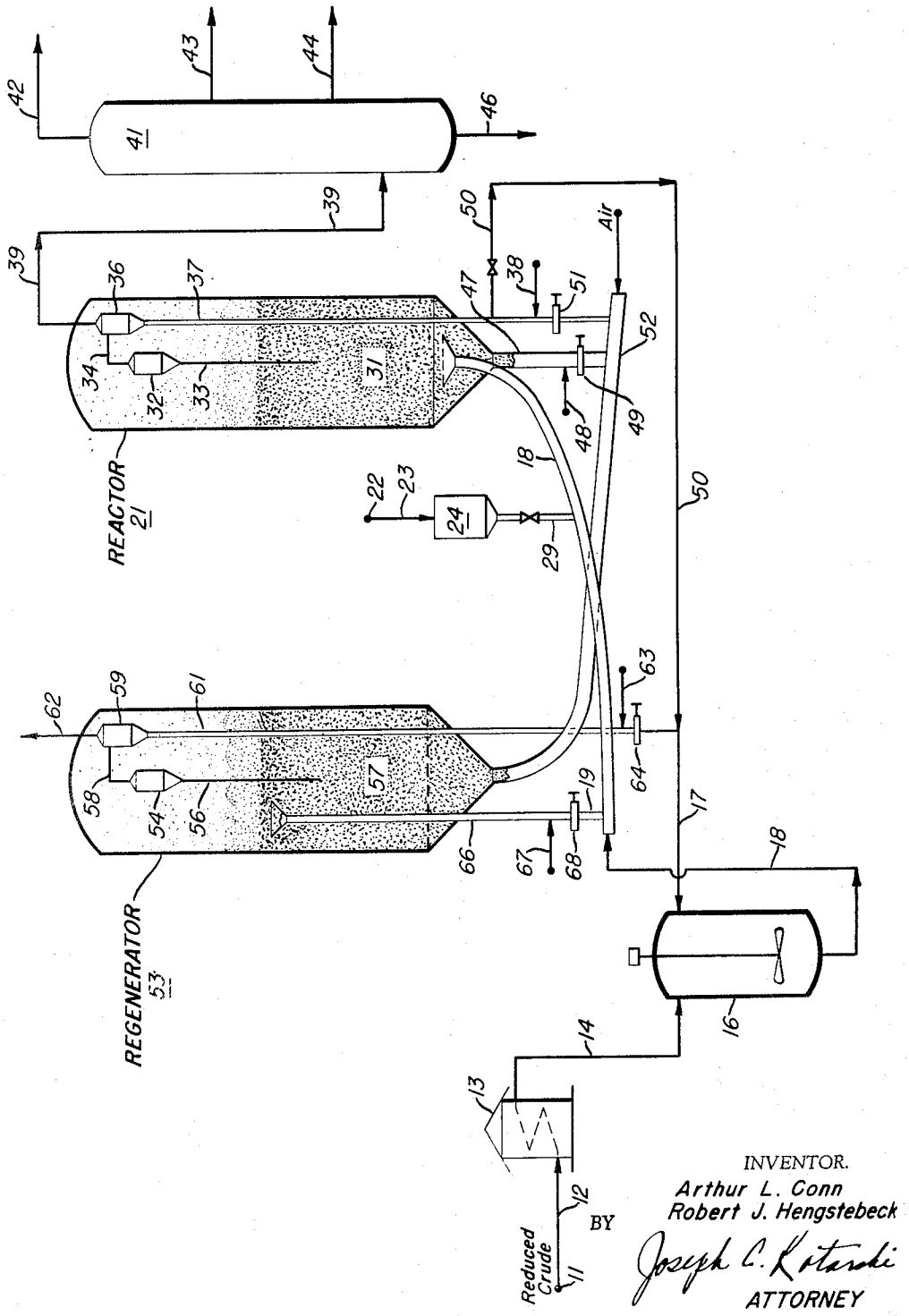
Oct. 11, 1960 A. L. CONN ET AL 2,956,004

