

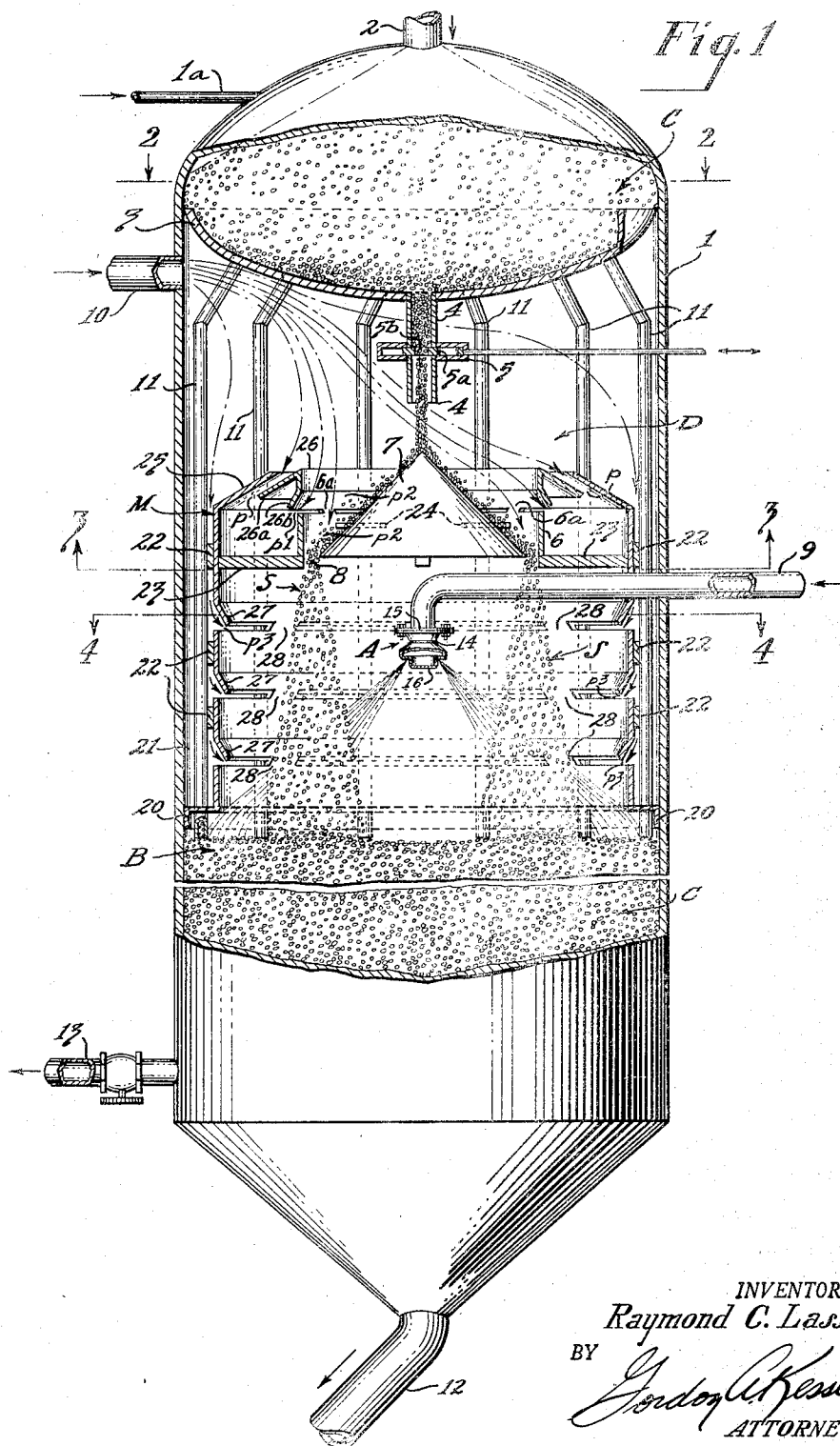
Jan. 3, 1950

R. C. LASSIAT
METHOD OF AND APPARATUS FOR MINIMIZING
DEPOSITION OF CARBONACEOUS MATERIAL

2,492,998

Filed Sept. 26, 1947

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

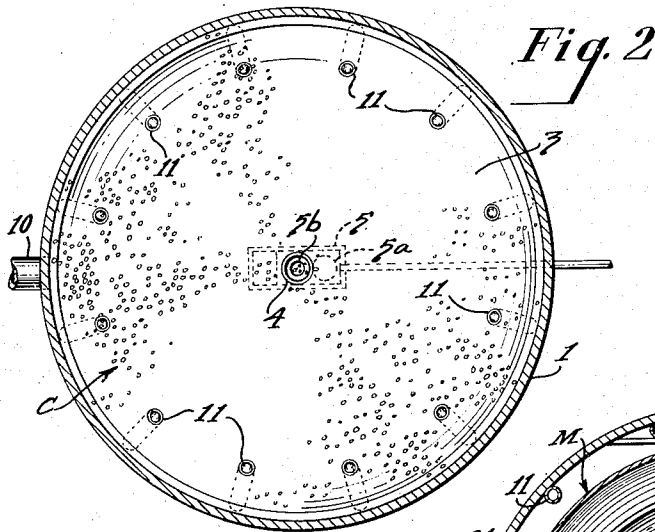


Fig. 2

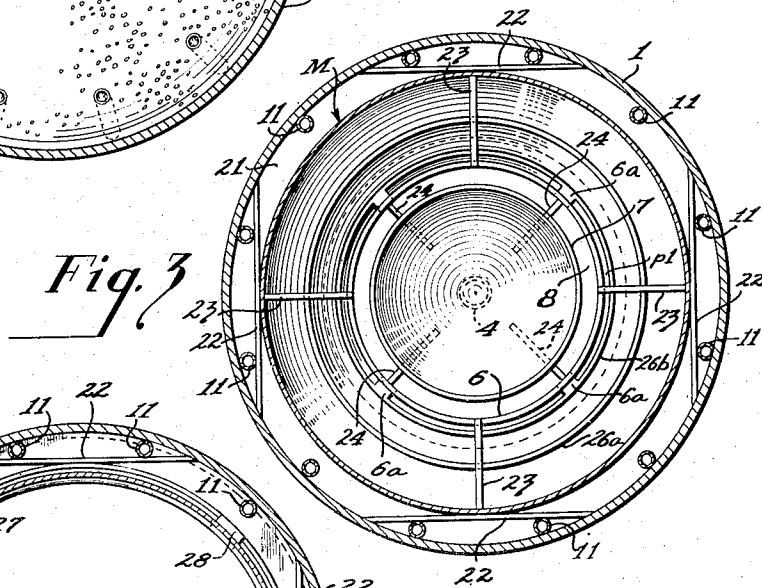


Fig. 3

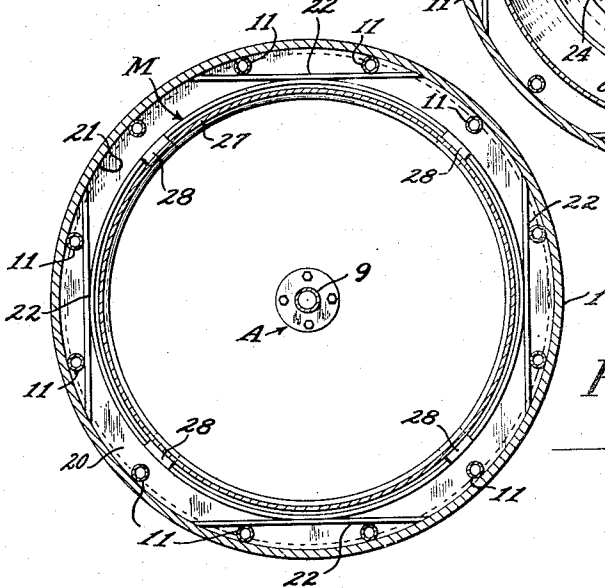


Fig. 4

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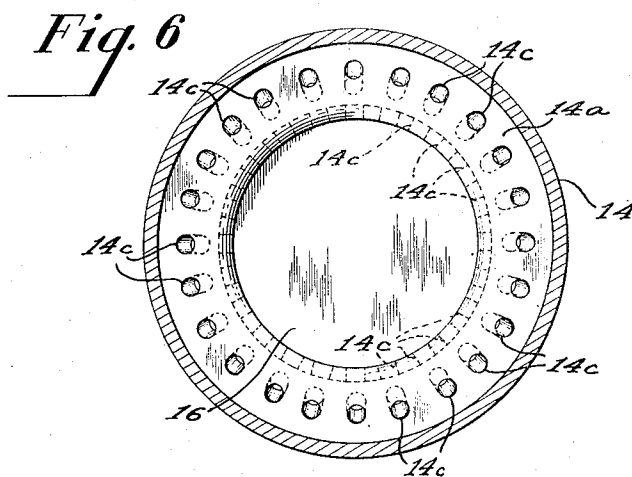
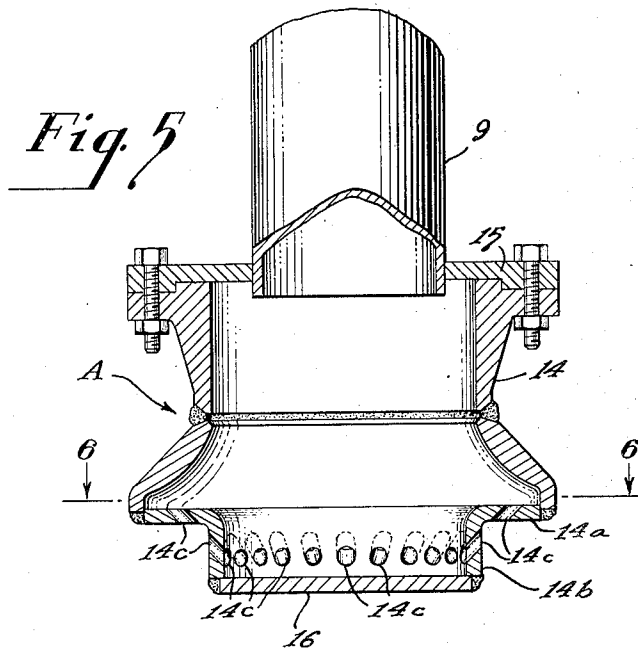
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UNITED STATES PATENT OFFICE

2,492,998

METHOD OF AND APPARATUS FOR MINIMIZING DEPOSITION OF CARBONACEOUS MATERIAL

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Application September 26, 1947, Serial No. 776,201

9 Claims. (Cl. 196—52)

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My invention relates to a hydrocarbon conversion system and has particular reference to a method of and apparatus for at least substantially preventing deposition of carbonaceous material on the interior surface of a conversion housing or on selected surfaces interiorly thereof.

