

Nov. 15, 1938.

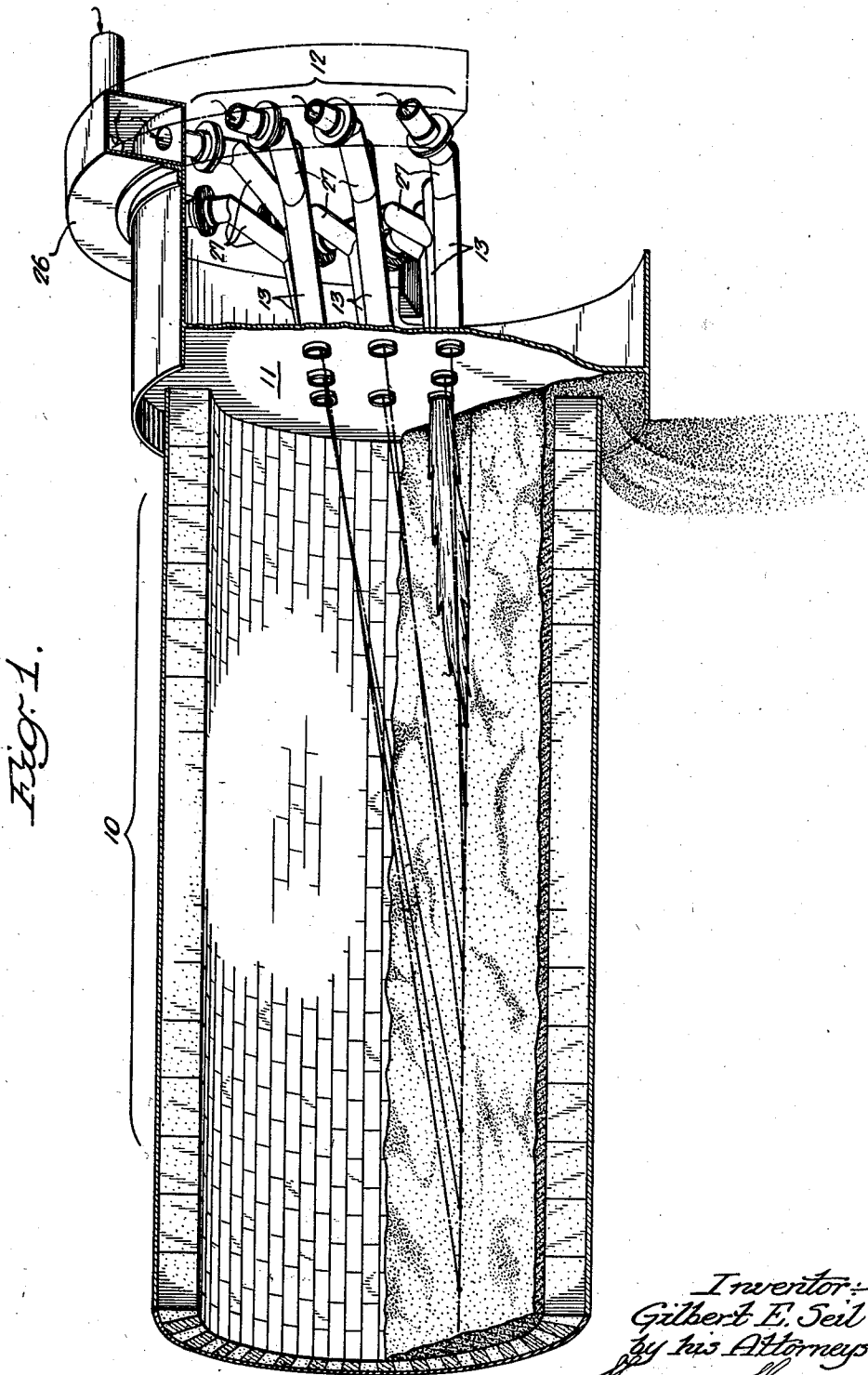
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2,137,185