REMOVING METAL CONTAMINANTS FROM FEEDS

Filed March 25, 1958



United States Patent Office

2,956,004
Patented Oct. 11, 1960

2,956,004

REMOVING METAL CONTAMINANTS FROM FEEDS

Arthur L. Conn, Chicago, Ill., and Robert J. Hengstebeck, Valparaiso, Ind., assignors to Standard Oil Company, Chicago, Ill., a corporation of Indiana

Filed Mar. 25, 1958, Ser. No. 723,894

10 Claims. (Cl. 208—91)

This invention relates to a catalytic cracking process and particularly concerns the processing of metals-containing heavy oils.

It is well appreciated that metals-containing heavy oils such as heavy gas oils and reduced crudes are less desirable charging stocks to catalytic cracking because the metals contaminate the catalyst, cause excessive amounts of coke to be formed upon the catalyst, produce larger amounts of gas and lesser amounts of naphtha. After processing such a charge stock, the catalyst becomes so contaminated with metals such as iron, vanadium, nickel and the like that even when light gas oils which are essentially free of metals are cracked using the contaminated catalysts the distribution of products is much poorer than is the case when employing a catalyst which is less contaminated with the aforementioned metals.

An object of the present invention is to provide a process for the catalytic cracking of metals-containing heavy oils which minimizes metals contamination of the cracking catalyst. Another object is to provide a catalytic cracking process employing fluidized catalyst particles which minimizes metals contamination of the catalyst and produces a more desirable distribution of the products from the cracking of the heavy oil. A further object is to provide a fluidized catalytic cracking process for metals-containing heavy oils which reduces the rate at which catalyst activity normally declines when cracking such oils. A still further object is to provide a method for treating heavy oils to remove the metals therefrom by the use of demetallizing materials which pass through the subsequent cracking reaction and catalyst regeneration reaction without harmful effect therein. An additional object is to provide a source of demetallizing materials which is integral with a fluidized catalytic cracking reaction system. Another object is to provide an integrated system for the catalytic cracking of metals-containing heavy oils which requires a minimum of additional equipment and treating materials and at the same time maximizes production of desirable products while minimizing production of undesirable products and lowering the rate of catalyst activity decline. These and other objects will be more apparent from the detailed description of the invention.

In accordance with this invention a metals-containing heavy oil such as reduced crude or the like is contacted with a finely divided or powdered solid material such as clay fines, cracking catalyst fines which are preferably of low activity, finely divided alumina or the like at an elevated temperature of from about 500 to 1000° F. for a time sufficient to cause the metals in the heavy oil to be deposited upon the finely divided solids. The length of time employed in the treating step is usually less than about one minute when temperatures approaching 1000° F. are employed, and the time may be as long as 10 hours at lower temperatures of about 500° F. In this pretreating step the extent of conversion of the oil to lower boiling products should be held to less than about 20 to 25%, and preferably to the minimum desirable consonant with the desired amount of metals removal. By using finely