As known in the art of converting hydrocarbons, it is desirable, under some circumstances, for atomized liquid hydrocarbon material to form at least a part of the total hydrocarbon charge which is engaged with heated contact material adapted to gravitate or flow through a housing while having conversion temperature. In a process of this character, the atomizer for the liquid hydrocarbon material is suitably located in a chamber of said housing which, in part, is traversed by atomized liquid material ejected by the atomizer into engagement with at least a substantial portion of the gravitating contact material. This atomized liquid material is ejected from the atomizer at high velocity, some of which, in an unintended or undesired manner and, unless prevented, migrates or tends to migrate to the interior housing surface and/or the surface or surfaces of one or more other members disposed within said housing. In the event that such atomized liquid material reaches said surface or surfaces, as the conversion operation proceeds, there is a resultant undesired accumulation of carbonaceous material thereon.

In accordance with my invention, a stream of vapors having suitable velocity for deflecting purposes are passed into the path followed by atomized liquid material migrating or tending to migrate to such a surface as aforesaid. These vapors deflect at least a substantial portion of such atomized liquid material and effectively minimizes the aforesaid undesired formation of carbonaceous material.

In accordance with another aspect of my invention, a stream or layer of vapors at substantial velocity sufficient to prevent passage or resist penetration therethrough of migrating atomized liquid material is directed along a predetermined path. Such a path, of which there may be several, depending upon the desired course of travel of the atomized liquid material, is disposed to enclose desired volume or volumes occupied by the latter while isolating such volume or volumes from surfaces presented by the housing or its component interior parts. In practice of the invention, said streams or layers of vapors confine the atomized liquid material to predetermined zones and, in its preferred aspects, assist in moving the same toward a bed of contact material.

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In a more restricted sense, my invention relates to a hydrocarbon conversion system wherein at least a substantial portion of the contact material falls freely in a chamber defined by the conversion housing. While the contact material falls freely as stated, atomized liquid material is engaged therewith and, by utilization of the described stream of deflecting vapors, undesired migration of atomized liquid material is controlled in such manner that one or more of the aforesaid surfaces are maintained substantially free from deposited carbonaceous material.

In accordance with an important aspect of my invention, suitable vapors such, for example, as hydrocarbon vapors to be converted are admitted to an upper atomizer-containing chamber of the aforesaid conversion housing, the velocity of the vapors, after admission to said chamber, being substantially increased, by utilization of a baffle member or in other equivalent manner, and, in circumferentially complete configuration, the vapors are directed downwardly around the atomizing zone and into the path of such atomized liquid material as migrates or tends to migrate toward the interior housing surface to thereby at least substantially prevent contact with said surface of atomized liquid material resulting in deposition of carbonaceous material thereon.

Various other objects and advantages of my invention will become apparent from the following detailed description.

My invention resides in the method of and apparatus for minimizing deposition of carbonaceous material on one or more surfaces within a conversion housing, features and arrangements of the character hereinafter described and claimed.

For an understanding of my invention and for an illustration of one form of apparatus with which the invention may be practiced, reference is to be had to the accompanying drawings, in which:

Fig. 1 is a vertical sectional view, partly in elevation, showing a conversion housing and an associated baffle member as constructed in accordance with one form of the invention;

Figs. 2, 3 and 4 are transverse sectional views, partly in plan, taken on the respective lines 2—2, 3—3 and 4—4 of Fig. 1;

Fig. 5 is a vertical sectional view, partly in elevation, showing an atomizer; and

Fig. 6 is a horizontal sectional view, partly in plan, taken on the line 6—6 of Fig. 5.

In an application of James E. Evans Ser. No. 756,031, filed June 20, 1947, there is disclosed a

hydrocarbon conversion process involving utilization of an arrangement for engaging atomized liquid hydrocarbon material with a freely falling shower of contact material. For purposes of explanation as regards my invention, I have included in this application a general disclosure of the subject matter illustrated and described in the aforesaid Evans application.

Thus, referring particularly to Fig. 1, I have shown a vertical housing 1 which, in horizontal cross section, may be circular or of any other suitable configuration. The housing 1 defines a reaction zone wherein hydrocarbon material is cracked or otherwise converted in the presence of contact material C which moves downwardly therethrough under the influence of gravity; the contact material C being introduced into said housing 1 in suitable manner, as by an inlet pipe 2 extending through the top housing wall at the center thereof.