MULTIPLE BURNER ARRANGEMENT

Filed Feb. 28, 1933

4 Sheets-Sheet 1



Inventor:
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4 Sheets-Sheet 2

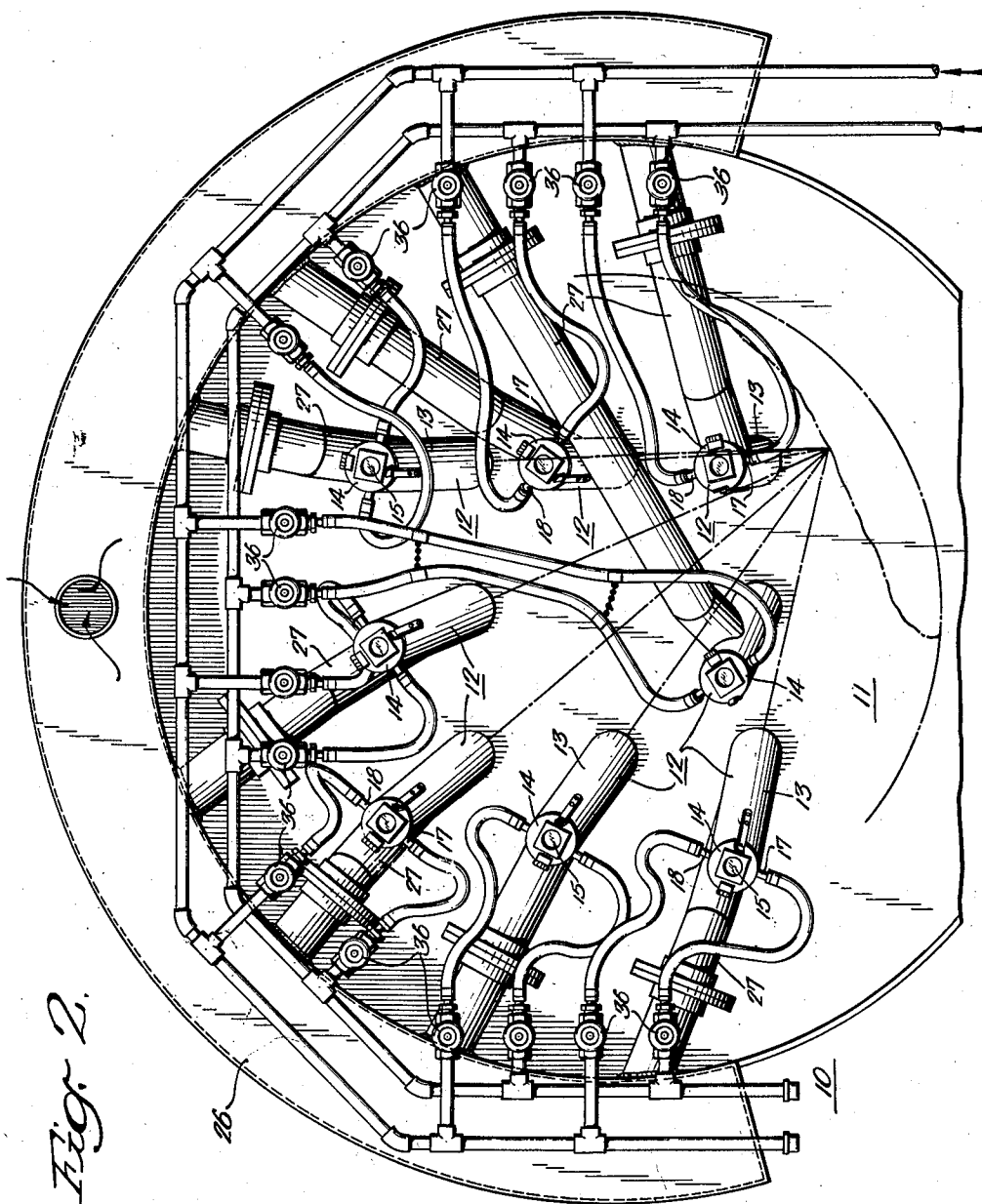


Fig. 2.

