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MANUFACTURE OF PETROLEUM COKE

Filed April 25, 1962

2 Sheets-Sheet 1

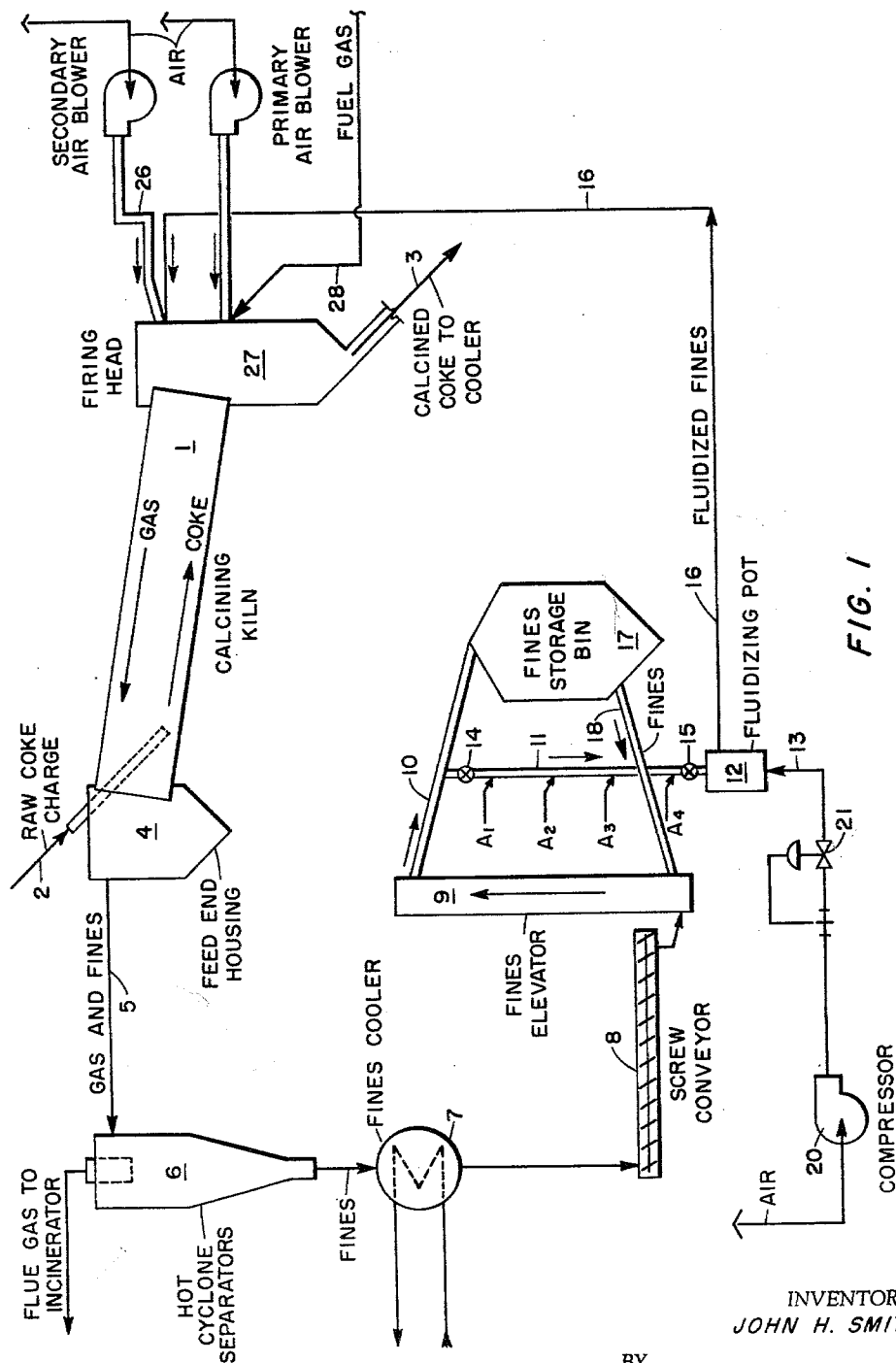


FIG. 1

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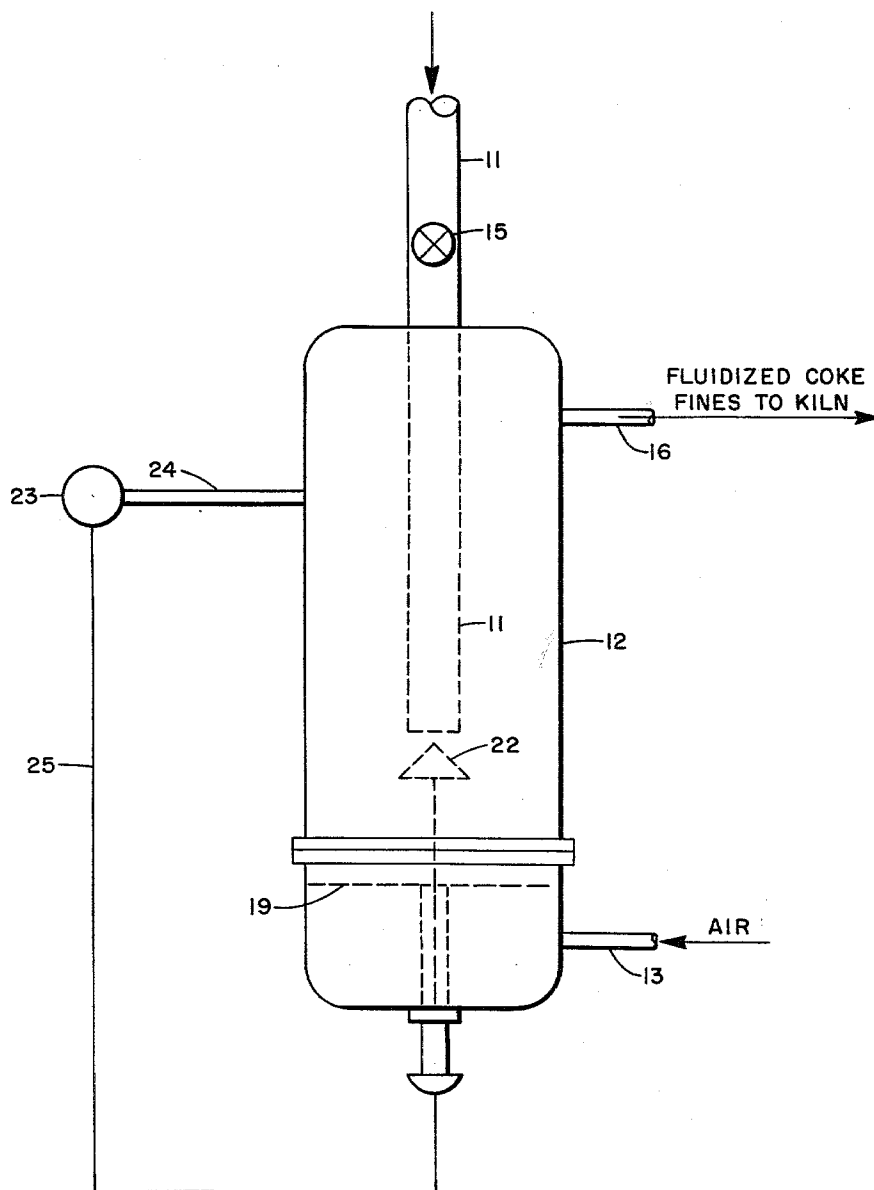


FIG. 2

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MANUFACTURE OF PETROLEUM COKE

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This invention relates to the manufacture of petroleum coke. More particularly, it relates to the use of coke fines recovered from the coke manufacturing operations to provide fuel for the calcining of the green coke produced during the delayed coking step. Still more particularly, the invention relates to the fluidization of recovered coke fines or dust and the use of the fluidized fines as fuel for the calcining step.

In the delayed coking process, a petroleum fraction is heated to a temperature at which it will thermally decompose. The oil is then fed into a drum under sufficient pressure to prevent at least the heavier fractions of the oil from vaporizing until they have partially decomposed. This thermal decomposition produces a very heavy tar which undergoes additional decomposition depositing a porous coke mass in the drum.

In the usual application of the delayed coking process, residual oil is heated by exchanging heat with the liquid products from the process and is fed into a fractionating tower where any light products which might remain in the residual oil are distilled out. The oil is then pumped through a furnace where it is heated to the required temperature and discharged into the bottom of the coke drum. The first stages of thermal decomposition reduce this oil to some volatile products plus a very heavy tar or pitch which further decomposes to yield solid coke. The vapors formed during this decomposition produce pores and channels in the coke thru which the incoming oil from the furnace may pass. This process is continued until the drum is filled with a mass of coke. The vapors formed in the process leave from the top of the drum and are returned to the fractionating tower where they are fractionated into the desired cuts.