A shallow receptacle-like member 3 may be suitably supported in the upper portion of the housing 1, said member 3 having a central discharge pipe 4 opening therethrough and extending downwardly therefrom. Slidably associated with the discharge pipe 4 is a horizontal valve member 5 having an operating handle extending through and terminating exteriorly of the housing 1. The valve member 5 may comprise two spaced passages 5a and 5b, the diameter of the passage 5a being the same as the internal diameter of the pipe 4 and the diameter of the passage 5b being suitably less than said internal diameter of the pipe 4. Suitably supported, in the manner hereinafter described, beneath the pipe 4 is a tubular member 6 and a conical member 7, the conical member 7 being disposed interiorly of the tubular member 6. The base of the conical member 7 has exterior diameter somewhat less than the interior diameter of the tubular member 6 and, by reason of the fact that these two members are symmetrically related to each other, there is an annular slot or passage 8 therebetween at the lower ends thereof.

A pipe 9, adapted to be traversed either partially or entirely by liquid phase hydrocarbon material, extends from the exterior of the housing to the interior thereof and the inner end thereof communicates with and supports an atomizer A of any suitable character but which, preferably although not necessarily, is of the character disclosed in the aforesaid Evans application. A pipe 10 adapted to be traversed by hydrocarbon vapors extends from the exterior of the housing 1 to the interior thereof and this pipe 10 should be positioned at a higher level than the aforesaid pipe 9.

As shown, the pipe 4, the tubular member 6, the conical member 7 and the atomizer A should be so related to each other that their respective longitudinal axes are in coincidence with each other and also with the longitudinal axis of the housing 1.

In operation, regenerated or other heated contact material C having suitable conversion temperature passes continuously from the pipe 2 and, to suitable extent, fills the receptacle 3 which defines an upper zone of the housing 1. When the valve member 5 is positioned as illustrated, namely, with its passage 5b aligned with the pipe 4, a desired control is effected on the amount of contact material which gravitates downwardly through the discharge pipe 4 from the receptacle 3. The valve member 5, then, restricts or controls the downward flow of contact material under

the influence of gravity through that part of said pipe 4 above the plane of said valve member 5. After leaving the valve member 5, the contact material, in the manner hereinafter described, falls or moves downwardly under the influence of gravity until it comes to rest upon and at least partly defines the upper surface of a bed B of gravitating contact material which constitutes the conversion zone proper, the bottom surface of this bed of contact material engaging a tube sheet, not shown, which is horizontally disposed in the housing 1 and suitably secured to the interior surface thereof. As the contact material falls freely below the conical member 7, it is engaged by liquid hydrocarbon material after atomization thereof by the aforesaid atomizer A.

In view of the foregoing, it clearly appears that the atomizer A is disposed in a chamber D of the housing 1, said chamber D being bounded, at its lower end, by the zone defined by the upper surface of the bed B and, at its upper end, by the aforesaid zone defined by the receptacle 3.

If desired, a plurality of pipes 11 may be spaced uniformly around the interior surface of the housing 1. The upper ends of these pipes 11 communicate with the chamber defined by the member 3, which may support said pipes, and the lower ends thereof terminate at the upper surface of the aforesaid bed B of contact material. They are adapted to be traversed by a portion, preferably a minor portion, as 20% more or less of the total amount of contact material gravitating downwardly through the housing 1. The pipes 11, when utilized, contribute as regards maintenance of the surface of the bed B at a level approximately that of the lower ends of said pipes.

As stated, the bed B of contact material gravitates through the housing 1 and any suitable known or other arrangement, not shown, may be utilized for discharging the spent contact material from the housing 1 for passage through a discharge pipe 12 in a controlled manner. Likewise, any suitable known or other arrangement, not shown, may be provided for disengaging cracked or converted vapors from the contact material C so that they may pass through an outlet pipe 13.

Referring particularly to Figs. 5 and 6, the atomizer A hereinbefore referred to should be one which produces fog, mist, spray or other liquid particles having suitable dimensions from the liquid hydrocarbon material admitted thereto. As shown, the atomizer A comprises a casing 14 having a top wall 15 through which the lower end of the hereinbefore described pipe 9 opens and to which said pipe is secured. The casing 14 has a lower wall 16 above which said casing 14 comprises horizontal and vertical circular plate portions 14a and 14b related to each other in right-angle relation. In the form of atomizer herein shown, although not necessarily, a row of ports or passages 14c open through the respective casings portions 14a and 14b, these ports 14c being aligned in sets. Hydrocarbon material admitted by the pipe 9 to the casing 14 passes to and through each of said ports 14c and, in atomized condition, engages the freely falling contact material as hereinafter described.

When hydrocarbon material is to be cracked in the housing 1, the contact material C hereinbefore referred to should be catalytic in character and the temperature thereof, upon admission to the housing 1, should range between 800° F. and 1000° F. or higher for example, about 900° F. Any suitable kind of catalytic contact ma-

terial may thus be utilized such, for example, as activated clay pellets, or synthetic silica-alumina pellets or beads, etc. having suitable major dimensions such as between $\frac{1}{16}$ and $\frac{3}{4}$ of an inch. Other suitable catalysts for cracking include synthetic plural oxide composites, silicious or non-silicious in character and containing, for example, zirconia, alumina or beryllia. In lieu of a cracking operation, other types of conversion operations such, for example, as one wherein hydrocarbon material of the character referred to below is desulphurized under known conditions with catalytic contact material of the general character referred to above, or equivalent. Or, reforming or dehydrogenation of naphthas or other normally liquid hydrocarbons may be effected in the presence of the above or other desired types of catalyst, certain of which are well known in the art.

