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APPARATUS FOR CARBON BLACK MAUFACTURE

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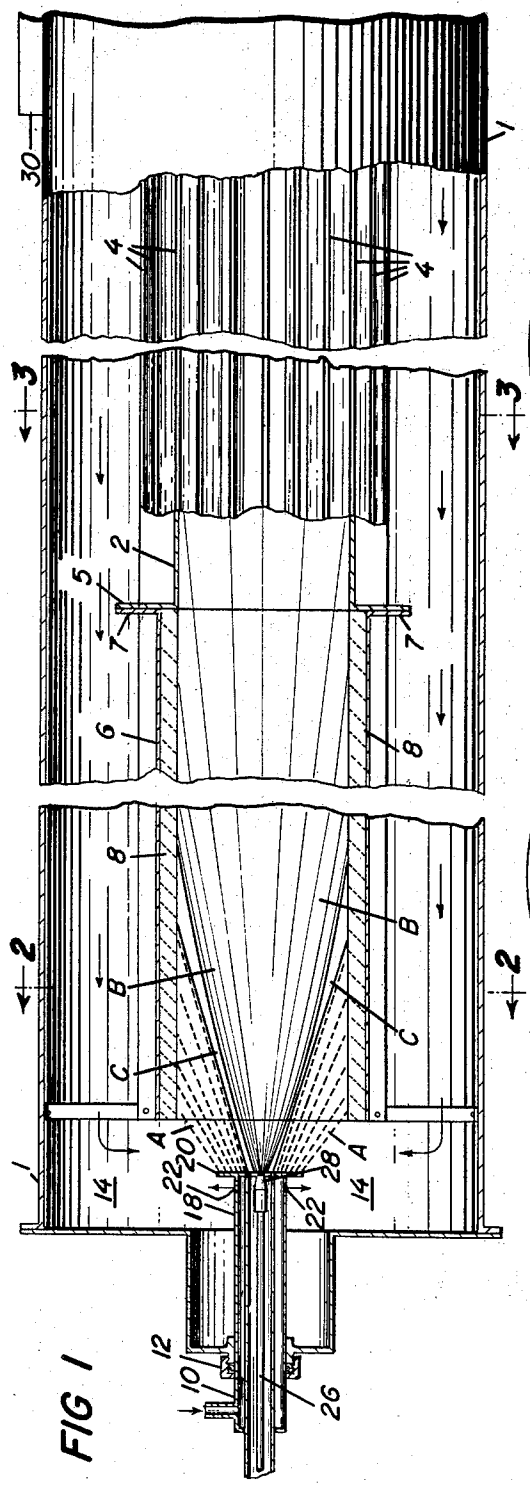


FIG 1

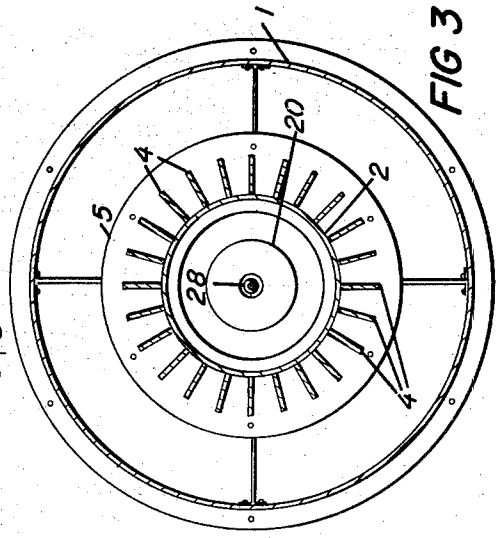


FIG 3

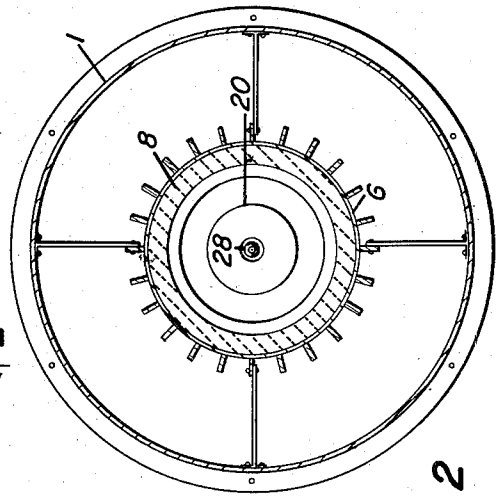


FIG 2

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APPARATUS FOR CARBON BLACK MANUFACTURE

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1 Claim. (Cl. 23—259.5)

This invention relates to the manufacture of carbon black from petroleum oils, or any type hydrocarbon, such as shale oil, coal tar, etc.

