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COMBUSTION APPARATUS

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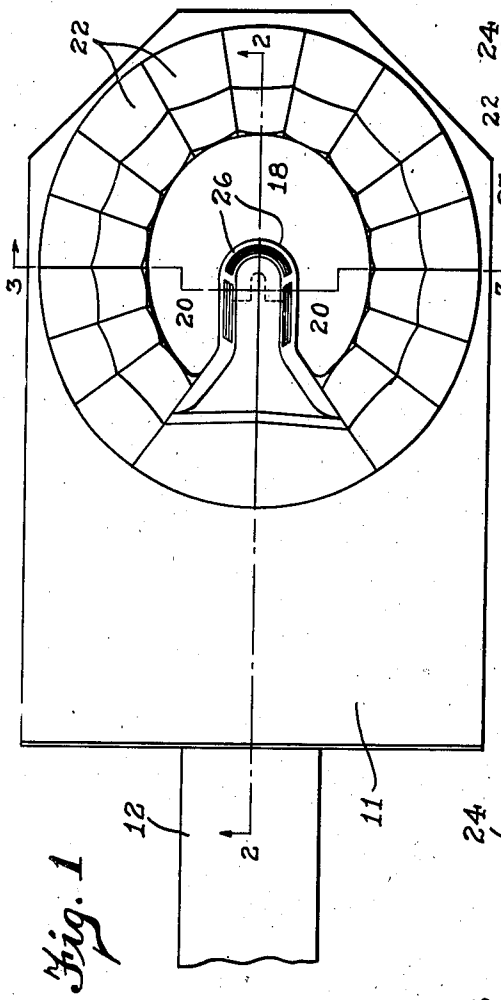


Fig. 1

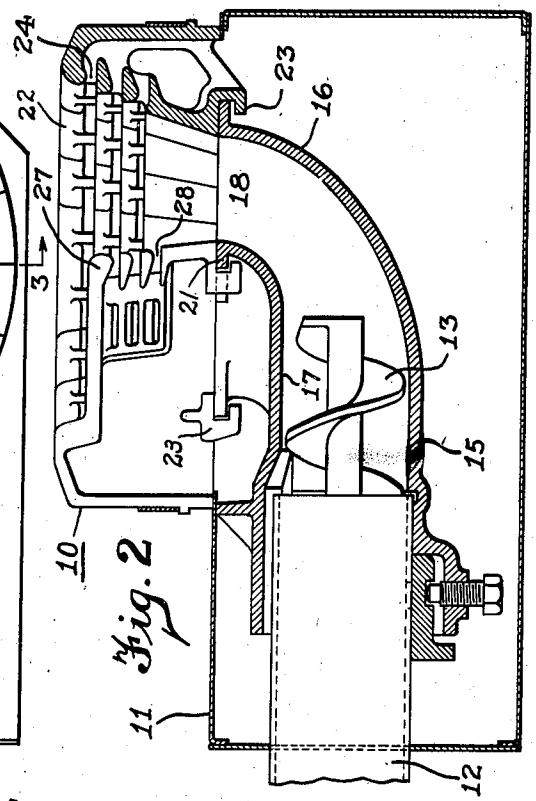


Fig. 2

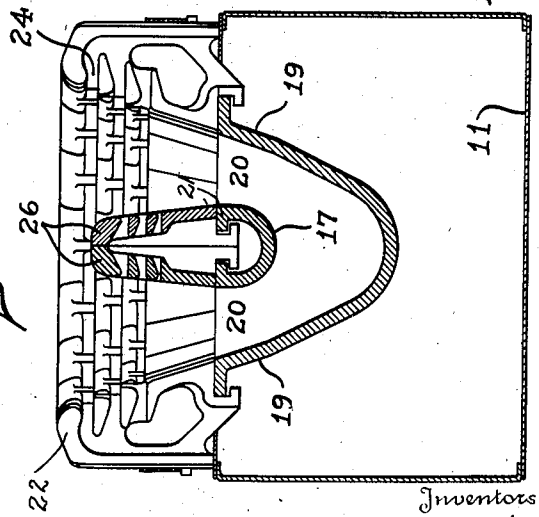


Fig. 3

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COMBUSTION APPARATUS

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6 Claims. (Cl. 110—45)

This invention relates to combustion apparatus and more particularly to retorts for the burning of solid fuel.