During operation with suitable cracking contact material, vapors such, for example, as vaporized gas oil, naphtha or lighter hydrocarbons having suitable elevated temperature, as in a range from 850° F. to 950° F. are admitted continuously to the housing 1 by way of the conduit 10. Simultaneously, liquid hydrocarbon material such, for example, as a suitable residual stock, topped or reduced crude having temperature elevated to a suitable range as, for example, from 400° F. to 800° F. is charged continuously through the pipe 9 under superatmospheric pressure ranging, for example, from 10 lbs. to 200 lbs. per square inch gauge or as otherwise may be required for causing the atomized liquid material from the atomizer A to engage the contact material freely falling from the conical member 7. The liquid hydrocarbon material thus traversing the pipe 9 passes through the atomizer casing 14 and, as disclosed in the aforesaid Evans application, the aligned atomizer ports 14c of the respective sets thereof are traversed, respectively, by streams of hydrocarbon material which pass toward and engage each to produce resultant streams of atomized material which, as a mist or fog, pass downwardly in inclined relation and engage the aforesaid freely falling contact material, Fig. 1.

As stated, hydrocarbon vapors, which in connection with a cracking operation preferably have temperature substantially higher than that of the hydrocarbon material admitted to the atomizer A, are passed into the housing 1 by way of the pipe 10. These vapors pass through the housing 1 concurrently as regards the contact material C and in the presence thereof, are converted to cracked products. In so doing, the heat content of these vapors, by reason of the temperature relation referred to immediately above, assists as regards vaporization of the liquid hydrocarbon material entering said housing 1 through the atomizer A and provide a desired control on the space velocity of the entire charge traversing the housing 1. Simultaneously, in the manner described above, atomized liquid hydrocarbon material is engaged with the freely falling contact material with resultant vaporization of such atomized liquid material and formation of cracked products while passing through the housing 1 concurrently as regards the contact material C. As regards the total charge entering the housing 1, the ratio of vapors to liquid material may be such as is suitable and desirable. Thus, for example, between 10% and 30% of the charge may be in the liquid phase for passage to the atomizer A and the remainder

in the vapor phase for passage through the pipe 10.

The contact material C, except for the deflecting action thereon of the conical member 7, moves or falls freely downward under the influence of gravity while traveling along the path from valve member 5 to the top of the bed B, the velocity of the contact material constantly increasing while it travels along said path. The tubular member 6 is provided solely to prevent undesired bouncing movement of the contact material toward the wall structure of the housing 1, after engagement thereof with the conical member 7, and the horizontal dimension of the annular passage 8 defined in part by said tubular member 6 is such that it does not restrict or choke downward movement of the contact material. Therefore, at and below said annular passage 8, the contact material falls freely as a shower S of such material which, in horizontal section, may be approximately circular, the longitudinal axis thereof coinciding generally with the vertical axis of the housing 1. By reason of the foregoing, and further by reason of the fact that the base diameter of the conical member 7 is substantial, for example, approximately or nearly one-half the internal diameter of the housing 1, it follows that the individual pieces of contact material C, while falling below said conical member 7, are spaced from each other to substantial extent. Thus, the density or compactness of the falling shower S of contact material is such that it does not prevent or bar passage therethrough of some or even a substantial portion of the atomized liquid material which is directed downwardly in an inclined direction by the atomizer A and engaged with an inner, circumferentially complete area thereof, said atomizer A, with this end in view, being supported by the pipe 9 or equivalent interiorly of and generally concentrically with respect to said shower of contact material. The atomized liquid material which thus passes through the shower S of freely falling contact material continues on its downward course and, as shown in Fig. 1, is deposited on the contact material defining a portion of the upper surface of the bed B which, as hereinbefore stated, forms the reaction zone proper. The foregoing holds true with respect to all of the atomized liquid material except the migrating portion thereof hereinafter specifically discussed.

Accordingly, in view of the foregoing, it will be understood that hydrocarbon material admitted to the housing 1 by way of the pipes 9 and 10 is converted in the presence of the contact material C to produce cracked products. As the operation proceeds, hydrocarbon vapors, principally, fill the aforesaid chamber D under pressure determined by the pressure existing in the hereinbefore described outlet pipe 13. In known manner, a suitable sealing medium, such as a stream of flue gases, is admitted to the top of the housing 1 by way of a pipe 1a, Fig. 1, this sealing medium being maintained under pressure slightly greater than that of the said hydrocarbon vapors last named in order to prevent passage of these hydrocarbon vapors upwardly through the pipe 2. Due to this pressure relation which exists in the chamber D, hydrocarbon material admitted to said chamber by way of the pipes 9 and 10, as described above, is caused to pass downwardly concurrently as regards the gravitating contact material, this hydrocarbon material being cracked in the presence of said contact material

and the resulting cracked vapors being suitably disengaged therefrom whereupon they are passed to any suitable destination by way of the hereinbefore described outlet pipe 13. In known manner and by suitable means, not shown, a suitable gaseous medium such as steam is admitted to the lower portion of the housing 1, below the pipe 13 and under pressure above that existing at the level thereof, to prevent passage of the hydrocarbon vapors through the pipe 12.