The attrition associated with removing petroleum coke from delayed coking drums and the subsequent coke handling and calcining produces a considerable amount of undersized coke fines. Prior to development of this invention, these fines constituted a disposal problem.

This invention provides a method for using recovered coke fines in fluidized form as fuel for the coke calcining step.

It is an object of this invention to provide a method of disposing of coke fines that normally are entrained in the flue gases exiting from a petroleum coke calciner.

It is a further object of this invention to reduce fuel costs for the calcining step of a combined coker-calciner operation.

It is a further object to provide improved calciner kiln performance resulting in higher kiln throughput and more thorough calcination.

Broadly stated, the invention is a process for producing petroleum coke which comprises subjecting a heavy petroleum residue to coking conditions of temperature and pressure, recovering and calcining the green coke, recovering the coke fines (or dust) from the calciner flue gas, fluidizing said coke fines, and burning said fluidized coke fines in the calciner kiln to provide a major portion of the fuel requirements.

In the drawings:

FIGURE 1 is a flow diagram showing the process of the present invention beginning with the introduction of raw coke charge into the calciner kiln.

FIGURE 2 is a side elevation of the fluidizing pot shown in FIGURE 1.

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Selection of suitable charge stocks for coking operations is well known in the art. The principal charging stocks are high boiling virgin or cracked petroleum residua such as: virgin reduced crude; bottoms from the vacuum distillation of reduced crudes, hereinafter referred to as vacuum reduced residuum; Duosol extract; thermal tar; and other heavy residua. Blends of these materials are often used to provide a feed which will provide a suitable coke having a sufficiently low sulfur content.

As indicated above, the preferred coking process is the well-known delayed coking process. In this process, which is one of the most commonly-used and most economical at the present time, the charge stock is pumped at 150 to 500 p.s.i. into a furnace where it is preheated to 850 to 950° F. and then discharged into a vertical coking drum through an inlet at the base. The pressure in the drum is maintained at 20 to 80 p.s.i., and the drum is well insulated to minimize heat loss, so that the reaction temperature lies between about 830° F. and 900° F. The hot charge stock decomposes over a period of several hours, liberating hydrocarbon vapors which rise through the mass continuously, stirring the contents of the coking drum vigorously.

After removing the coke from the drum (usually by means of a high impact water jet), the coke is broken into lumps and is calcined, generally at a temperature of 1000° C. to 1500° C.

The coking operations whereby the raw coke calciner charge is produced comprise the standard coking process known as delayed coking, and no claim is made to such process per se.

The preferred mode of operation is illustrated in the flow diagram of FIGURE 1. The raw coke charge is introduced to the calciner 1 at point 2 and flows downwardly through the rotating kiln countercurrently to the flow of hot gas and passes out of the calciner at 3. The hot flue gases containing entrained fines leave kiln 1 through feed end housing 4 and line 5 and enter cyclone separator 6 which is a cylindrical vessel with a cone-shaped lower portion. (Actually more than one such separator may be used in parallel.) The gases are introduced horizontally and tangentially to the inside surface of the cyclone. The fines drop to the bottom and are cooled in fines cooler 7 from which they are moved by conveyor 8 into elevator 9.

The coke fines from the top of elevator 9 pass by means of a chute 10 into standpipe column 11 which is of sufficient diameter to convey the required amount of fines and of sufficient height to permit the column of fines to build sufficient static pressure to flow into fluidizing pot 12. The fines pass downwardly through standpipe column 11 to the fluidizing pot or vessel 12 wherein they are fluidized by means of air supplied through line 13 from compressor 20 and air rate control means 21. Air is also introduced into the column 11 at points A-1, A-2, A-3, and A-4 in order to facilitate the even flow of fines by providing sufficient cushioning gas between the particles to prevent compaction and bridging. These additional amounts of air preferably are introduced into the column at a downward angle of approximately 45° as shown in FIGURE 1. Although the number of points of air introduction and the amount of air flow utilized are largely matters of engineering design, I prefer to have the points of injection about 12 feet apart and add just enough air at each point to overcome the increase in static head compression from the next point higher to maintain nearly constant bulk density throughout the standpipe.