divided solids having little if any cracking activity and by the use of lower temperatures within the range pointed out, it is possible to obtain minimum conversion of the oil in the pretreating step. The amount of the finely divided solids which are contacted with the oil may range between about 0.1 to 10 pounds per pound of Ramsbottom or Conradson carbon content of the metals-containing heavy oil. Thereafter the mixture of oil and finely divided solids is passed into a bed of fluidized cracking catalyst under cracking conditions whereupon the oil is converted to lower boiling vaporous products such as gas, naphtha, gas oils, etc. The average particle size of the bulk of the catalyst particles employed in the fluid catalytic cracking reactor is greater than the average particle size of the finely divided solids employed in the pretreating step. Vaporous products pass upwardly through the bed of fluidized cracking catalyst and are removed from the cracking reactor after entrained solid material is removed therefrom. Both cracking catalyst particles and the finely divided solids employed in the pretreating step become entrained in the vaporous products and ordinarily may be removed therefrom by the use of cyclones or other solids-gas separation equipment. The separated catalyst particles recovered from the vaporous products are returned to the catalytic cracking reactor, usually directly to the bed of dense fluidized catalyst; and the entrained finely divided solids which have been recovered from the vaporous products are passed to a regeneration zone wherein hydrocarbonaceous material is burned from the finely divided solids. Thereafter the finely divided solids are returned to the pretreating step wherein they are contacted with additional amounts of metals-containing heavy oil. Because the metals-containing finely divided solids are rapidly removed from the catalytic cracking zone and are not recirculated back thereto with the entrained catalyst particles recovered from the vaporous products, these metals-contaminated solids catalyze no substantial amount of cracking even when catalyst fines are employed as the pretreating solids. There is also much less opportunity for the contaminated metals contained upon the finely divided solids to transfer therefrom onto the larger size active cracking particles. Catalyst activity is thus maintained for longer periods of time and the product distribution is more favorable.

In operating the fluidized catalytic cracking process, a portion of the catalyst in the cracking reactor is withdrawn therefrom and passed in a continuous manner to a regenerator. A fluidized bed of cracking catalyst particles containing hydrocarbonaceous deposits is maintained in the regenerator. The hydrocarbonaceous deposits are burned from the catalyst and finely divided solids at an elevated temperature by passing an oxygen-containing gas upwardly through the fluidized bed. After regeneration, the catalyst particles are returned to the catalytic cracking zone and the finely divided solids are passed to the pretreating step.

The single figure shows in diagrammatic form an embodiment of the present invention for the fluidized catalytic cracking of a metals-containing reduced crude. In this figure the metals-containing reduced crude from source **11** is passed by way of line **12** into the heated tubes of furnace **13**. The reduced crude has a metals content of approximately 50 p.p.m. of nickel, iron, vanadium and other metals. Heavy oils of higher and lower metals content may of course be charged to this invention, the particular metals concentration varying with the crude source, the extent of reduction, etc. The heated oil is then passed by way of line **14** into stirred vessel **16**. It is therein agitated with hot catalyst fines (from the regenerator) for about one-half hour at a temperature of about 650° F. The amount of catalyst fines, which are in this embodiment predominantly of an aver-

age particle size between about 10 to 40 microns, are introduced into vessel **16** by way of line **17** in the amount of about 2 pounds per each pound of Conradson carbon residue present in the reduced crude. In this embodiment the reduced crude has a Conradson carbon residue of 4% (a Ramsbottom carbon residue of close to 4%) and the catalyst fines are employed in the amount of about 25 pounds per barrel (approximately 8 weight percent of catalyst based on oil) of reduced crude charged to vessel **16**.

In vessel **16** the metals contained in the reduced crude become deposited upon the catalyst fines, thereby producing a reduced crude of lowered metals content and catalyst fines containing the contaminating metals. While the embodiment illustrated in the figure employs catalyst fines as the finely divided or powdered solids which are contacted with the metals-containing reduced crude in the pretreating step, other finely divided solids may be employed so long as they do not do serious harm to the cracking catalyst or adversely affect the charge oil or cracked products. The finely divided solids should preferably, although not necessarily, have a rather high surface area. Examples of suitable finely divided solids, which may have approximately the same particle size as the catalyst fines employed in the illustrated embodiment, are clays such as kieselguhr, pumice, infusorial earths, diatomaceous earths, decolorizing clays and the like, finely divided alumina or bauxite and similar materials. Low activity cracking catalyst fines, either synthetic or natural, are highly useful in this process since they are readily available from the fluidized cracking process. The amount of finely divided solids contacted with the oil in the pretreating step is usually about 1 to 10 pounds (suitably about 2 to 5 pounds) per pound of Conradson carbon residue of the metals-containing heavy oil. The weight percent Conradson carbon residue may be determined in accordance with ASTM D 189–52.