As stated above, atomized liquid material is directed preferably downwardly and in inclined relation as shown in Fig. 1 and a portion thereof is engaged with the contact material forming the falling shower S. The remainder passes therethrough and, to substantial extent, is engaged with the top surface of the bed B. However, some of the atomized liquid material which thus traverses the falling shower S passes, not into engagement with the top surface of the bed B, but more or less directly toward the interior surface of the housing 1 and the pipes 11, when utilized. At the same time, some of the atomized liquid material last named, migrates or tends to migrate upwardly and outwardly through the chamber D toward said interior surface of the housing 1. Should atomized liquid material be deposited on said interior surface of the housing 1 during continuance of the conversion operation, there is resultant production or deposition, on this surface, of carbonaceous material which, in the course of time, breaks off into chunks of such material that move into and through the bed B of contact material with resultant partial or complete plugging of the outlets, not shown, at the bottom of the housing 1. Should this happen to any substantial extent, it is necessary for operation of the system to be discontinued for cleaning purposes. The foregoing, of course, is undesired and is at least substantially prevented, in accordance with my invention, as hereinafter described.

Thus, referring to Figs. 1, 3 and 4, I have shown a baffle member M which is disposed within the housing 1 in the lower portion of the housing chamber D, said baffle member M being suitably supported, as by an annular member 20 which is secured to the interior surface of said housing 1, Fig. 1. As herein shown, the baffle member M is circular in horizontal section and the vertical axis thereof coincides with the vertical axis of the housing 1. Further, the diameter of said baffle member is such that the outer surface thereof forms with the interior surface of the housing 1 a vapor path 21 having relatively small width, Figs. 3 and 4, and closed at its lower end by the horizontal portion of the aforesaid annular member 20.

If desired, a plurality of bars 22 may be utilized to anchor the baffle member M in the position of the drawings. If so, these bars 22 may be welded or otherwise suitably secured to the baffle member and housing surfaces which are engaged thereby. As shown in Figs. 1 and 3, the baffle member M may carry a plurality of horizontal, inwardly extending bars 23 which are secured to and support the hereinbefore described tubular member 6, which, in turn, may carry a plurality of horizontal, inwardly extending bars 24 extending toward and being secured to the hereinbefore described conical member 7 in order to support the latter in operative position as shown in Fig. 1.

In accordance with a detailed feature of the invention, the baffle member M may comprise an

inwardly extending, upwardly inclined portion 25, Fig. 1. Cooperative with this inclined portion 25 is a structure 26 which may be integrally formed with the aforesaid tubular member 6 in the sense that it is connected thereto by narrow ribs 6a, Fig. 1. The structure 26 may comprise an inclined portion 26a extending substantially parallel with the aforesaid baffle member inclined portion 25 and forming an annular passage p1 therewith. Further, the structure 26 may comprise a vertical wall portion terminating in a lower inclined portion 26b which, except for said ribs 6a, forms an annular passage p1 with the top surface of the above described tubular member 6. As shown, the structure 26 and the tubular member 6 form an annular passage p2 with the conical member 7.

Further in accordance with the invention, the vertical portion of the baffle member M comprises a plurality of inwardly extending, downwardly inclined portions 27 spaced with respect to each other in vertical relation, each portion 27 forming an annular passage p3 with the adjacent, lower baffle plate wall surface. If desired, although by no means necessarily, the sections of the vertical baffle portion which would otherwise be entirely separated by the passages p3 may be connected together by narrow ribs 28 so as to form an integral baffle member structure.

As described above, the cracking or other conversion operation is conducted under conditions such that admitted hydrocarbon material flows downwardly through the housing 1 concurrently as regards the gravitating contact material C. More particularly, the hydrocarbon vapors admitted to said housing 1 by way of the pipe 10 flow downwardly through the housing chamber D and a substantial portion thereof traverse the path 21 and then flow through the described baffle plate passages p, p1, p2 and p3. As a result, in each of these passages, the velocity of the vapors is increased to substantial extent and such increased vapor velocity persists, although dissipated to some extent, as the vapors move downwardly within the baffle member M adjacent the interior surface thereof and reach the upper surface of the bed B. In view of the foregoing, it will be understood that these high velocity vapors move into the path of such atomized liquid material that passes or migrates along paths leading toward the interior surface of the housing 1 with the result that such atomized liquid material is deflected from these paths and effectively swept into engagement with the contact material forming the top surface of the bed B.

