Sept. 24, 1929.                W. M. DUNCAN                1,728,958

ROTARY FURNACE

Filed May 14, 1926                4 Sheets-Sheet 1

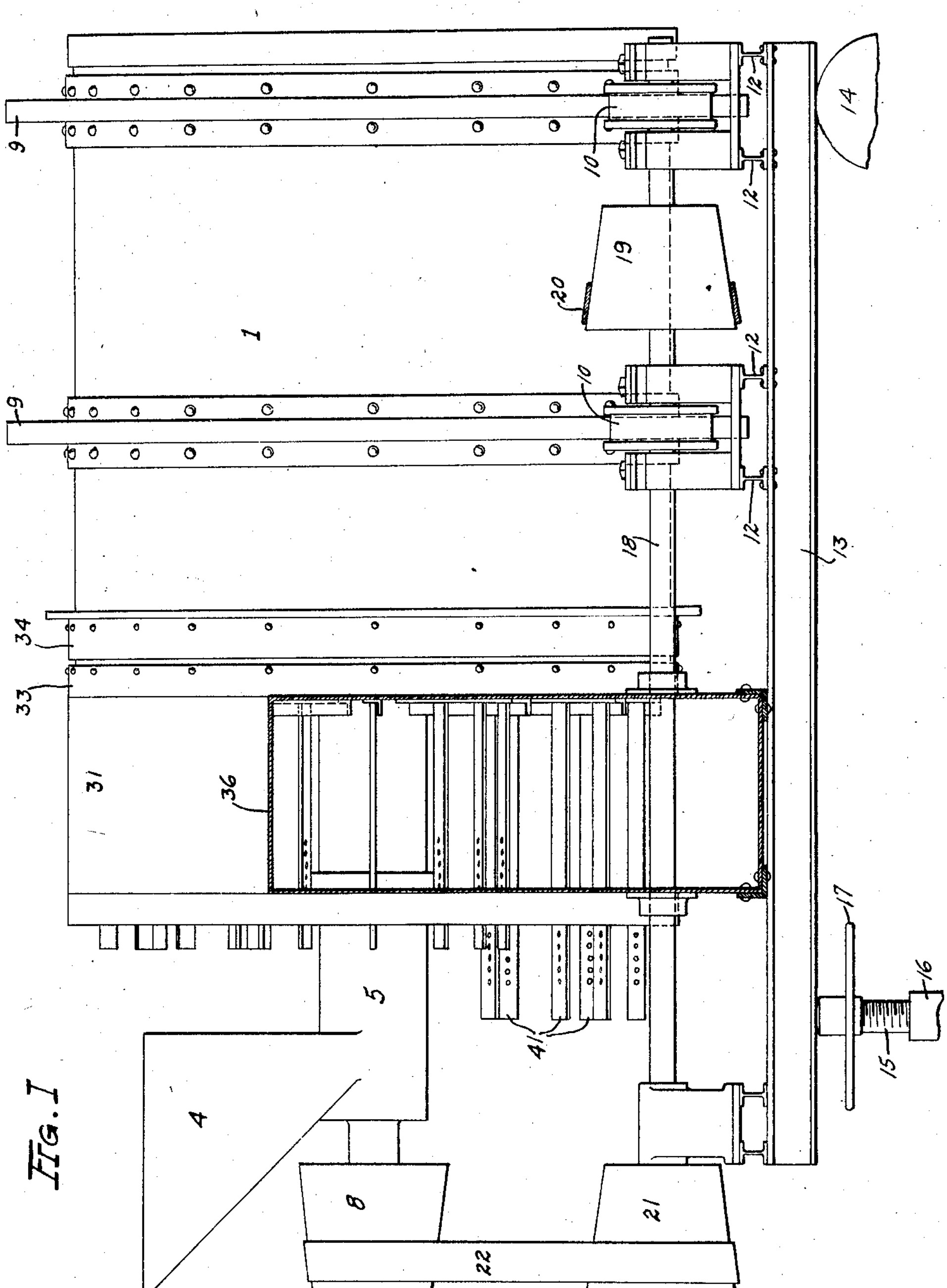



FIG. I

INVENTOR
W. M. DUNCAN
BY Cook & McCauley
ATTORNEYS

Sept. 24, 1929. W. M. DUNCAN 1,728,958

ROTARY FURNACE

Filed May 14, 1926 4 Sheets-Sheet 2

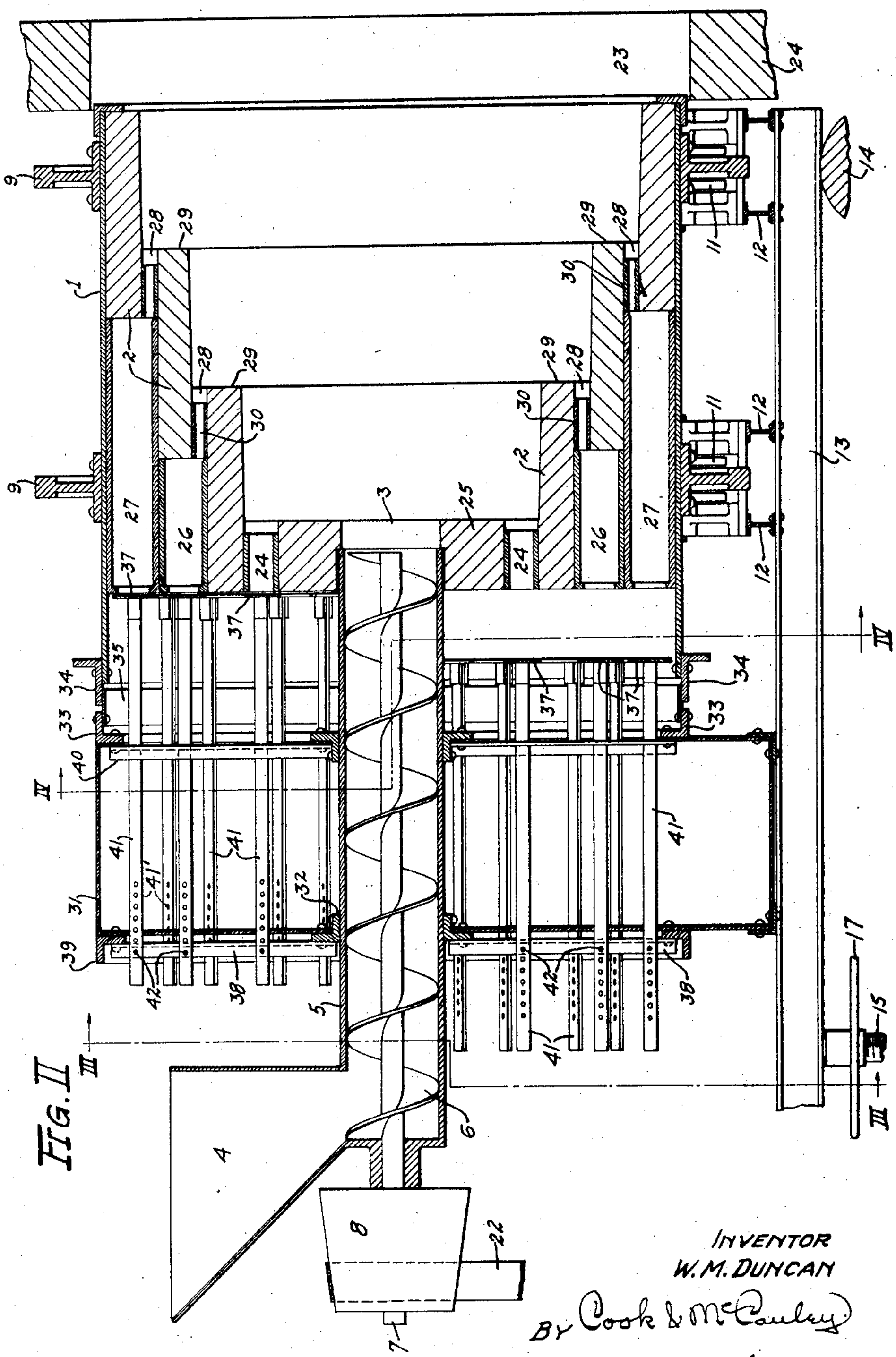


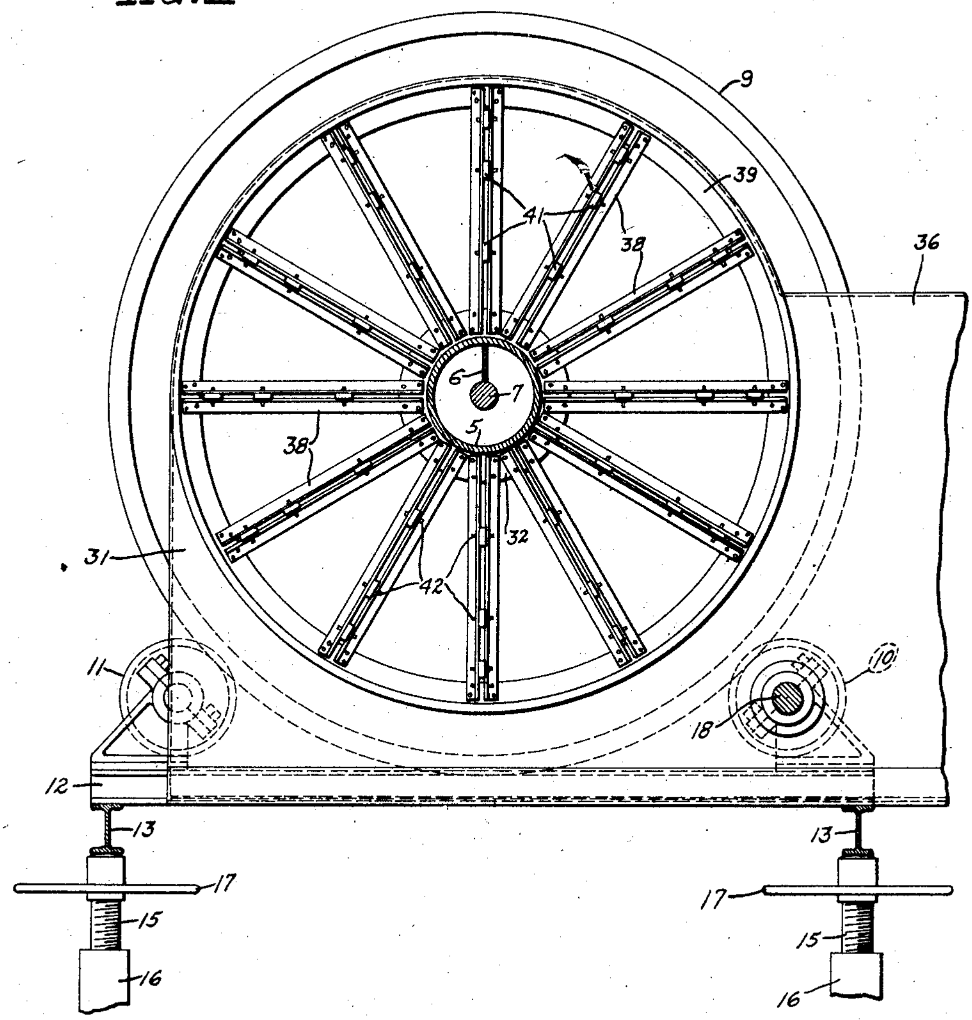
FIG. II

INVENTOR
W. M. DUNCAN

BY Cook & McCauley

ATTORNEYS

FIG. III



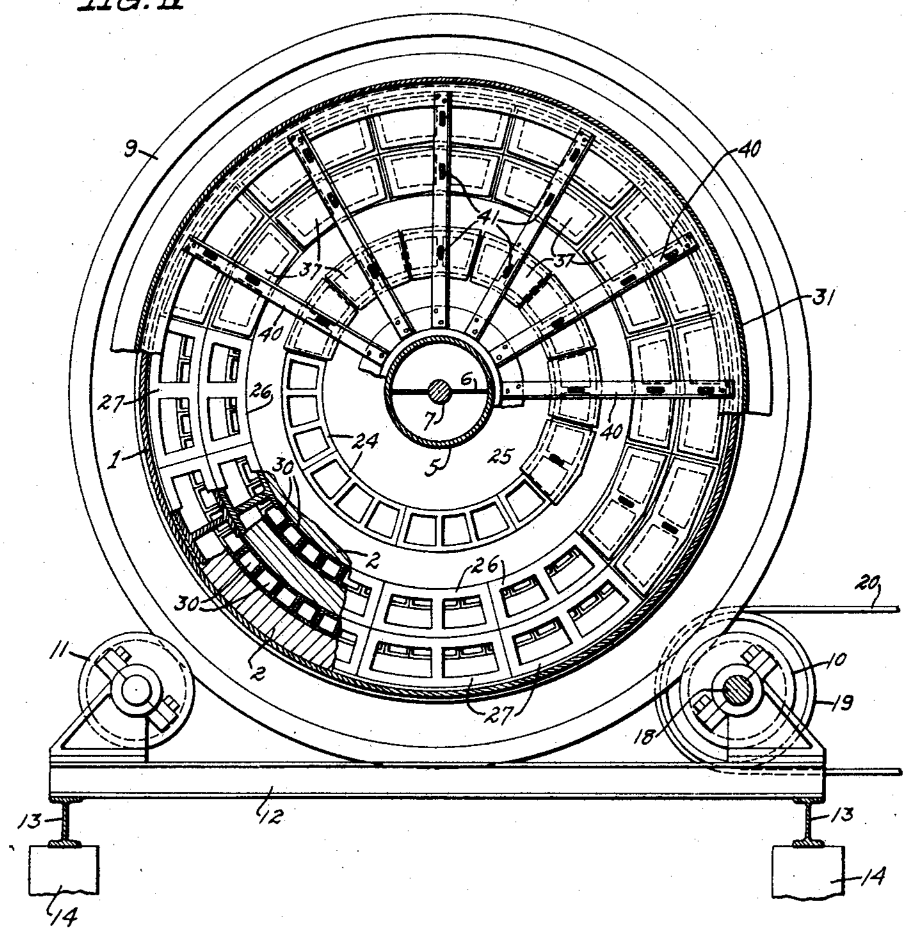

INVENTOR
W. M. DUNCAN
BY Cook & McCauley
ATTORNEYS

Sept. 24, 1929. W. M. DUNCAN 1,728,958

ROTARY FURNACE

Filed May 14, 1926 4 Sheets-Sheet 4

FIG. IV




INVENTOR
W. M. DUNCAN

BY Cook & McCauley

ATTORNEYS

Patented Sept. 24, 1929 1,728,958

# UNITED STATES PATENT OFFICE

WILLIAM M. DUNCAN, OF ALTON, ILLINOIS