While the embodiment illustrated herein employed a temperature of about 650° F. and a contact time of about one-half hour in the pretreating step, the pretreating temperature may be varied from about 500° F. to 1000° F. Longer contact times are employed at the lower temperatures and shorter contact times at the higher temperatures. Thus at contacting temperatures of about 900° F. the contact time will be less than a minute and usually will be a matter of seconds or fractions thereof. When the pretreating is carried out at the higher temperatures the reduced crude may be heated to about 800°–950° F. in the furnace tubes. The catalyst fines (or other finely divided pretreating material) may be added to the oil prior to its entry to the furnace tubes or immediately after it exists from the furnace tubes. In any event the fines are contacted with the hot oil at the high temperatures of about 800–950° F. for a short time which is sufficient to cause the metals to be deposited upon the fines prior to the time the fluidized catalyst is introduced into the line carrying the hot oil charge to the cracking reactor. At the lower pretreating temperatures which may be from about 500 to 750° F. the contact time will generally range between about 0.1 to 10 hours, the lower the temperature the longer the contact time. Incipient cracking occurs at about 700–750° F. At temperatures below incipient cracking, the metals-containing materials in the oil are adsorbed upon the finely divided solids. Only a slight amount of conversion of the reduced crude to lower boiling products occurs at such temperatures. As the temperature is increased above about 750° F., a greater extent of conversion of the reduced crude to lower boiling products occurs and larger amounts of hydrocarbonaceous deposits are formed on the finely divided solids. The extent of conversion of the reduced crude should be limited to less than about 20 to 25%, e.g. less than 10%. This may readily be accomplished by employing short contact times in the pretreating step as the pretreating temperature is increased.

Returning to the figure, the pretreated reduced crude, heated to the usual temperature employed in a fluidized catalytic cracking operation, picks up hot regenerated catalyst from standpipe **19** and the mixture of oil, regenerated catalyst, and metals-containing catalyst fines is passed into catalytic cracking reactor **12**. Make-up catalyst may be introduced into the system when necessary. Make-up catalyst from source **22** is passed by way of line **23** into catalyst hopper **24**. Make-up catalyst is often employed to maintain desired catalyst activity and proper particle size distribution for good fluidization. The make-up catalyst then passes from hopper **24** by way of valved line **29** into line **18** by which it is passed into the catalytic cracking reactor **21**.

In reactor **21** a typical fluidized catalytic cracking process is carried out. Usual reaction conditions for the catalytic cracking of such a heavy charge stock are employed. These may comprise a temperature of 850 to 1000° F., a pressure of about 5 to 50 p.s.i.g., a catalyst to oil weight ratio in the range of about 2:1 to 20:1, and a weight space velocity in the range of about 0.2 to 20 pounds of oil per pound of catalyst per hour. Specific cracking conditions comprising a temperature of about 925° F., a pressure of about 25 p.s.i.g., a catalyst to oil weight ratio of about 10, and a space velocity of about 3 pounds of oil per hour per pound of catalyst are used herein. A siliceous cracking catalyst, synthetic silica-alumina containing about 15–20% alumina, is employed herein. Other cracking catalysts such as natural or activated clays, silica-magnesia or silica-alumina-zirconia, may also be used if desired. The bulk or major portion of the cracking catalyst particles have an average particle diameter or size between about 40 to 80 microns. A minor proportion of fluid-size cracking catalyst has a particle diameter greater than 80 microns, and likewise a minor proportion of typical fluid-size cracking catalyst present in the fluidized cracking process has a particle diameter between about 10 to 40 microns. Material finer than about 10 microns is ordinarily rapidly lost from the system with the flue gases passed from the regenerator to the atmosphere.