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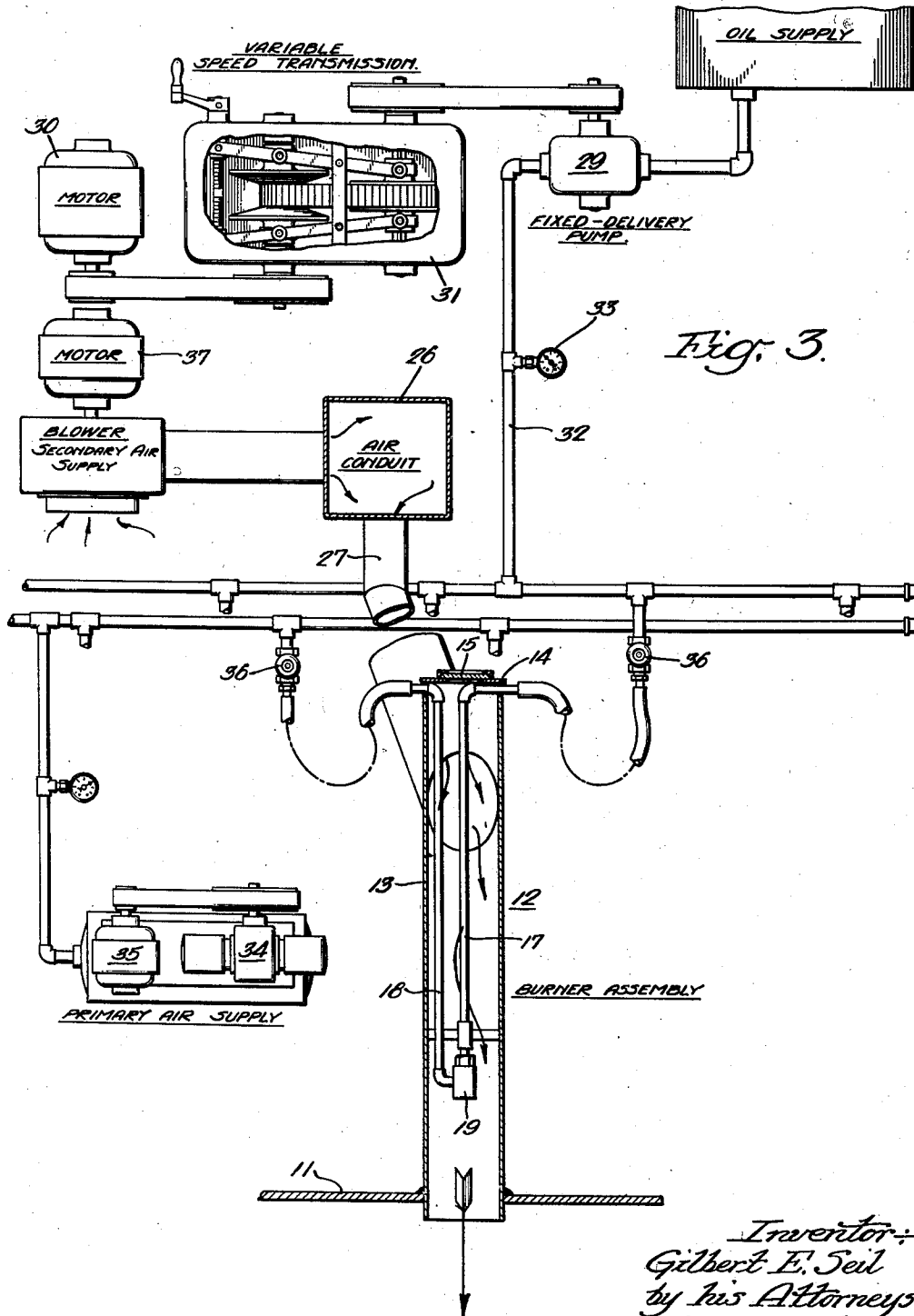


Fig. 3.

