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APPARATUS FOR PRODUCING CARBON BLACK

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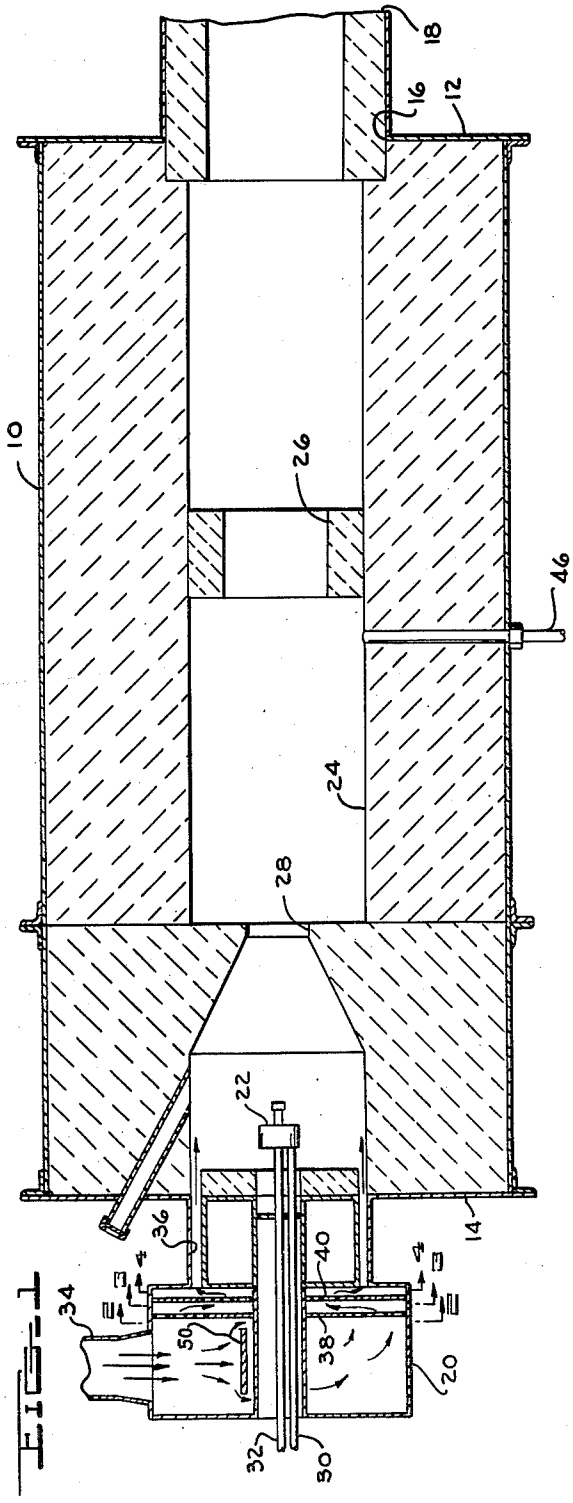


FIG. 1

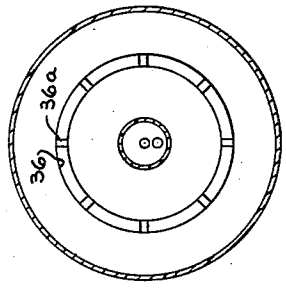


FIG. 4

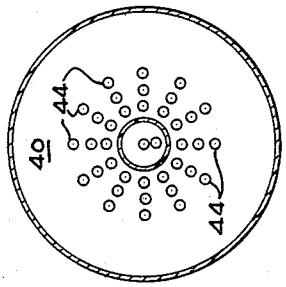


FIG. 3

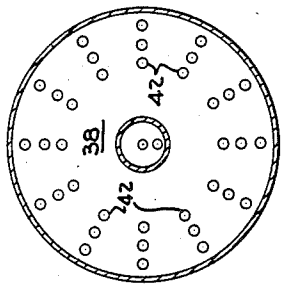


FIG. 2

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APPARATUS FOR PRODUCING CARBON BLACK

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3 Claims. (Cl. 23—259.5)

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The present invention relates to improvements in apparatus for producing carbon black by the decomposition of fluid hydrocarbons, such for example as natural gas, vaporized liquid hydrocarbons, and the like.

One of the objects of the present invention is to provide a novel apparatus for producing carbon black by the decomposition of a hydrocarbon gas or vapor which apparatus is adapted to provide improved control of the process to control the quality and yield of the produced carbon black.

Another object of the present invention is to provide an air header or manifold for use in apparatus for producing carbon black, which air header or manifold is adapted to provide a uniform distribution of air and control the direction of flow of air within said apparatus.