Vaporous products are continuously removed from the catalytic cracking reactor. These vaporous products are removed from reactor **21** at a point therein which is above the dense fluidized bed **31**. Entrained cracking catalyst and fines are removed from the vapors by means of cyclone separators or other suitable apparatus for gas-solids separation. The solid particles entrained in the vapors are to a great extent the smaller diameter particles such as the catalyst fines employed in the pretreating step. As shown herein, the vaporous products pass into a first stage cyclone separator **32** which is preferably sized so as to remove catalyst particles having an average diameter between 40 to 80 microns. Catalyst particles in this size range are then passed down dip leg **33** into the dense fluidized bed of cracking catalyst **31**. This first stage cyclone separator shown herein may comprise one or more units. Vaporous products containing entrained catalyst fines of 0 to 40 microns pass from the first stage cyclone separator **32** by way of line **34** into second stage cyclone separator **36**. While complete separation of the 0 to 40 micron particles from the 40 micron and greater particles is not ordinarily practicable, it is desirable to obtain as sharp a separation as possible so that very little if any fines of 0 to 40 microns are returned by dip leg **33** to the dense fluidized bed and very little if any of the catalyst particles having a size of 40 microns and greater are passed into cyclone separator **36**. In this second stage cyclone, catalyst fines of 10 to 40 microns are separated from their vaporous products and are passed down standpipe **37** wherein they are fluidized. Steam or other stripping and fluidizing gas is introduced into standpipe **37** by way of line **38**. If desired, standpipe **37** can be eliminated and the 10–40 micron catalyst fines may be passed from cyclone **36** into standpipe **47**.

Because the catalyst fines used in the pretreating step will have contaminating metals deposited thereon, it is important that the residence time of the catalyst fines in the reactor be minimized. These metal and coke-containing fines behave just as badly contaminated catalyst behaves in that they produce lower gasoline yields and greater gas and coke yields. Also, the longer the residence time of such metal-containing fines in the reactor, the greater is the likelihood of contaminating metals being transferred from the fines onto the larger size active cracking catalyst.

The vaporous products removed from cyclone separator **36** are passed by way of line **39** into a fractionating system depicted herein as column **41**. Gases and naphtha are removed overhead by way of line **42** and are subsequently processed to recover dry gas, wet gas, and catalytic naphtha. A light cycle oil is removed from column **41** by way of line **43**. It may be recycled to the reactor or employed for blending with other stocks to make fuel oils. A heavy cycle oil is removed by way of line **44** and is similarly disposed of. A bottoms stream containing very small catalyst fines (usually the 0 to 10 micron size material) is removed from column **41** by way of line **46**. This stream is ordinarily processed to separate a decanted oil, which is removed from the cracking system, from a slurry oil containing the catalyst fines which is returned to the reactor.

Referring to reactor **31**, a portion of the fluidized cracking catalyst therein is continuously withdrawn through standpipe **47** for passage to the regenerator wherein hydrocarbonaceous deposits are removed from the catalyst particles by burning with an oxygen-containing gas at an elevated temperature. Steam or other suitable stripping and fluidizing gas is introduced by way of line **48** into standpipe **47**. The amount of catalyst to be passed to the regenerator is controlled by means of slide valve **49**. Slide valve **51** is positioned in standpipe **38** for this same reason. Air, which may be diluted with flue gas, nitrogen or inert gas, is introduced into line **52** and picks up the catalyst fines from standpipe **37** and catalyst to be regenerated from standpipe **47** and carries the mixture of catalyst and fines into the lower portion of regenerator **53**. A portion of the fines in standpipe **37** may be passed by means of valved line **50** into line **17** by which it is returned to pretreater **16**. The catalyst and fines are maintained in a dense fluidized state in regenerator **53**. The carbonaceous deposits are burned from the catalyst and pretreating fines at a temperature of about 1000–1150° F. Combustion gases are removed from the top of the regenerator after passage through cyclone separators. At least two stages of cyclone separator are employed in regenerator **53** in the same manner as they were employed in reactor **21**. The combustion gases containing entrained catalyst particles and fines pass into the first stage cyclone separator **54**. Catalyst particles which predominantly have a size of 40 microns and greater are separated from the combustion gases and returned by dip leg **56** to the dense fluidized bed **57**. Catalyst particles having a size of less than 40 microns are not removed from the combustion gases by cyclone separator **54**. The combustion gases are passed by way of line **58** into the second stage cyclone separator **59** wherein the fines of 10 to 40 microns are removed. As was indicated earlier, it is highly desirable to obtain as sharp a separation as is possible between the 40 or 45 microns and larger particles and the particles below about 35 to 40 microns in size.