Chute 10 also runs past column 11 to storage bin 17, and line 18 permits the return of fines from bin 17 to elevator 9. By closing valve 14 at the top of column 11, all of the fines bypass the fines burning system and enter

the storage bin to be saved until the burning system is again in service. When the fines burning system is in service, most of the fines flow through the standpipe column into the fluidizing pot 12, with a slight excess of circulation through the fines bin at all times to insure a dense column of fines in standpipe 11 to overcome the difference in pressure between fluidizing pot 12 and chute 10. Typically the fines (or dust) recovered from the kiln flue gas runs 4 to 5 percent based on total calcined coke, and over a period of time all of them may be burned in the kiln, although the rate of burning need not equal the rate of recovery at any given instant. To provide the necessary flexibility to permit the ultimate burning of all recovered fines, the burning system should be operable over a range of 50-160 percent of typical fines production rate, and the storage bin should have capacity to store several days' recovery of fines.

Referring to FIGURE 2, coke fines passing downwardly through column 11 enter the fluidizing pot a short distance above a perforated plate 19. A constant but adjustable source of air is supplied to the lower section of the fluidizing pot below the perforated plate through line 13. The air passes through holes in the perforated plate into the upper section of the fluidizing pot, wherein the fines are fluidized by the air stream and carried out of the pot to the firing end of the kiln through line 16.

Typical operating conditions (for 300 tons/day of calcined coke):

Fines recovered: 14 tons/day

Fines burned (range): 10-22 tons/day

Fines burned (preferred range): 12-17 tons/day

Air rate of fluidizing pot: 100 standard cubic feet per minute

Fuel gas rate to kiln: 15,000-20,000 standard cubic feet per hour

The fines rate to the fluidizing pot 12 is regulated by an automatically operated plug valve 22 in the base of the column 11. This valve is operated by a pressure controlled system comprising pressure recorder controller 23, which is responsive to the pressure inside the fluidizing pot by means of line 24. Pressure recorder controller 23 actuates valve 22 through impulse line 25. If the pressure in the pot, which with constant rate of air supply through pipe 13 is a measure of the fines rate in line 16, increases beyond the predetermined set pressure indicating a high fines rate, the pressure control system causes the plug valve 22 to close somewhat thereby partially reducing the fines rate. A low pressure in the fluidizing pot has the opposite effect.

Referring once again to FIGURE 1, the fluidized fines line 16 enters the secondary air duct 26 just outside the firing hood 27. This line 16 continues inside the secondary air duct, terminating just short of the inside face of the firing hood. Thus the fines are blown into the firing end of the kiln above the fuel gas inlet 28. In the kiln, the fines, picking up heat radiated by the hot coke and kiln liner and passing through the fuel gas flame, are ignited and burned to provide the major portion of the heat required for the calcining operation.

In addition to disposing of coke fines (which constitute a low value or even a nuisance waste material) and

reducing fuel costs by cutting down the required amount of fuel gas to the kiln, this process improves kiln performance by widening the zone of high temperature in the kiln. This is due to the fact that fines burn slower than gas or oil resulting in a longer section of the kiln being at the maximum allowable kiln temperature, thereby increasing residence time at the highest temperature. The overall effect results in more thorough calcination at any given rate of throughput or more throughput at any given level of calcination.

Another advantage of this process is an increase in coke yield. In certain prior art systems, the burning of fuel gas alone does not spread out the heat release sufficiently for good calcination, so that it is necessary to burn a portion of the coke itself to provide part of the heat. The present process eliminates this need, because, as indicated above, the burning of the coke fines is slow enough to result in a widening of the hot zone in the kiln.

Although, in the process just described, air is used for fluidizing and conveying the coke fines from the fluidizing pot to the kiln, any gaseous medium could be used, and, in some specific instances, a fuel gas might be preferred.

While specific details of the preferred mode of operation have been given in the foregoing for purposes of illustration, it is to be understood that the invention is not limited thereby, but is to be taken as limited solely by the language of the appended claims.

I claim:

1. The process for the production of petroleum coke by the delayed coking method comprising the steps of introducing a heavy petroleum residuum into the bottom of a coking drum, subjecting said residuum to delayed coking conditions of temperature and pressure to thermally decompose said residuum to produce a mass of solid raw coke filling the coking drum, removing the raw coke from the drum, calcining said raw coke by passing it downwardly through an elongated calcining zone maintained at a temperature of about 1000° C. at one end of said zone and about 1500° C. at the other end of said zone by passing hot gases upwardly through said zone countercurrently to said coke, recovering the coke fines from the gases passing from the calcining zone, fluidizing the coke fines recovered from the calcining zone, and burning said fluidized coke fines in said calcination zone in an amount sufficient to provide a major portion of the fuel requirements to the calcining zone.

2. The process of claim 1 in which ignition and burning of the fluidized coke fines are facilitated by introducing said fines into the calcining zone, in admixture with a source of air, above a gas flame.

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