## ROTARY FURNACE

Application filed May 14, 1926. Serial No. 109,064.

This invention relates to a rotary furnace adapted for various purposes including the destruction of refuse material, or to economize in the combustion of valuable fuels that can be burned with less efficiency in ordinary furnaces.

A high grade of fuel can be rapidly burned in the new apparatus to obtain an exceptionally high temperature with the advantage of almost complete combustion due to the conditions inside of the combustion chamber. A low grade fuel, or refuse material that cannot be readily burned, may be supplied to the furnace and effectively consumed, and the conditions can be regulated to obtain the results desired. The furnace can be used in conjunction with boilers and other apparatus wherein high temperatures are required, or for the purpose of heating or destroying material inside of the combustion chamber.

Air, preferably under presure, is supplied to the fuel in the combustion chamber. Particular attention is hereafter directed to the manner in which the air is delivered to the fuel, preferably to various points in the moving fuel bed, so as to not only result in more complete combustion, but also in the desired rate of combustion, and especially a rapid combustion to obtain high temperatures, or for the burning of constituents that cannot be consumed in an ordinary furnace.

With the foregoing and other objects in view, the invention comprises the novel construction, combination and arrangement of parts hereinafter more specifically described and illustrated in the accompanying drawings, wherein is shown the preferred embodiment of the invention. However, it is to be understood that the invention comprehends changes, variations and modifications which come within the scope of the claims hereunto appended.

In the preferred form of the invention, the fuel is continually fed into a combustion chamber so as to lie within the lower portion thereof, and the combustion chamber is preferably rotated to lift and drop the burning fuel. If a rotary motion is imparted to the chamber, its fuel-supporting surface will emerge from beneath the burning fuel and pass above it. Thus the exposed surface becomes highly heated before again serving in a fuel-carrying capacity. These conditions, including the lifting and dropping of the burning fuel and supporting the same on a highly heated surface, are very favorable for combustion, but to obtain the highest efficiency an ample supply of air must be delivered to the fuel.