Sharper separations can be obtained by using three stage cyclones, each of which stages are suitably designed and operated so as to remove coarse, intermediate, and fine catalyst particles. For example, cyclone separator **54** may be designed and operated to remove catalyst particles of 50 microns and larger which are passed by dip leg **56** into the dense fluidized bed; an intermediate cyclone stage not shown herein may operate on the combustion gases from cyclone **54** to remove catalyst particles of between 30 and 50 microns, which catalyst particles may be mildly attrited and then returned to the regenerator; and cyclone separator **59** may be operated as a third stage to recover catalyst fines of 10 to 30 microns from the combustion gases from the intermediate cyclone, such catalyst fines being cycled to the pretreating step. By obtaining the sharp separation between the catalyst fines used in the pretreating step and the circulating cracking catalyst, it is possible to obtain an essentially separate circulation system for the pretreating fines, and such a system is contemplated herein. By rapidly removing the catalyst fines from the regenerator, there is much less opportunity for the contaminating metals on the fines to become transferred to the larger size active cracking catalyst. In addition, these metals-contaminated catalyst fines are not recycled to the catalytic cracking reactor together with the regenerated catalyst and therefore the metals-contaminated fines do not function to any substantial extent as cracking catalyst where they would produce unfavorable product distribution and the like.

Referring again to the figure, the regenerated catalyst fines of 10 to 40 microns size are separated from the combustion gases in cyclone separator **59** and passed into standpipe **61** wherein they may be maintained in a fluidized condition. Combustion gases containing 0–10 micron particles and contaminant metals are vented from cyclone separator **59** to the atmosphere by way of line **62**. Steam, flue gas, or other oxygen-free gas is introduced into the base of standpipe **61** by way of line **63** to maintain the regenerated fines in a fluidized state. Slide valve **64** regulates the rate at which the catalyst fines are removed from standpipe **63** and passed by way of line **17** into pretreating vessel **16**. These hot pretreating fines which may be at a temperature of 1000–1150° F. supply a portion of the heat to the reduced crude in pretreating vessel **16**. Regenerated catalyst having a lowered carbon content is continuously withdrawn from regenerator **53** down standpipe **66**. Steam, flue gas or other suitable oxygen-free gas is introduced by way of line **67** into standpipe **66**. Slide valve **68** regulates the rate at which the regenerated catalyst passes into line **19** and then into line **18** wherein it is picked up by the pretreated reduced crude and passed into catalytic cracking reactor **21**.

In the embodiment described herein the pretreating fines were employed in a defined amount based on the reduced crude, and the bulk of the catalyst fines used in pretreating had an average particle size of 10 to 40 microns. It is apparent that the size of the catalyst fines (or other pretreating materials) may be varied depending upon the particular amounts of pretreating fines necessary for the proper or desired performance of the pretreating step. For example, under certain circumstances which depend upon the amount of catalyst fines which are used in the pretreating step, the cut point between the recirculating catalyst fines and the active cracking catalyst may be about 50 microns. The cyclones in the reactor and regenerator may be designed and operated so as to segregate catalyst from fines at a cut point of about 50 microns. Under different circumstances the cut point between the active catalyst and the pretreating fines may be 30 microns. If additional amounts of catalyst fines are needed in the pretreating step, a portion of the larger size used (and thus less active) catalyst may be attrited and introduced into the cracking system for this purpose.