It is a principal object of the invention to provide a construction of retort for use in the burning of solid fuel which provides for the burning thereof in such manner that objectionable formation of coke trees is avoided and a smooth and regulated combustion is secured.

It is a further object to provide a retort into which the solid fuel such as bituminous coal is fed from below in a section of predetermined form and shape such that air supplied thereinto from the tuyères causes burning to take place through the full section thereof, resulting in the disintegration and frequent breaking up of the body of fuel and avoiding the building up of objectionable bodies of coke.

It is also an object to provide such a retort in which the upward feed of fuel is not materially obstructed, but is arranged to flow smoothly and uniformly into the retort, and in which the tuyères that supply combustion air are so arranged and located that they are not adversely affected by the heat of the combustion.

Other objects and advantages will be apparent from the following description, the accompanying drawing, and the appended claims.

In the drawing,

Fig. 1 is a plan view of a retort constructed in accordance with the present invention;

Fig. 2 is a vertical sectional view thereof on the line 2—2 of Fig. 1; and

Fig. 3 is a sectional view on the line 3—3 of Fig. 1.

In the combustion of solid fuel, and more particularly in the case of under-feed stokers such as those utilized in the household heating field, a body of fuel is supplied upwardly into a retort, where air is made available for purposes of combustion. When the fuel, particularly soft or bituminous coal, is supplied in a body of substantial size or thickness, it is sometimes found that an objectionable coking tendency takes place, that is, there is a failure to secure complete combustion throughout the body of the fuel. That portion of the body of fuel which is not properly supplied with combustion air is nevertheless highly heated, and this heating results in distillation and driving off of the volatile gases of such portion of the fuel body, producing an action equivalent to an actual coking operation. The fuel in this zone thus forms into a more or less solid mass, and one having substantial structural strength so that it may tend to build up, and form what is referred to in the trade as a coke tree. When the formation reaches such a point that it can no longer support itself, it falls and this results in an uneven and undesired supply of fuel, such formation and the resulting inequality of burning being more objectionable during periods of moderate temperature where only infrequent or intermittent operation of the furnace is required. This results in unnecessary supply of fuel under conditions not regulated by the normal furnace controls, reducing the efficiency and effectiveness of the combustion operation.

In accordance with the present invention, a construction of retort is provided which substantially avoids or eliminates objectionable formation of coke deposits so that proper and regulated operation of the stoker may be secured under both high and low rate conditions. In accordance with this invention the body of fuel supplied into the combustion zone is regulated to have a predetermined form and shape such that its section is relatively thin. Combustion air is then supplied to the section of the fuel, and made effective upon both sides thereof, the relation between the fuel body and the supply of combustion air being such that the air is made effective from the two sides of the body of fuel to secure substantially complete combustion through the entire section thereof. Preferably the fuel is fed into the retort by a feeder which produces feed impulses such as to cause agitation of the body of fuel tending to assist in the breaking up thereof. In this way the entire body of fuel is actually consumed and this objectionable coking tendency in the interior part of a body of fuel which is not properly supplied with combustion air, is avoided. Further the arrangement is such that the tuyères through which the air is introduced are properly supported and protected against excess temperature conditions such as might result in the fusing or burning away thereof; and a properly balanced and well regulated supply of fuel is afforded without materially increasing the obstruction to the fuel feed.

Referring to the drawing which discloses a preferred embodiment of the invention, the retort structure is indicated generally at 10, and includes a supporting casing or chamber 11 which is supplied with combustion air under pressure from a suitable source. This casing thus forms a plenum chamber from which air is supplied through openings in the tuyères into the combustion zone.

The fuel supply conduit is shown at 12 leading from a suitable source of fuel supply, and having a feed worm 13 therein suitably driven. As an example of a satisfactory form of drive, that

shown in Scholl Patent No. 2,145,943, owned by the assignee of this case, may be used. That drive provides timed feed impulses each of substantially the same magnitude to actually lift the fuel bed and assist in the breaking up of fuel bodies, and with provision for predetermining the length of the intervals between impulses to vary the actual rate of feed.