As regards the form of the invention herein disclosed, the respective streams of vapors traversing the upper passages p, p1 and p2 are intended, responsive to a deflecting action, to prevent undesired migration of atomized liquid material upwardly into that part of the chamber D above the baffle member M. More particularly, the respective streams of vapors traversing the passages p1 and p2 directly protect the tubular member 6 and conical member 7 from upwardly migrating atomized liquid material because deflecting the same downwardly.

At each of the passages p, p1, etc., a separate stream of vapors is produced but, as will be recognized, these separate vapor streams merge to substantial extent during continued downward movement thereof. However, as regards the merged vapor stream, the velocity thereof is increased as it flows past each of the lower baffle member passages p3 with the result that the velocity of said

merged vapor stream is adequate for the useful purpose described above.

As stated above, the streams of deflecting vapors are produced in response to flow thereof through the respective baffle member passages *p*, *pl*, etc. In the form of the invention herein shown, although not necessarily, the baffle member *M* is interposed in the direct path of atomized liquid material passing or migrating, not toward the upper surface of the bed *B*, but toward the interior housing surface and upwardly through the housing. Hence, this baffle member, unaided by the streams of deflecting vapors, is effective to prevent the migrating atomized liquid material from reaching and forming a carbonaceous deposit on said interior housing surface. However, as will be obvious, this function of the baffle member *M* would be futile if the conditions were such that said migrating atomized liquid material formed a carbonaceous deposit on the interior surface thereof, this being true, by reason of the fact that such a deposit, if formed, would interfere with proper operation of the conversion system for the reasons hereinbefore stated. It will be understood, then, as regards the disclosed form of the invention, that the direct function of the high velocity vapor streams is that of at least substantially preventing formation of a carbonaceous deposit on the interior surface of said baffle member *M*.

In the event that a small portion of the migrating atomized liquid material does pass through the aforesaid streams of vapors, the latter decreases the partial pressure of said last named atomized liquid material which, accordingly, is more readily vaporized by the ambient heat of the conversion system than would be the case if the partial pressure had not been decreased. Accordingly, even as regards this last named small portion of atomized liquid material, the described vaporizing action minimizes the amount thereof reaching the interior surface of the baffle member *M* with resultant decrease in the quantity of carbonaceous material which is formed thereon.

It will be understood, then, that in the absence in the arrangement comprising the baffle member *M*, or equivalent, for producing the described streams of high velocity vapors, migrating atomized liquid material would be deposited on the interior surface of the housing *I* with resultant, undesired production of carbonaceous material.

For purposes of explanation, the invention has been described in connection with a conversion system wherein the contact material gravitates through a housing in a particular manner. Obviously, however, the invention is not to be thus limited since it is applicable to conversion systems wherein the contact material to which the atomized liquid material is applied is controlled for movement, gravitating or otherwise, in any desired manner whether freely falling or not.

Obviously, in lieu of the baffle member *M*, any other suitable form of baffle member may be utilized and it may be positioned as desired within the housing chamber *D*. Again, all baffle members may be omitted in favor of a nozzle or equivalent which directs through said housing chamber a stream of vapors having velocity sufficient for the useful purpose described herein. It is significant, however, as regards a broad concept of the invention that some arrangement shall be provided for producing a stream of vapors having velocity adequate to deflect migrating atomized liquid material out of a path leading to the inner surface of a conversion housing, to the sur-

face of a baffle within said housing, or to the respective surfaces of other members for example, such as the tubular member *6* and the conical member *7* disposed with the chamber *D*, any or all of the surfaces last named or equivalent surfaces being hereinafter generically referred to in some of the appended claims as "a surface which should be maintained free from a carbonaceous deposit."

It shall also be understood that the invention is not to be limited to the utilization of hydrocarbon vapors for the purpose described herein. Obviously, other vapors such as superheated steam may be admitted to the housing chamber *D* and utilized for deflecting purposes as described with respect to the hydrocarbon vapors admitted to said chamber by the pipe *10*.

The preceding description relates to catalytic conversion processes but the invention is not to be so limited. Thus, the contact material *C* may be substantially inert catalytically such, for example, as fused alumina (Alundum), fused silica and alumina, heat-resistant quartz or quartz pebbles, fused silica, etc., this material having approximately spherical or chunk-like configuration and the major dimensions ranging between $\frac{1}{4}$ to $\frac{3}{4}$ of an inch, for example. With contact material of this character, hydrocarbon vapors may be admitted to the housing *I* by way of the pipe *10* under the conditions hereinbefore described and the atomizer *A* may be supplied with at least partially liquid phase heavy hydrocarbon material such, for example, as entire crudes, reduced or topped crudes, crude bottoms, residual or heavy bottoms, distillation residuums, etc., all of which contain heavy, difficultly vaporizable fractions or components such as tar, asphalt or the like in various proportions. Inert contact material of the character described should gravitate through the housing *I* while having temperature within a range between 800° F. and 1250° F. and the heavy hydrocarbon material should be supplied to the atomizer *A* while having temperature ranging up to 750° F. or higher. When the operation is of this character, the liquid portion of the heavy hydrocarbon material is vaporized and viscosity-broken, in the example shown, in response to engagement thereof with the freely falling inert contact material and that forming the top surface of the bed *B*, the resulting vaporized products being withdrawn from the housing *I* by way of the conduit *13*.