It is, of course, well known in the art that superior grade carbon blacks are obtained by rapidly cracking a finely divided hydrocarbon at a relatively high temperature in a turbulent atmosphere wherein the rate of heat transfer to the hydrocarbon is very rapid. Also that, when preheated air is used, a higher yield is obtained due to the fact that a smaller portion of the hydrocarbon has to be burned to heat the gases and remaining hydrocarbon up to the cracking temperature. The velocity of the gas is very high (being, in some instances, above the speed of sound) and the high temperatures which are involved (especially when producing carbon black of small particle size) tremendously reduce the period of utility of the reactor, when the latter is, for the most part, composed of costly refractory material.

Among the objects of the present invention is the provision of an apparatus for making carbon black which results in materially reduced production cost without loss in quality.

Another object is to provide an apparatus for attaining the foregoing objectives which is comparatively simple and inexpensive to install, operate and maintain.

The invention, then, comprises the features hereinafter fully described and as particularly pointed out in the claim, the following description and the annexed drawings setting forth in detail certain illustrative embodiments of the invention, these being indicative of but several of a number of ways in which the principles of the invention may be employed.

In said drawings:

FIGURE 1 is a fragmentary longitudinal elevation, partly in section, and illustrating one form of apparatus which embodies the teachings of the present invention; and

FIGURES 2 and 3 are transverse sectional views taken on the lines 2—2 and 3—3, respectively, of FIGURE 1.

Referring more particularly to the drawings, the numeral 1 designates an elongate metallic cylindrical housing within which there is concentrically disposed a cylinder 2 which is composed entirely of metal. This metallic cylinder 2 carries on its outer surface a series of longitudinally extending radial fins 4 which are also composed entirely of metal, and constitutes what is known in the art as a fin-tube. Such fin-tubes are frequently formed of stainless steel and are heat resistant to a substantial extent. The fin-tube 2 forms the downstream end of the combustion chamber or reactor of the apparatus of the present invention; and it is shown as provided on its upstream end with an annular flange 5.

It has heretofore been proposed to construct the entire combustion chamber or reactor of metal; but it has been found that considerable surface oxidation occurs on the exteriors thereof, and the same may melt due to excessively high temperatures at the combustion end of the reactor, unless, of course, the metal utilized is a special (and necessarily expensive) high-temperature alloy. The teachings of the present invention contemplate a refractory lined or shielded tube disposed in axial alignment with the upstream end of the fin-tube 2 in order to protect this high-temperature area or section of the reactor where

initial combustion takes place. As distinguished from the considerably more costly fin-tube, this upstream tube may be formed of simple steel, as shown at 6, and provided with a refractory liner 8. The downstream end of the metallic cylinder 6 may be provided with an annular flange 7 which is suitably connected to the annular flange 5 of the (downstream) fin-tube 2. It will be understood, however, that the aforementioned means for connecting the downstream fin-tube 2 and the upstream metallic cylinder 6 are simply illustrative and that other, and perhaps more suitable, means may be employed in lieu thereof. As shown in the drawings, the inside diameter of the refractory cylindrical liner 8 in the metallic cylinder 6 is substantially the same as that of the (all metal) fin-tube 2. This refractory liner 8 is pre-cast and may be composed of any refractory which possesses a sufficiently low thermal co-efficient (such as silicon carbide) in order that it may withstand sudden heat shock without cracking. Other suitable materials include the carbides of other refractory metals, such as zirconium, titanium, molybdenum, etc.

According to an acceptable embodiment, the refractory pre-cast liner 8 may be of between approximately one and approximately three inches in thickness, have an inside diameter of approximately eight inches for cooperation with a fin-tube 2 of corresponding internal dimension; and it may be from approximately four to approximately eight feet in length.

The (all metal) fin-tube 2 may be of any length which is found suitable and it communicates at its downstream end with a carbon black collecting system and an area provided with one or more quench-water sprays; all of said elements being, of course, well-known in the art.