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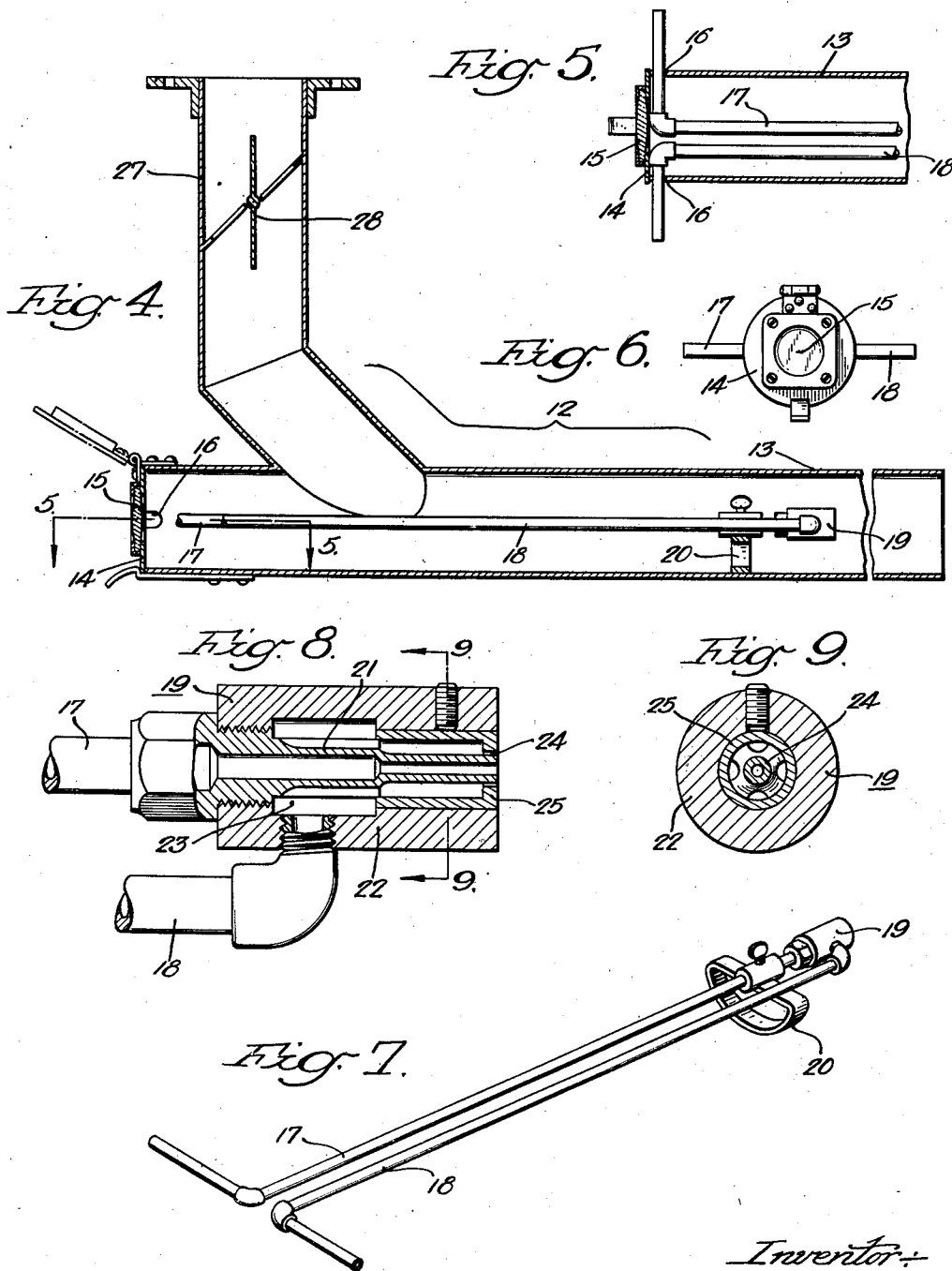
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MULTIPLE BURNER ARRANGEMENT

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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

2,137,185

MULTIPLE BURNER ARRANGEMENT

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Application February 28, 1938, Serial No. 193,205

24 Claims. (Cl. 263—33)

This invention relates to a multiple-burner arrangement for industrial furnaces such as rotary kilns and the like, and has for its primary objects the provision of a method of introducing into the kiln a constant fuel input per unit of time; the provision of a novel control for the combustion conditions in the kiln, and the control of the region of heat intensity.