The apparatus hereafter described comprises air ducts carried by the rotary combustion chamber to discharge air at various points through or onto the fuel-supporting surface, and a means whereby air is supplied to the ducts, together with an air-controlling device adapted to govern the flow of air through the ducts not covered by the fuel bed. The air can be projected into the fuel without causing an excessive flow through the ducts above the fuel bed, even though all of the air ducts rotate with the chamber, the desired variation in the air delivery being maintained in response to the rotary motion of the chamber so as to provide the desired flow of air into the fuel bed. The air-regulating device can be adjusted to obtain a predetermined variation of the pressure in the ducts at locations angularly fixed with reference to a vertical plane through the axis of the combustion chamber and, thereafter, when an an air duct passes from one position to another the flow of air through the moving duct will be automatically varied to obtain the predetermined delivery of air at each fixed location.

Fig. I is a side elevation of a rotary furnace embodying the features of this invention, the air conductor being shown in section.

Fig. II is a longitudinal section of the apparatus shown in Fig. I.

Fig. III is a vertical section taken on the line III—III in Fig. II.

Fig. IV is a vertical section taken on the line IV—IV in Fig. II, some of the parts being broken away to show the discharge nozzles which lie within a wall of the rotary combustion chamber.

The rotary combustion chamber comprises a cylindrical outer shell 1 and refractory lining members 2. A fuel inlet 3 is formed at one end of this chamber.

The means for delivering fuel into the chamber comprises a fuel hopper 4, a tube 5 extending from the bottom of said hopper and projecting into the central fuel inlet 3, and a screw conveyor 6 located in the tube 5 to feed the fuel from the bottom of the hopper to the interior of the rotary combustion chamber. The screw conveyor 6 is formed on a shaft 7 provided with a driving pulley 8 which may be operated at any desired speed to maintain a substantially continuous delivery of fuel to the combustion chamber.

The means for supporting the rotary combustion chamber comprises annular tracks 9 surrounding said chamber and resting on the peripheries of wheels 10 and 11, said wheels being supported by suitable bearings mounted on transverse beams 12 resting upon and suitably secured to longitudinal beams 13. These beams support all of the elements of the structure above them and they can be tilted to locate the combustion chamber at the desired inclination. To illustrate this feature, I have shown supporting members 14 having curved upper faces on which the end portions of the beams 13 are mounted, and adjusting screws 15 located below the opposite end portions of said beams. The screws are mounted in stationary members 16 and provided with operating members 17 whereby they may be rotated to raise or lower one end of the apparatus.

To impart a rotary motion to the combustion chamber, the supporting wheels 10 are fixed to a rotary shaft 18 provided with a driving pulley 19. A rotary motion is transmitted to the pulley 19 through the medium of a belt 20 which may be operated by any suitable source of power.

The means for driving the fuel-feeding device comprises a pulley 21 fixed to the shaft 18 (Fig. I) and a belt 22 extending from said pulley 21 to the pulley 8 on the shaft 7.

To illustrate a suitable means for regulating the speeds of the fuel-feeding device and the combustion chamber, I have shown pulleys in the form of cones on which the belts can be adjusted to vary the speeds. For example, the belt 20 (Fig. I) can be shifted on the pulley 19 to vary the speed of shaft 18, and this adjustment alone would vary the speed of both the rotary combustion chamber and the fuel-feeding device, but it will be understood that the belt 22 can be shifted on the pulleys 8 and 21 to obtain the desired speed at the fuel-feeding device, so the mechanical stoker formed by this device can be regulated to provide the desired delivery of fuel, irrespective of the speed of the rotary combustion chamber, and by suitable adjustment of the belts the speed of the combustion chamber can be changed without varying the speed of the mechanical stoker.

The refractory material 2 is arranged to form steps inside of the combustion chamber, as shown in Fig. II, the step of smallest diameter being adjacent to the fuel inlet 3, and the step of largest diameter being at the opposite end of the combustion chamber where the products of combustion are discharged through an opening 23 in a wall 24. The flame and hot gases discharged through this opening may be used to heat a boiler or any other apparatus.