While the embodiment described herein employs a reduced crude, it is obvious that other metals-containing heavy oils such as heavy gas oils, deep cuts of vacuum distillates and the like are suitable charge stocks to the invention. Although the illustrated embodiment describes the use of internal cyclones, it is obvious that these may be externally located. The use of cyclones as the means for separating entrained solids from the gases is not essential and other separating means may be

employed by which the finely divided pretreating materials are separated from the larger size catalyst particles. It is also contemplated that the pretreating fines removed from the cracking reactor may be regenerated separately from the larger size catalyst particles and the fines thereafter returned to the pretreating step. Other modifications of the present invention will be apparent to those skilled in this art.

What is claimed is:

1. A process for catalytically cracking a metals-containing heavy oil in a catalytic cracking system comprising essentially a catalytic cracking zone, a regeneration zone, a pretreating zone, and interconnecting transfer line which process comprises pretreating a metals-containing heavy oil in the liquid phase by contacting said oil at an elevated temperature with a finely divided solid material that is inert toward cracking catalyst for a time sufficient to cause depositing of metals from said heavy oil onto the finely divided solids, passing treated oil of lowered metals content together with metals-containing finely divided solids into a catalytic cracking zone and therein catalytically cracking the treated oil at an elevated temperature to lower boiling vaporous products in the presence of a fluidized bed of cracking catalyst particles, the average particle size of the catalyst particles being greater than that of the finely divided solids, removing vaporous products, entrained catalyst particles and metals-containing finely divided solids from contact with the fluidized bed of catalyst, separating entrained catalyst particles and finely divided metals-containing solids from the vaporous products and recovering the latter, separating said catalyst particles from said finely divided metals-containing solids, returning said catalyst particles to said fluidized bed, withdrawing said finely divided solids from said zone separately from said catalyst particles, drawing said catalyst particles from said zone, introducing said particles and said metals-containing finely divided solids into a regeneration zone wherein hydrocarbonaceous material is burned off said particles and said finely divided solids, removing from said regeneration zone catalyst particles from which hydrocarbonaceous material has been burned and recycling said particles to said catalytic cracking zone, removing from the regeneration zone finely divided solids from which hydrocarbonaceous material has been burned and recycling finely divided solids produced solely from particles and solids circulating within said system into contact with additional portions of metals-containing heavy oil.

2. The process of claim 1 wherein the heavy oil is a reduced crude.

3. The process of claim 1 wherein the finely divided solids are cracking catalyst fines.

4. The process of claim 1 wherein the metals-containing heavy oil is contacted with the finely divided solids at a temperature between about 500 to 1000° F. for a period of time ranging from less than 1 minute at 1000° F. up to 10 hours at 500° F., said finely divided solids being employed in the contacting step in an amount between about 0.1 to 10 pounds per pound of Conradson carbon residue in the heavy oil.