In the firing of rotary kilns the usual practice is to employ what is known as a long lazy flame. The fuel is introduced through a single burner, usually at or near the center of the discharge end of the kiln and the temperature of the charge gradually increases to a maximum and then decreases toward the discharge end. The heat from the burning fuel is transferred to a large extent to the refractory lining of the kiln and thence to the material although, obviously, the material will receive a portion of its heat from the flame itself. This method of operation results in heating of the refractory lining to a higher temperature than that of the material being treated and, because of this condition, the attainable temperatures are limited by the refractory. If the charge must be brought to a temperature near its softening point, the refractory temperatures must be above that point in the zone of maximum temperature, with the result that the treated material tends to stick together and to the kiln lining and to form large balls or a ring in the kiln.

The system has a further disadvantage in that, with the single burner any impairment of the operation of the burner is reflected in the performance of the kiln. Changing, or even cleaning the burner, necessitates an interruption of kiln operation. To overcome this, multiple-burner systems have, in some cases, been adopted, but these systems are supplied with oil at constant pressure, the oil being supplied in amounts greater than the burners can utilize and the excess oil returned to the source of supply. Under these circumstances the amount of oil entering the kiln is a function of the oil pressure, the viscosity of the oil and the size of the orifices through which the oil is introduced, so that a change in any of these factors results in a change of the quantity of fuel entering the kiln. A partial stoppage of a burner orifice disturbs the equilibrium of the kiln and a temporary removal of a burner from operation, as when cleaning or changing the same, cuts the fuel input proportionately. In rotary kiln treatment there is always a definite time requirement, under given conditions of kiln speed, material feed,

and fuel input, to attain heat equilibrium, and any variable which is introduced, particularly variables in heat input, destroys the uniformity of the product.

An important object of my invention is the provision of a fuel supply system in which the fuel input is constant per unit of time, and is independent of the condition or number of burners and of the temperature, viscosity or other characteristics of the fuel.

Another important object of the invention is the control of the combustion conditions so that the kiln may be operated under adjustable flame conditions, being either a short hot flame or a long lazy flame as desired, but being at all times directed upon the material being treated in the kiln and at a predetermined region in the kiln.

These and other objects I attain by the construction shown in the accompanying drawings wherein, for the purpose of illustration, I have shown a preferred embodiment of my invention and wherein.

Fig. 1 is a sectional perspective of a rotary kiln having a burner assembly in accordance with my invention;

Fig. 2 is an end elevation of the burner assembly;

Fig. 3 is a diagrammatic view showing the method of supplying fuel and air to the burners;

Fig. 4 is a longitudinal sectional view through one of the burner units;

Fig. 5 is a section on line 5—5 of Fig. 4;

Fig. 6 is an end elevation of the burner tube;

Fig. 7 is a perspective view of the burner per se;

Fig. 8 is a longitudinal sectional view through the burner nozzle; and

Fig. 9 is a section on line 9—9 of Fig. 8.

Referring now more particularly to the drawings, the numeral 10 generally designates a rotary kiln at the discharge end of which a shield 11 is disposed. Directed through this shield are the inner ends of the individual burner units 12. Each burner unit 12 at present is shown as comprising a secondary air tube 13 the inner end of which is open and the outer end of which is provided with a door 14 preferably provided with a sight window 15, as shown. Adjacent the door the walls of the tube 13 are notched at 16 for the passage of oil and air supply pipes 17 and 18 which communicate with the burner nozzle 19. Through a suitable support 20 the burner unit is held in the desired position in the conduit.

Nozzle 19 is of that type illustrated in my prior Patent No. 1,659,992, for Method of and appa-

ratus for subdividing material, issued May 24, 1932, and comprises a central fuel supply tube 21 which combines with a surrounding casing 22 to form an annular air chamber 23 with which the primary air supply pipe directly communicates. The air from this chamber escapes about the tip of the fuel supply tube through an annular orifice 24, the size of which may be determined by use of a removable bushing 25. The secondary air tubes 13 are connected with a manifold 26 through conduits 27 preferably having arranged therein a control damper 28.