The fuel-supporting surface is stepped downwardly from the fuel inlet 3, and the fuel drops from one step to another in passing away from said inlet. The means for transmitting air to the interior of the combustion chamber comprises an annular row of ducts 24 surounding a central mass of refractory material 25, as shown by Figs. II and IV, an intermediate row of ducts 26 surrounding the ducts 24, and an outer row of ducts 27 surrounding ducts 26. Inlet ports 28 extend from the ducts 26 and 27 to shoulders 29 formed by the stepped fuel-supporting surface, so the air transmitted through these ducts is delivered directly to the fuel-supporting surface where it enters into the bottom of the mass of fuel resting thereon. Nozzles 30 may be arranged in the inlets 28. However, the members 26, 27, 28 and 30 provide continuous ducts, or passageways, extending from one end wall of the combustion chamber to the surfaces which support the fuel in said chamber.

The several ducts are arranged longitudinally of the combustion chamber, but the air inlets at the fuel-supporting surface are spaced longitudinally of said chamber to provide for the delivery of air to the fuel at different points between the ends of the chamber. Moreover, the ducts in each row are spaced circumferentially of the chamber to provide for the delivery of air at various points around the inner face of the chamber, and all of these ducts rotate with the chamber.

However, it is usually desirable to forcibly project air into the fuel and to admit less air through the ducts which lie above the bed of solid fuel. In some cases, it is desirable to prevent the admission of air through the ducts passing over the fuel bed, while the air is being forced with considerable pressure through the lower ducts.

I will now describe a means by which the desired regulation can be adjusted manually and maintained in conformity with the rotary motion of the combustion chamber, automatically varying the flow of air through the ducts as they pass from one position to another. A substantially circular air chamber 31 surrounds the tube 5, and is secured thereto by means of an angle bar 32 (Fig. II) which forms an air-tight joint between the outer face of the tube and said air chamber. A circular angle bar 33 is secured to one side of this air chamber, and an angle bar 34 is secured to the adjacent end of the cylindrical shell 1. This shell and the angle bar 34 rotate with the combustion chamber, but the angle bar 33 is fixed to the stationary air chamber 31.

A sealing ring 35 (Fig. II) contacts with the inner faces of the bars 33 and 34. This ring is preferably made of flexible material attached to the stationary bar 33 and in frictional contact with the rotary bar 34. 36 designates an air supply conduit leading to the chamber 31 and adapted to deliver air under pressure to said chamber and into the ducts 24, 26 and 27. It will be noted that the inlet ends of all of these ducts are flush with each other, as shown in Fig. II, and that dampers 37 can be adjusted toward and away from these inlet ends to regulate the delivery of air thereto. As will be hereafter described, the dampers 37 can be adjusted by hand, but they do not rotate with the combustion chamber. After the dampers have been adjusted they remain stationary while the combustion chamber is rotated, and if the dampers 37 at the upper portion of the chamber are located adjacent to the course of the ducts, while the dampers at the lower portion are remote from the ducts, as shown in Fig. II, the air will pass freely into the lower portion of the combustion chamber, and the ducts will be automatically closed, or restricted, when they pass behind the dampers which have been placed near or in the plane in which the inlet ends of the ducts lie.

To illustrate a suitable means for supporting the adjustable dampers, I have shown radial angle bars 38 outside of the air chamber (Figs. II and III), these bars being arranged in pairs. The inner ends of said bars 38 are secured to the annular bar 32, while the outer ends of said bars 38 are secured to a ring 39. Another series of radial angle bars 40 is secured inside of the air chamber, as shown in Figs. II and IV. Each damper 37 is a relatively small flat plate rigidly secured to one end of a horizontal bar 41, and each bar 41 passes through a slot in one of the angle bars 40, also through a slot in the vertical wall of air chamber 31 and thence between a pair of the angle bars 38. As shown by Fig. II, the outer end portion of each bar 41 is provided with a series of holes 41′ adapted to receive a pin 42 removably mounted in a pair of the angle bars 38. The pins 42 are shown most clearly in Fig. III.