Still another object of the present invention is to provide an improved converter for producing carbon black which is constructed and arranged to provide a series of zones of combustion for producing carbon black at a desired quality, and further which converter has a means therein for varying the rate of combustion in some of said zones.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

In the drawings:

Fig. 1 is a longitudinal sectional view showing a preferred form of converter embodying the present invention;

Fig. 2 is a sectional view taken on the line 2—2 of Fig. 1 looking in the direction of the arrows;

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 1 looking in the direction of the arrows; and

Fig. 4 is a sectional view taken on the line 4—4 of Fig. 1 looking in the direction of the arrows.

Before explaining the present invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

The accompanying drawings show one form of a novel converter embodying the present invention. This converter comprises an outer steel

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casing 10 of any suitable construction, which may be a single piece, or may be formed of a plurality of separate sections joined together in any suitable manner. In the converter construction illustrated in the drawings, it will be observed that the casing 10 is generally circular in cross section, thereby providing a generally cylindrical shaped converter. While this shape is preferred, it will be understood that the converter casing 10 may be of any desired size and shape and, consequently, may be provided with cross sectional configurations other than circular.

The casing 10 is provided with ends 12 and 14. The end piece 12 is provided with a centrally located opening indicated at 16 through which extends the flue 18. The end piece 14 has an air header or manifold 20 centrally located thereon and through which extends a fluid hydrocarbon injector 22.

The casing 10 and end pieces 12 and 14 thus provide a complete outer shell for the converter and define the inner enclosed space within the converter. The inner walls of this shell are lined with a suitable heat resisting refractory material, such for example as fire brick, which provides a refractory lining 24 therein. The refractory lining may follow the contour of the casing 10 and thus provide a substantially cylindrical interior in the furnace, but it is preferred that it be placed therein to provide a series of separate zones. The refractory lining 24 may be formed of any desired type of refractory material which can be heated to approximately 3000 degrees F. without undergoing excessive deterioration. The flue 18 also is lined with the same or a similar refractory material.

The refractory material 24 may be layed up within the casing 10 and the flue 18 in the form of bricks or blocks bonded together by any suitable type of heat resisting binding mortar, such for example as fire clay or the like. If desired, however, the refractory material 24 may be used in the form of prefabricated sections having a desired cross sectional contour.

The reference number 26 indicates in general, an annular mixing orifice formed of a suitable refractory material and located within the converter. The throat through which the hydrocarbons are introduced into the converter, is in the form of an orifice of somewhat smaller diameter and is indicated at 28. The throat 28 has a frusto-conical shaped opening for converging the gaseous mixtures passing therethrough to assure the desired mixing prior to discharge of the gaseous mixtures into the combustion chamber.

The mixing orifice 26 may be located in vari-

ous positions in the converter as desired to control the pattern of combustion within the converter. It is to be understood that the shape of the mixing orifice 26 may be varied as desired, but a generally annular orifice member, positioned as shown, is a preferred structure.

The throat 28 is preferably so positioned with relation to the fluid hydrocarbon injector 22 as to permit the hydrocarbons to be mixed on the upstream side of the throat before passing into the converter. The quality of the carbon black is partially regulated by the relative position of the injector 22 in the throat 28. It has been found that a converging frusto-conical orifice of the type shown, permits the restriction to be placed closer to the fluid hydrocarbon injector 22 than is possible when using a cylindrical mixing orifice of the type shown at 26, and hence, this converging orifice and its position relative to the hydrocarbon injector 22 are important features of the present invention.

Fluid hydrocarbons are injected into the converter through the fluid hydrocarbon injector 22 which is preferaby located on the axis of the converter. The injector 22 has a conduit 30, which is connected with a suitable source of hydrocarbon, for example, gas under pressure, and another conduit 32, which is suitably connected to another source of hydrocarbon, for example, a vaporized liquid hydrocarbon. However, it is contemplated that other forms of hydrocarbons than those described can be introduced into the converter through the conduits 30 and 32 and the injector 22. The injector 22 is a doughnut type of injector such as is shown and described in the copending application, Serial No. 197,741, filed November 27, 1950, in the name of Arthur L. Sweigart. However, it is to be understood that the claims of the present application are not limited to this particular type of injector.

Air under pressure is introduced into the converter from a radially disposed air duct 34 and enters the air distribution header or manifold 20. A baffle 50 extends across the chamber substantially at right angles to the center line of the radial air duct 34 and acts to break up and distribute the air stream passing into the header from the duct 34. The air then passes through the air header or manifold 20 and into the annular port 36 through which the air flows into the converter as a substantially uniformly distributed annular sheet extending on lines substantially parallel with the axis of said converter. Baffles 38 and 40, having a plurality of staggered apertures 42 and 44 therein, respectively, are mounted within the air header or manifold 20 to give the desired direction to the air before it passes into the converter.

While it is preferred to arrange apertures 42 and 44 as shown, it should be understood that other arrangements of openings in baffles 38 and 40 may be employed which will provide the desired flow of air parallel to the converter axis.