The burner units are arranged in definite angular relation to the kiln and to one another so that the flame emitted by any unit will be directed upon the longitudinal center line of the material passing through the kiln and will not cross or impinge upon the flame of any other burner. For example, in a rotary kiln 60 feet long and 4 feet 6 inches in inside diameter, in which 2 tons of material per hour are being treated at 1800° F., I have found it advantageous to employ two burners, the first of which is directed upon the center line of the kiln at a point 4 feet from the discharge end of the kiln, and the second of which is directed upon the center line of the kiln load at a point 5 feet 6 inches from the discharge end of the kiln.

In a kiln 75 feet long and 5 feet 6 inches in inside diameter, in which 150 tons per day were being treated at 3250° F., I have found it advantageous to use seven burners, the first burner of which is directed at a point on the center line of the kiln load 8 feet from the discharge end of the kiln and the remaining burners are so directed that they strike the center line of the kiln at intervals of one foot. As stated above, the installation must be such that the flame from any of the burners does not cross the path of that of another burner.

In the present illustration, an eight-unit burner assembly is shown and it will be obvious that by cutting in or out certain of the burners, or regulating the fuel and air supply to such burners the zone of intense heat may be shifted at will between the limits of the burner settings illustrated by the construction lines of Fig. 1.

In addition to controlling the concentration of flame intensity, it is also desirable that the amount of fuel may be maintained constant without regard to the number of burners which are in use; for example, it may be desirable to concentrate the heat intensity within the zone controlled by three burners, and at the same time to have the same B. t. u. content of admitted fuel as on other occasions would be supplied by the eight burners. To this end, the oil supply of all of the units is delivered to the units from a single fixed delivery pump 29, the sole outlet of which is the burner nozzles of the assembly units. This pump is driven from a constant speed motor 30 through a variable transmission 31 such, for example, as the well-known Reeves drive. It will be obvious that for a given pump output all of this output will be delivered to the kiln without regard to the fact that certain of the burners, through accident or design, are not discharging into the kiln. If five burners, for example, are being intentionally operated and one of these burners ceases to feed fuel to the furnace through clogging of its outlet orifice, the fuel delivered by the pump will be discharged through the remaining burners and the B. t. u. content per unit of time will remain unchanged. Obviously, any accidental stoppage of this character will be re-

flected in the pressure of the discharge line 32 of the pump and, accordingly, a pressure gauge 33 responsive to the pump discharge pressure becomes a telltale, signaling improper operation on the part of any burner.

The supply of primary air comprises a compressor unit 34 driven by a motor 35, the discharge lines of both pumps 34 and 29 being provided with individual valves 36 permitting any burner to be thrown out of operation at will. The secondary air supply to manifold 26 comprises a motor 37 and, obviously, through control of this air supply the type of flame delivered by the burner units may be regulated either to a short hot flame or a long lazy flame, as may be desired.

While I have illustrated and described my invention in connection with a rotary kiln, it will be obvious that the method of fuel supply and control is adaptable to use with furnaces of all types and I, accordingly, do not wish to be understood as limiting myself to the particular adaptation herein illustrated except as hereinafter claimed.

I claim:

1. The combination with a heat-treating chamber of means for supplying a definite B. t. u. input per unit of time thereto comprising a plurality of liquid fuel burners discharging thereto, a liquid fuel supply and a single force pump means discharging said fuel to all of and only to said burners.
2. The combination with a heat-treating chamber of means for supplying a definite B. t. u. input per unit of time thereto comprising a plurality of liquid fuel burners discharging thereto, a liquid fuel supply, a single force pump means discharging said fuel to all of and only to said burners, and a pressure gauge in the connection between the pump means and said burners.
3. The combination with a heat-treating chamber of means for supplying a definite B. t. u. input per unit of time thereto comprising a plurality of liquid fuel burners discharging thereto, a liquid fuel supply, a single force pump means discharging said fuel to all of and only to said burners, a constant speed motor to operate said pump means and a micrometrically variable transmission in the connection between the pump means and said motor.
4. The combination with a heat-treating chamber of means for supplying a definite B. t. u. input per unit of time thereto comprising a plurality of liquid fuel burners discharging thereto, a liquid fuel supply, a single force pump means discharging said fuel to all of and only to said burners, a constant speed motor to operate said pump means, a micrometrically variable transmission in the connection between the pump means and said motor, and means to indicate stoppage of the fuel supply to any of said burners.
5. In a rotary kiln, a plurality of burners discharging into the kiln, said burners being constructed and arranged to direct a flame upon the material within the kiln at approximately the longitudinal center line of the kiln load, and the flame of each burner being directed upon the material of the kiln at a point spaced longitudinally of the kiln from that of the flames of all of the remaining burners.
6. In a rotary kiln, a plurality of burners discharging into the kiln, said burners being constructed and arranged to direct a flame upon the material within the kiln at approximately the longitudinal center line of the kiln load, the flame