5. A process for the catalytic cracking of a metals-containing heavy oil in a catalytic cracking system comprising a catalytic cracking zone, a regeneration zone, a pretreating zone, and interconnecting transfer lines which comprises pretreating said oil in the liquid phase with a minor amount of a finely divided solid material at an elevated temperature for a time sufficient to cause depositing of metals from said heavy oil onto said finely divided solids while limiting the extent of conversion of said oil to lower boiling products to less than about 20 to 25%, said finely divided solids being inert toward the cracking catalyst employed in a subsequent step, passing treated oil of lowered metals content together with metals-containing finely divided solids into the lower section of a catalytic cracking zone wherein treated oil is contacted at an elevated temperature with a fluidized bed of cracking catalyst particles and cracked to lower boiling vaporous products, the average particle size of the bulk of the cracking catalyst particles being greater than that of the finely divided solids, flowing vaporous cracked products upwardly through and out of the fluidized bed of cracking catalyst particles and thereafter separating entrained catalyst particles and finely divided metals-containing solids from the cracked products and recovering the latter, separating said catalyst particles from said finely divided solids, returning separated catalyst particles back to the catalytic cracking zone, introducing the separated metals-containing finely divided solids into a regeneration zone, withdrawing a portion of the catalyst particles from the catalytic cracking zone and introducing said catalyst particles into said regeneration zone, maintaining a fluidized bed of catalyst particles and metals-containing solids in said regeneration zone at an elevated temperature and burning hydrocarbonaceous deposits therefrom by passing an oxygen-containing gas through said fluidized bed, removing regenerated catalyst particles from said regeneration zone and returning them to the catalytic cracking zone, and removing finely divided solids from the regeneration zone and recycling finely divided solids produced solely from solids and particles circulating within said system into contact with additional amounts of metals-containing heavy oil.

6. The process of claim 5 which has the added steps of separating entrained catalyst and finely divided solids from the products of combustion of said regeneration zone, returning separated catalyst to the regeneration zone, and passing the separated finely divided solids to said pretreating step wherein they are contacted with additional amounts of the metals-containing heavy oil.

7. A catalytic cracking process which comprises pretreating a metals-containing liquid reduced crude by contacting it with a minor amount of cracking catalyst fines at an elevated temperature for a time sufficient to cause depositing of metals from said reduced crude onto the catalyst fines while limiting the extent of conversion of the reduced crude to less than about 20 to 25%, passing treated oil of lowered metals content together with the metals-containing catalyst fines into a cracking reactor comprising a confined fluidized bed of cracking catalyst particles which is maintained at cracking temperatures and therein cracking the treated oil to form lower boiling hydrocarbons and hydrocarbonaceous material which is deposited upon the catalyst, the bulk of the catalyst particles in said fluidized bed having an average particle size which is greater than the average particle size of the bulk of the catalyst fines employed in the pretreating step, flowing vaporous hydrocarbon products upwardly through and out of said fluidized bed of cracking catalyst particles and thereafter separating cracking catalyst particles and metals-containing catalyst fines from the vaporous hydrocarbon products and recovering the latter, returning separated catalyst particles back to the fluidized bed of catalyst particles in the cracking reactor, passing the separated metals-containing catalyst fines into a regeneration zone, withdrawing a portion of the catalyst particles from the fluidized bed of catalyst particles in the reaction zone and passing said catalyst particles into the regeneration zone, maintaining a fluidized bed of catalyst particles and metals-containing catalyst fines in said regeneration zone at an elevated temperature, passing an oxygen-containing gas upwardly through said fluidized bed and burning hydrocarbonaceous deposits from said catalyst particles and catalyst fines and thereby forming combustion gases, separating entrained catalyst particles and catalyst fines from said combustion gases and returning the catalyst particles to the fluidized bed in the regeneration zone while passing catalyst fines without grinding to the pretreating step wherein they are contacted with additional portions of metals-containing reduced crude.

8. The process of claim 7 wherein a portion of the metals-containing catalyst fines which are separated from the vaporous hydrocarbon products and from the larger size catalyst particles is passed to the pretreating step.

9. The process of claim 1 wherein said finely divided metals-containing solids after being separated from said catalyst particles and withdrawn from said catalytic cracking zone are treated with air before being introduced into said regeneration zone.

10. The process of claim 1 wherein a portion of said finely divided metals-containing solids after being withdrawn from said catalytic cracking zone are introduced into contact with additional metals-containing heavy oil.

References Cited in the file of this patent

UNITED STATES PATENTS

2,414,973	Nelson	Jan. 28, 1947
2,689,825	McKinley	Sept. 21, 1954
2,777,802	Peet	Jan. 15, 1957
2,848,379	Rehner et al.	Aug. 19, 1958