Obviously many modifications and variations of the invention as hereinbefore 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 claims.

I claim as my invention:

1. In the art of converting hydrocarbons in the presence of contact material which gravitates through a reaction zone while having conversion temperature, the method which comprises causing atomized liquid hydrocarbon material to pass through a chamber in the upper portion of said reaction zone and to be engaged with at least a substantial portion of said contact material, admitting a stream of vapors to said chamber, increasing the velocity of said stream of vapors to substantial extent after admission thereof to said chamber, and passing said stream of vapors, after the velocity thereof has thus been increased, into the path followed by some of the atomized liquid material migrating or tending to migrate along said path toward a surface which should be main-

tained free from a deposit of carbonaceous material.

2. The method of claim 1 wherein a portion of the contact material which is engaged by the atomized liquid material falls freely through said chamber.

3. In the art of converting hydrocarbons in the presence of contact material which gravitates through a reaction zone while having conversion temperature, the method which comprises passing liquid hydrocarbon material into an atomizing zone disposed in a chamber in the upper portion of said reaction zone, directing the atomized liquid material into engagement with at least a substantial portion of said contact material, admitting a stream of vapors to said chamber, increasing the velocity of said stream of vapors to substantial extent after admission thereof to said chamber, and passing a circumferentially complete stream of said vapors, after the velocity thereof has thus been increased, downwardly around the atomizing zone and into the path followed by some of the atomized liquid material migrating or tending to migrate toward the interior surface of said reaction zone.

4. The method of claim 3 wherein a portion of the contact material which is engaged by the atomized liquid material falls freely through said chamber.

5. In the art of converting hydrocarbons in the presence of contact material which gravitates through a reaction zone while having conversion temperature, the method which comprises passing liquid hydrocarbon material into an atomizing zone disposed in the upper portion of said reaction zone, directing the atomized liquid material into engagement with at least a substantial portion of said contact material, admitting a stream of vapors to said chamber, increasing the velocity of said vapors to substantial extent after admission thereof to said chamber in response to flow thereof through a restricted annular passage defined by a barrier disposed within said reaction zone substantially in concentric relation with respect to the interior surface thereof, and passing said stream of vapors, after the velocity thereof has thus been increased, into the path followed by some of the atomized liquid material migrating or tending to migrate along said path toward said barrier to minimize formation of a deposit of carbonaceous material thereon.

6. The method of claim 5 wherein a portion of the contact material which is engaged by the atomized liquid material falls freely through said chamber.

7. In the art of converting hydrocarbons in the presence of regenerated contact material which gravitates through a housing while having conversion temperature, the method which comprises causing atomized liquid hydrocarbon material to pass through a chamber in the upper portion of said housing from an atomizing zone and to be engaged with at least a substantial portion of said contact material, admitting hydrocarbon vapors to said chamber and passing a circumferentially complete stream of such vapors through a plurality of annular, restricted passages concentrically disposed interiorly of said housing to

increase the vapor velocity during downward movement thereof around the atomizing zone and into the path followed by some of the atomized liquid material migrating or tending to migrate toward the interior housing surface, the velocity of said stream of vapors being sufficient to deflect migrating atomized liquid material from said path and at least substantially prevent engagement thereof with said interior housing surface.

8. In apparatus of the character described, a vertical conversion housing, means for causing gravitating contact material to fall freely through a chamber in the upper portion of said housing, said contact material thereafter gravitating through the lower portion of said housing as a solid bed of contact material, an atomizer in said chamber, means for supplying liquid hydrocarbon material to said atomizer from which atomized liquid material is ejected into engagement with the freely falling contact material and the top surface of said bed, means for admitting vapors to said housing for downward movement through at least a part of said chamber, and a vertical baffle member disposed within said chamber relatively close to the interior surface thereof and related concentrically to said housing, said baffle member defining a plurality of annular passages located at different respective levels and having substantially equal diameters, said passages being traversed by downwardly moving vapors with resultant increase in velocity thereof to thereby deflect migrating atomized liquid material toward the top surface of said bed of contact material.

9. In apparatus of the character described, a conversion housing, means for causing gravitating contact material to fall freely through a chamber in the upper portion of said housing, said contact material thereafter gravitating through the lower portion of said housing as a solid bed of contact material, an atomizer in said chamber, means for supplying liquid hydrocarbon material to said atomizer from which atomized liquid material is ejected into engagement with the freely falling contact material and the top surface of said bed, means for admitting vapors to said housing for downward movement through at least a part of said chamber, and a baffle arrangement disposed within said chamber relatively close to the interior surface thereof and related concentrically to said housing, said baffle arrangement defining a plurality of annular passages located at different respective levels, some of said annular passages having diameter greater than that of other annular passages, said annular passages being traversed by downwardly moving vapors with resultant increase in velocity thereof to thereby deflect migrating atomized liquid material toward the top surface of said bed of contact material.

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REFERENCES CITED

The following references are of record in the file of this patent.

"Commercial T. C. C. Operations on Partially Vaporized Charge Stocks," by Noll et al., Houdry Pioneer, Oct. 1946.