of each burner being directed upon the material of the kiln at a point spaced longitudinally of the kiln from that of the flames of all of the remaining burners and means to selectively render any

5 of said burners operative or inoperative at will.

7. In a rotary kiln, a plurality of burners discharging into the kiln, said burners being constructed and arranged to direct a flame upon the material within the kiln at approximately the longitudinal center line of the kiln load, and the flame of each burner being directed upon the material of the kiln at a point spaced longitudinally of the kiln from that of the flames of all of the remaining burners, said burners being further so directed that the flame axis when projected does not cross the projected axis of that of any other burner assembly between the burner and the point of contact with the kiln load.

8. In a rotary kiln, a plurality of burners discharging into the kiln, said burners being constructed and arranged to direct a flame upon the material within the kiln at approximately the longitudinal center line of the kiln load, and the flame of each burner being directed upon the material of the kiln at a point spaced longitudinally of the kiln from that of the flames of all of the remaining burners, said burners being further so directed that the flame axis when projected does not cross the projected axis of that of any other burner assembly between the burner and the point of contact with the kiln load, and means to selectively render any of said burners operative or inoperative at will.

9. In a rotary kiln, a plurality of burners discharging into the kiln, said burners being constructed and arranged to direct a flame upon the material within the kiln at approximately the longitudinal center line of the kiln load, and the flame of each burner being directed upon the material of the kiln at a point spaced longitudinally of the kiln from that of the flames of all of the remaining burners, a force pump discharging fuel to all of and only to said burners, and means to supply air to said burners.

10. In a rotary kiln, a plurality of burners discharging into the kiln, said burners being constructed and arranged to direct a flame upon the material within the kiln at approximately the longitudinal center line of the kiln load, the flame of each burner being directed upon the material of the kiln at a point spaced longitudinally of the kiln from that of the flames of all of the remaining burners, means to selectively render any of said burners operative or inoperative at will, a force pump discharging fuel to all of and only to said burners, and means to supply air to said burners.

11. In a rotary kiln, a plurality of burners discharging into the kiln, said burners being constructed and arranged to direct a flame upon the material within the kiln at approximately the longitudinal center line of the kiln load, and the flame of each burner being directed upon the material of the kiln at a point spaced longitudinally of the kiln from that of the flames of all of the remaining burners, said burners being further so directed that the flame axis when projected does not cross the projected axis of that of any other burner assembly between the burner and the point of contact with the kiln load, a force pump discharging fuel to all of and only to said burners, and means to supply air to said burners.

12. In a rotary kiln, a plurality of burners discharging into the kiln, said burners being constructed and arranged to direct a flame upon the material within the kiln at approximately the longitudinal center line of the kiln load, and the flame of each burner being directed upon the material of the kiln at a point spaced longitudinally of the kiln from that of the flames of all of the remaining burners, said burners being further so directed that the flame axis when projected does not cross the projected axis of that of any other burner assembly between the burner and the point of contact with the kiln load, means to selectively render any of said burners operative or inoperative at will, a force pump discharging fuel to all of and only to said burners, and means to supply air to said burners.

13. A device as claimed in claim 6 together with means to supply fuel to said burners constructed and arranged to positively deliver a selected amount of fuel to the kiln through said burners without regard to the number of burners which is in operation.

14. A device as claimed in claim 8 together with means to supply fuel to said burners constructed and arranged to positively deliver a selected amount of fuel to the kiln through said burners without regard to the number of burners which is in operation.