The conduit 12 opens into a feed passage member 15 preferably formed as a casting, having a forwardly and upwardly curved passage 16 projecting forwardly beyond the end of the feed worm. It is also provided with a forwardly extending top portion 17 the lower side of which is given a generally semi-cylindrical curvature as shown in Fig. 3 so as to deflect the upwardly moving body of fuel to either side thereof with a minimum of frictional resistance and with the avoidance of dead feed zones. This top portion 17 is an integral part of the fuel supply conduit and thus is in direct heat transfer relation with the entire mass thereof. It terminates short of the forward wall 16 leaving an open feed zone 18 of curved shape. At either side of this portion 17 the walls of conduit 15 diverge upwardly as shown at 19, leaving a pair of side passages 20, in direct and continuous communication with passage 18, and providing for the unrestricted and regulated upward flow of fuel. Flanges 21 are formed at the upper surface of portions 17 and 19 for receiving cooperating parts of the tuyères thereon in interlocked but readily removable manner.

As will be apparent from Fig. 1, the shape of the combined passages 18 and 20 is substantially C-shaped in cross section, and the relative areas of the several portions of the section are suitably regulated so as to provide for substantially uniform flow of the fuel throughout the entire arcuate extent of the feed passage so that proper and regulated distribution is obtained into all parts of the combustion zone.

A plurality of tuyères 22 are mounted on the upper end of the feed passage, being provided with a locking portion 23 received on flanges 21 to be guided and supported in proper positioning thereon and providing for individual removal and replacement thereof if necessary. These tuyères are so formed that in the assembled form they constitute a substantially complete ring, sloping outwardly and upwardly, and providing for supplying combustion air to the fuel in the course of its upward travel, through several series of openings 24 which are in direct communication with the plenum chamber.

An additional set of tuyères is supported upon the section 17, this group comprising a pair of complementary tuyère sections 26 suitably supported upon the member 17 so as to be in heat-transferring relation therewith throughout their entire length. The forward ends 27 of these tuyères recede upwardly in the same manner as the group of tuyères 22, thereby providing for progressive enlargement of the cross section of the fuel passage at higher levels. The series of openings 28 in this auxiliary group of tuyères supplies air from the plenum chamber to the inner periphery of the body of fuel, the lowermost such openings preferably being located at a somewhat lower level than those of the outer series of tuyères 22, and the uppermost openings being located below the level of the uppermost openings 24. This provides for locating the entire tuyère sections 26 at a lower level and thus not in the highest heat zone.

From the foregoing it will be seen that this construction provides for introducing into the combustion zone a body of fuel all portions of which are adapted to be properly supplied with combustion air, being of relatively narrow cross section throughout, the section being such that under ordinary combustion conditions, the supply of combustion air from both the outer and inner peripheries would normally result in securing substantially complete combustion throughout the entire section. In this way the combustion is carried forward substantially completely, and the tendency to the formation of coke trees is largely overcome and rendered unobjectionable, the physical arrangement and distribution of the body of fuel and of any body of coke which may tend to form being such that it does not have inherent structural strength and under the actual conditions of combustion will break down and be consumed. Also the mechanical agitation afforded by the feeding impulses assists in overcoming the tendency for the fuel to form into such bodies, the mechanical agitation afforded by the feeding stroke being substantially the same at high feed as at low feed since the magnitude of the impulses is not changed. It will be further noted that the inwardly projecting tuyères 26 are in direct air and heat-transferring relation with the remainder of the retort structure, are protected from the highest heat zone of the fuel bed and that no portions thereof are subjected to such excessive temperature conditions as to result in the fusing or burning away thereof.