Referring to the left-hand end of FIGURE 1, the burner is shown as comprising a tube 10 which extends through a packing gland 12 in the center of the adjacent end wall of the housing 1 and extends axially into the cylindrical or drum-like compartment 14 which is formed between the end wall of the housing and the upstream end of the refractory pre-cast cylindrical liner 8. A tube 18 is disposed concentrically in the tube 10 and extends equidistantly into the cylindrical or drum-like compartment 14, the ends of said tubes being welded to a vertically disposed and centrally apertured plate or disk 20.

As shown in the drawings the diameter of the plate or disk 20 is considerably greater than the outside diameter of the tube 10: and the diameter of its central aperture is substantially that of the inside diameter of the tube 18.

Immediately behind the plate or disk 20, the tube 10 is provided with a series of evenly spaced apertures 22.

An oil pipe 26 is disposed concentrically within the tube 18 and terminates in a spray head 28, the outer end of which is flush with the outer face of the disk 20. A suitable oil constituting the carbon black feedstock is supplied to the oil pipe 26.

Axial air is supplied to the interior of the inner tube 18.

Combustion gas is supplied to the annular space between the inner tube 18 and outer tube 10 and emerges through the apertures 22 in the latter.

From the foregoing construction and arrangement it will be observed that combustion air enters the air inlet 30, passes along the annular space between the interior of housing 1 and the exterior of the fin-tube 2, then along the exterior of the metallic cylinder 6 and then into the cylindrical or drum-shaped compartment 14 and finally into combustion area within the refractory liner 9. The combustion area of the refractory cylindrical liner 9 is divided into the three following zones:

I. Oxidizing zone A which is indicated by radiating

dash lines. In this zone there is an excess of oxygen above that necessary to burn all the gas from the hereinbefore described gas burner.

II. Reducing zone B indicated by radiating solid lines. This zone includes the volume covered by the oil spray from the spray head **28** and when there is an excess of hydrocarbon above that which can be consumed by the air.

III. Boundary zone C marked by heavy solid lines, which is theoretically of a modified bent cone shape, indicating the boundary area which is between oxidizing zone A and reducing zone B. In this zone or area there is just enough oxygen to consume all the oil and gas by combustion and thus temperatures above 3000° F. may be reached; the hottest refractory area being where the reducing zone C intersects with the inside of the refractory liner **9**.

It will be understood by those skilled in the art that if desired a refractory cylindrical liner **9** could be substituted for the entirely metallic fin-tube **2**. However, this will necessarily result in an increase in cost. Also that the other gas burners etc. may be substituted for the one illustrated herein, which, as such forms no part of the present invention.

It will be understood by those skilled in the art that many modifications and variations of the invention as above set forth may be made without departing from the spirit and scope thereof; and therefore only such limitations should be imposed as are indicated in the appended claim.

I claim:

In an apparatus for making carbon black, an elongate metallic tubular housing; a metallic cylinder disposed concentrically within said elongate metallic tubular housing and forming the downstream end of a combustion chamber; a second metallic cylinder disposed concentrically within said elongate metallic tubular housing and secured to, and axially communicating with, the upstream end of said first-named metallic cylinder; the

inner diameter of said second-named metallic cylinder being larger than the inner diameter of said first-named metallic cylinder; a refractory cylindrical lining within said second-named metallic cylinder and having an inner diameter which is substantially the same as the inner diameter of said first-named metallic cylinder thereby providing at this point a peripheral surface for confining the gases flowing downstream which is of substantially uniform diameter; said axially aligned metallic cylinders providing an air jacket between their exterior surfaces and the inner surface of said elongate metallic tubular housing; one end of said elongate metallic tubular housing extending beyond the corresponding end of said metallic cylinder and its refractory lining and providing an unobstructed chamber therein; a closure member for the aforementioned end of said elognate metallic tubular housing; an air inlet disposed adjacent the other end of said elongate metallic tubular housing and communicating with the downstream end of said air jacket; a gas burner disposed in said unobstructed chamber and in axial alignment with said upstream end of said second-named metallic cylinder; means for supplying liquid carbon black feedstock to the flame produced by said gas burner; and a series of metallic heat-transfer fins on the outer surfaces of both of said metallic cylinders; said metallic heat-transfer fins being adapted to guide the air from said air inlet toward the upstream end of said second-named metallic cylinder.

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