15. In combination with a furnace through which material is progressively moved, a plurality of burners discharging into the furnace, said burners being constructed and arranged to direct a flame upon the material within the furnace at approximately the longitudinal center line of the furnace load, and the flame of each burner being directed upon the material of the furnace at a point spaced longitudinally of the furnace from that of the flames of all of the remaining burners.

16. In combination with a furnace through which material is progressively moved, a plurality of burners discharging into the furnace, said burners being constructed and arranged to direct a flame upon the material within the furnace at approximately the longitudinal center line of the furnace load, the flame of each burner being directed upon the material of the furnace at a point spaced longitudinally of the furnace from that of the flames of all of the remaining burners and means to selectively render any of said burners operative or inoperative at will.

17. In combination with a furnace through which material is progressively moved, a plurality of burners discharging into the furnace, said burners being constructed and arranged to direct a flame upon the material within the furnace at approximately the longitudinal center line of the furnace load, and the flame of each burner being directed upon the material of the furnace at a point spaced longitudinally of the furnace from that of the flames of all of the remaining burners, said burners being further so directed that the flame axis when projected does not cross the projected axis of that of any other burner assembly between the burner and the point of contact with the furnace load.

18. In combination with a furnace through which material is progressively moved, a plurality of burners discharging into the furnace, said burners being constructed and arranged to direct a flame upon the material within the furnace at approximately the longitudinal center line of the furnace load, and the flame of each burner being directed upon the material of the furnace at a point spaced longitudinally of the furnace from that of the flames of all of the remaining

burners, said burners being further so directed that the flame axis when projected does not cross the projected axis of that of any other burner assembly between the burner and the point of contact with the furnace load, and means to selectively render any of said burners operative or inoperative at will.

19. In combination with a furnace through which material is progressively moved, a plurality of burners discharging into the furnace, said burners being constructed and arranged to direct a flame upon the material within the furnace at approximately the longitudinal center line of the furnace load, and the flame of each burner being directed upon the material of the furnace at a point spaced longitudinally of the furnace from that of the flames of all of the remaining burners, a force pump discharging fuel to all of and only to said burners, and means to supply air to said burners.

20. In combination with a furnace through which material is progressively moved, a plurality of burners discharging into the furnace, said burners being constructed and arranged to direct a flame upon the material within the furnace at approximately the longitudinal center line of the furnace load, the flame of each burner being directed upon the material of the furnace at a point spaced longitudinally of the furnace from that of the flames of all of the remaining burners, means to selectively render any of said burners operative or inoperative at will, a force pump discharging fuel to all of and only to said burners, and means to supply air to said burners.

21. In combination with a furnace through which material is progressively moved, a plurality of burners discharging into the furnace, said burners being constructed and arranged to direct a flame upon the material within the furnace at approximately the longitudinal center line of the furnace load, and the flame of each burner being directed upon the material of the

furnace at a point spaced longitudinally of the furnace from that of the flames of all of the remaining burners, said burners being further so directed that the flame axis when projected does not cross the projected axis of that of any other burner assembly between the burner and the point of contact with the furnace load, a force pump discharging fuel to all of and only to said burners, and means to supply air to said burners.

22. In combination with a furnace through which material is progressively moved, a plurality of burners discharging into the furnace, said burners being constructed and arranged to direct a flame upon the material within the furnace at approximately the longitudinal center line of the furnace load, and the flame of each burner being directed upon the material of the furnace at a point spaced longitudinally of the furnace from that of the flames of all of the remaining burners, said burners being further so directed that the flame axis when projected does not cross the projected axis of that of any other burner assembly between the burner and the point of contact with the furnace load, means to selectively render any of said burners operative or inoperative at will, a force pump discharging fuel to all of any only to said burners, and means to supply air to said burners.

23. A device as claimed in claim 16 together with means to supply fuel to said burners constructed and arranged to positively deliver a selected amount of fuel to the furnace through said burners without regard to the number of burners which is in operation.

24. A device as claimed in claim 18 together with means to supply fuel to said burners constructed and arranged to positively deliver a selected amount of fuel to the furnace through said burners without regard to the number of burners which is in operation.

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