularly disposed each to the other so the streams of air and fuel will unite, change their directions, become thoroughly commingled so as to form one stream, means for supplying air and fuel to the pipes; and means for adjusting the said pipes and holding them in relatively adjusted positions.

8. The combination with a rotary kiln, of two fuel discharge pipes each movable at one end in the wall of a hood or housing and flexibly united at the opposite end to a pipe; means for supplying air and fuel; and means for moving the discharge pipes to different angular positions so the streams of air and fuel will unite to form one stream.

9. The combination with a rotary kiln, of two pipes having ends freely movable for delivering two streams of air and fuel into the kiln so they will unite to form practically one stream; and means for forcing the said stream to one side of the meeting place of the said two streams of air and fuel.

10. The combination with a rotary kiln of a housing having an opening, a plate with an opening supported so as to move horizontally relative to the opening in the housing, an air and fuel supply pipe and a fuel discharge pipe carried by said movable plate and universally jointed to the air and fuel supply pipe at a point outside of and independent of the said plate.

11. The combination with a kiln and a housing having an opening, of two plates, one of said plates movable horizontally and the other vertically; an air and fuel supply pipe and a fuel discharge pipe supported by one of said plates and united by a universal joint to the air and fuel supply pipe.

12. The combination with a kiln, of a housing provided with two openings, and two horizontally movable plates each having an opening and suitably supported; two fuel discharge pipes angularly disposed each to the other within the openings of the plates and movable with the same; and means for supplying air and fuel to the pipes; whereby the two streams of air and fuel may be united change their directions and form one stream within the kiln, and whereby the direction of the stream may be changed.

13. The combination with a housing provided with two openings, of two vertically movable plates each having an opening; two horizontally movable plates each supporting one of the vertically movable plates; and two fuel discharge pipes located within the openings of the plates and movable with the same.

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

EARL M. BUNCE.

Witnesses:

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JOHN HOWELL.