While the form of apparatus herein described constitutes a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise form of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. A retort of the character described for burning solid fuel substantially uniformly and without objectionable formation of coke deposits comprising a fuel feeding passage, means overlying one end of said passage forming a substantially C-shaped combustion zone for receiving and burning the fuel, the combustion zone being continuous and uninterrupted from one end to the other, a first group of tuyères around the outer periphery of said combustion zone for supplying combustion air into the outer surface of the body of fuel as it flows upwardly into and through the combustion zone, and another group of tuyères projecting toward the interior of said combustion zone from the opposite side thereof to supply combustion air thereto from the opposite side to secure substantially complete combustion of the entire section of the fuel body, said other group of tuyères being located directly above said end of said fuel feeding passage, and means for feeding fuel from beneath said other group of tuyères in the direction toward said first group of tuyères to supply fuel to the more remote portions of said fuel body by direct upward travel and to the less remote portions of said fuel body by deflected upward travel.

2. A retort of the character described for burning solid fuel substantially uniformly and without objectionable formation of coke deposits comprising a fuel supply conduit, said conduit having an upwardly curved open passage at its forward end and having a centrally located forwardly extending top portion terminating short of the op-

posite wall of said passage forming a pair of supply passages at either side thereof in direct communication with said upwardly curved passage, tuyères mounted around the outer periphery of said passage and upon said forwardly extending portion providing for supplying combustion air to the body of fuel from both sides thereof as it travels upwardly through said retort, and fuel feed means extending forwardly beneath said top portion for delivering fuel substantially uniformly by direct upward flow to the more remote upwardly curved passage and by laterally deflected flow under said top portion to said less remote side passages.

3. A retort of the character described for burning solid fuel substantially uniformly and without objectionable formation of coke deposits comprising a fuel supply conduit, said conduit having an upwardly curved open passage at its forward end and having a centrally located forwardly extending top portion overlying and spaced from the end of said conduit forming a pair of supply passages at either side thereof in direct communication with said upwardly curved passage, means in said conduit for advancing fuel under said top portion in the direction of said upwardly curved passage, tuyères located above said passage and around the periphery thereof, said tuyères being arranged in an outer generally arcuate manner extending from one of said side passages to the other and defining an arcuate retort for supplying combustion air to the outer surface thereof, and additional tuyères located on said forwardly extending portion for supplying combustion air to the body of fuel inwardly of the ends of said arcuate fuel body and cooperating with said first mentioned tuyères for assuring substantially complete combustion of the entire section of the fuel body.

4. A retort of the character described for burning solid fuel substantially uniformly and without objectionable formation of coke deposits comprising a fuel supply conduit, said conduit having an upwardly curved open passage at its forward end and having a centrally located forwardly extending top portion spaced from the end of said conduit forming a pair of supply passages at either side thereof in direct communication with said upwardly curved passage, a feed worm for feeding fuel through said conduit, said feed worm extending toward said upwardly curved passage and located directly beneath said top portion to provide for positive upward feed of fuel in a forward direction into said more remote upwardly curved passage and with a deflected flow under said top portion into said side passages, and tuyères mounted above said top portion and said conduit and arranged in an outer generally circular manner extending from one of said side passages to the other for supplying combustion air to the inner surface of said body of fuel and to the outer periphery thereof to provide for substantially complete combustion of the entire section of the fuel body.

5. A retort of the character described for burning solid fuel substantially uniformly and without objectionable formation of coke deposits comprising a fuel supply conduit, said conduit having an upwardly curved open passage at its forward end and having a centrally located forwardly extending top portion spaced from said end of the conduit forming a pair of supply passages at either side thereof in direct communication with said upwardly curved passage, means positioned directly below said top portion for feeding solid fuel through said conduit in a direction toward said upwardly curved passage with deflected flow occurring from opposite sides of said conduit beneath said top portion into said side supply passages, the cross-sectional area of said upwardly curved passage being relatively large and of said side passages becoming smaller in the portions thereof removed from the zone of direct communication with said upwardly curved passage to provide predetermined substantially uniform flow of the fuel throughout the entire body thereof, and tuyères located around the periphery of said passage and on said forwardly extending portion for supplying combustion air to both the inner and outer surface of said body of fuel to secure substantially complete combustion thereof.

6. A retort as recited in claim 3 in which said additional tuyères are constructed to supply the combustion air at a level below that supplied by said first mentioned tuyères, said additional tuyères being located out of the highest heat zone.

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