To adjust the dampers 37, the bars 41 are moved longitudinally and then secured by means of the pins 42. Fig. IV shows that the relatively small dampers 37 are located adjacent to each other so as to form a substantially continuous baffle adapted for making contact with the adjacent end face of the combustion chamber so as to entirely or in part prevent the admission of air to all of the ducts 24, 26 and 27. Each circular row of ducts is associated with a circular row of the dampers, and each damper can be adjusted independently of the others. The advantage of a regulation of this kind is believed to be apparent, especially in a rotary combustion chamber containing air ducts extending directly to the fuel-supporting surface in the chamber.

In the preferred form of the invention, the air ducts terminate at the shoulders 29, and the air is delivered in lines extending lengthwise of the chamber. This construction causes the air to enter the bottom of the fuel bed, and there is very little liability of the air ducts being choked or clogged by the particles of fuel or residual matter.

It is to be understood that any kind of fuel or mixtures of different fuels may be employed, and that the air may be admitted at various peripheral locations so as to contact directly with the flame and volatile gases, and also with the body of fuel in the combustion chamber. The admission of air to the various ducts can be regulated to obtain the best results in the use of different fuels.

I claim:

1. A rotary combustion chamber having a fuel inlet and a series of internal fuel-supporting surfaces of different diameters in the form of steps, the step of smallest diameter being adjacent to said inlet and the step of largest diameter being remote from said inlet, and air-ducts carried by said chamber and arranged longitudinally thereof, the discharge ends of said ducts being located in the rising portions of said steps.

2. A rotary combustion chamber having an internal fuel-supporting surface, a series of air-ducts carried by said chamber and having discharge ends at the interior thereof, said ducts being provided with inlets spaced circumferentially of said chamber, and means whereby the flow of air through said ducts is varied, said means comprising a normally stationary closure adjustable toward and away from the course of said inlets to check

the flow of air to the successive ducts passing said closure.

3. A rotary combustion chamber having an internal fuel-supporting surface, a series of air-ducts carried by said chamber and having discharge ends at the interior thereof, said ducts being provided with inlets spaced circumferentially of said chamber, and a normally stationary closure located adjacent to the course of said inlets to check the flow of air to the successive ducts passing said closure, and said closure including independently adjustable dampers movable toward and away from the course of said inlets to regulate the flow of air to different portions of said chamber.

4. A rotary combustion chamber having an internal fuel-supporting surface, a series of air-ducts carried by said chamber, said air-ducts being arranged longitudinally of said chamber and spaced apart circumferentially of the chamber, each of said ducts having an inlet at one end of said rotary chamber and a discharge end within said chamber, and a relatively stationary air-controlling device arranged at said end of the chamber to check the flow of air through the ducts at the upper portion of said chamber, said air-controlling device being located adjacent to the course of the inlets of said ducts.

5. A rotary combustion chamber having an internal fuel-supporting surface, a series of air-ducts carried by said chamber, said air-ducts being arranged longitudinally of said chamber and spaced apart circumferentially of the chamber, each of said ducts having an inlet at one end of said rotary chamber and a discharge end within said chamber, and dampers to vary the flow of air through said ducts, said dampers being located adjacent to the course of the inlet ends of the ducts, and said dampers being adjustable toward and away from said end of the rotary chamber.

6. A rotary combustion chamber having an internal fuel-supporting surface, a series of air-ducts carried by said chamber, said air-ducts being arranged longitudinally of said chamber and spaced apart circumferentially of the chamber, each of said ducts having an inlet at one end face of said rotary chamber and a discharge end within said chamber, a stationary air chamber located at said end of the rotary chamber to communicate with the ducts, and a sealing member to prevent the escape of air at the junction of said stationary chamber and rotary chamber, said sealing member contacting both the rotary chamber and the stationary chamber throughout their peripheries.

7. A rotary combustion chamber having an internal fuel-supporting surface, a series of air-ducts carried by said chamber, said air-ducts being arranged longitudinally of said chamber and spaced apart circumferentially of the chamber, each of said ducts having an inlet at one end of said rotary chamber and a discharge end within said chamber, a stationary air chamber located at said end of the rotary chamber to communicate with the ducts, a sealing member to prevent the escape of air at the junction of said stationary chamber and rotary chamber, said sealing member contacting both the rotary chamber and the stationary chamber throughout their peripheries, and a series of normally stationary air-dampers adjustable toward and away from the inlet ends of said ducts.

In testimony that I claim the foregoing I hereunto affix my signature.

WILLIAM M. DUNCAN.