The air from the air duct 34 follows in general, the paths of the arrows indicated in Fig. 1 and passes through the apertures 42 and 44 and then through the annular port 36 into the interior of the converter. If desired, spacers 36*a* may be secured between the shells defining the annular port 36 to provide an accurate spacing thereof and define a plurality of separate paths within the port 36. Other types of spacers may be provided as desired in place of the spacers 36*a*. By virtue of the construction of the air header 20 and the baffles therein, the air will flow uniformly into the converter adjacent the walls thereof in paths parallel to the axis of the converter.

The absence of any tangential or rotational flow of the air is an important feature of the present invention. By virtue of a non-rotational flow of air, a more uniform and better controlled flame is provided in the converter. It has been found in converters using tangential flow of air, that the vortex formed within the converter contributes to flame fluctuation therein which disturbs the uniform quality and yield of carbon black. When the air is introduced into the converter, as herein disclosed, in an annular nonrotating sheet, the flame within the converter may be much more readily controlled and stabilized with the result that the production of carbon black is maintained at a uniform quality and yield.

Extending through the casing 10 to the converter is a conduit 46 through which a gas can be introduced for the purpose of quenching the combustible mixture passing through the converter and thus control the temperature pattern within the converter. In the embodiment of the invention here shown, it is preferred that the gas for quenching the combustible mixture be introduced adjacent the mixing orifice 26 and immediately upstream thereof. By virtue of this quenching gas, the operator can further control the quality of the produced carbon black.

In operation, hydrocarbons in the form of gases or vapors are injected into the converter through the injector 22, and air under pressure is introduced at the desired rate and volume through the annular air port 36. The air forms an annular layer about the inner circumference of the refractory lining 24 and a limited amount is mixed with the hydrocarbon gases and vapors to provide limited combustion thereof. The flame, hydrocarbon gas or vapors and air are converged into the conical throat 28 causing further mixing so that rapid combustion will occur in the converter between the throat 28 and the mixing orifice 26.

The temperature level can be controlled by the amount of quenching gas which is introduced through the conduit 46. It is believed to be readily understood that as greater quantities of gas are introduced through the conduit 46, the temperature of the flame and gases passing through the mixing orifice 26 will be lowered.

Additional combustion may occur in the converter on the downstream side of the mixing orifice 26, and thereafter, the products of combustion and the carbon black formed from decomposition of the hydrocarbons is discharged from the converter through the flue 18. The carbon blacks suspended in the discharged gases are then isolated from the gases by any desired separating and collecting apparatus known to the art.

The amount of air and fluid hydrocarbon introduced into the converter is regulated carefully so that the mixture of fluid hydrocarbons and air is always such that a portion of the fluid hydrocarbon is not burned, but is decomposed through heating by the burning hydrocarbon and air mixtures. Consequently, the air supply duct 34 is connected with a suitable source of air under pressure, such for example as a power-driven blower. The quantity of air introduced is regulated by controlling the speed of such blower by regulating the master air control valve. Since the blowers and control mechanism for such valves are well known in the art, they are not illustrated in the drawings, although their use in

connection with the present apparatus is contemplated herein.

The amount of fluid hydrocarbons injected through the injector 22 is also regulated carefully. For this purpose, any known suitable measuring and regulator device may be used. Metering valves, pressure regulators and other gas and vapor regulating means are also well known in the art and their use is contemplated herewith, although such regulating devices are not specifically illustrated in the drawings.

Having thus described our invention, we claim:

1. A converter for producing carbon black from fluid hydrocarbons comprising a cylindrical refractory lined reaction chamber provided at one end with a flue outlet, a fluid hydrocarbon injector extending coaxially into the other end of said reaction chamber, an air inlet manifold for directing an air stream into the converter in non-rotary flow around the injected fluid hydrocarbons, said manifold having an annular discharge port opening into said converter, a first partition positioned normal to the axis of said port and upstream therefrom, said partition having rings of concentrically arranged apertures located radially inwardly of the annular discharge port, a second partition parallel to the first partition and upstream thereof, said second partition having rings of concentrically arranged apertures located radially outwardly of the first-named rings of apertures, and means for directing air into said manifold upstream of said second-named partition.

2. The apparatus defined in claim 1 wherein the apertures in the first and second-named partitions have substantially the same total cross-sectional area.

3. A converter for producing carbon black from fluid hydrocarbons comprising a cylindrical refractory lined reaction chamber provided at one end with a flue outlet, a fluid hydrocarbon injector extending coaxially into the other end of said reaction chamber, an annular air inlet port formed in the other end of said reaction chamber for directing air along the side walls of said reaction chamber substantially parallel to the axis thereof, and a manifold communicating with said annular air inlet port and with a source of air under pressure, said manifold having a plurality of pairs of adjacent spaced apart apertured baffles mounted normal to the axis of said reaction chamber through which the air from said source must flow, the apertures in each pair of adjacent baffles being arranged so that the apertures in one baffle are spaced radially toward the axis of the reaction chamber, and the apertures in the other baffle are spaced radially outwardly from the axis of the reaction chamber.

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