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(54) ## Delayed coking.

(57) A process for reducing the amount of coke formed in the coke drums of a delayed coking process by reducing the partial pressure of the heavy oil in the coke drums.

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The present invention relates to delayed coking. In particular, this invention relates to a process for minimizing the quantity of coke produced in a delayed coking process.

Delayed coking is a process in which heavy oil is rapidly heated in a coker furnace and then passed to a reaction zone comprising one or more coke drums. There, the heavy oil undergoes cracking and condensation reactions, resulting in coke and a full boiling range of oils and gases which are then subjected to fractionation in a coker fractionator.

The goal in a delayed coking process is to minimize the quantity of low value coke while maximizing the quantity of liquid product output. Traditionally, to minimize the quantity of coke formed, the pressure in the coke drum is set at minimum levels. In today's delayed cokers, the minimum practical pressure level is about 10 to 15 psig. To achieve lower pressures requires large and expensive equipment with high compression requirements.

As an alternative to lowering the pressure, the same result can be achieved by operating the process at a lowered effective pressure, which is achieved by lowering the partial pressure of the heavy oil in the coke drum.

Most delayed coker processes use water or steam in the coker furnace to increase the velocity of the heavy oil through the furnace and to reduce the formation of coke within the furnace. This water or steam also reduces the oil partial pressure in the coke drum slightly, but to use the steam for this purpose would be impractical because expensive high-valued, high-pressure steam is required to increase the velocity of the oil and to reduce the formation of the coke.

In the case of water injection, additional fuel must be fired to provide the heat necessary to produce the steam within the coker furnace. In addition, this steam leaves the coker unit eventually as sour water which, in order to be disposed of, must first be treated.

As a result, the quantity of steam or water injected into the coker furnace has conventionally been limited to only that amount of steam or water required to maintain the velocity of the heavy oil and reduce coking in the furnace tubes. Similarly, certain instruments and valves are purged with steam, but again the rate is set at the minimum required to meet the purging requirements.

The delayed coking process is such that large amounts of waste heat can be recovered in the fractionation portion of the process. Some of this heat is available at high and useful levels. Some of it is at such a temperature as to be useful only for producing low pressure steam. Frequently, this steam is in excess and is of little or no value.

SUMMARY OF THE INVENTION

The instant invention provides for using this low value heat, or low value heat from another process, to provide an inexpensive source of steam or other heated fluid that can be used to reduce the partial pressure of the heavy oil in the coke drums and thereby the amount of coke formed therein.

The instant invention then is a method for reducing coke formation in a delayed coking process carried out in a coker unit comprised of a coker furnace, a coke drum and a coker fractionator, wherein heavy oil is heated to coking temperature in the coker furnace and then passed to the coke drum where coke and overhead vapors are formed and wherein the overhead vapors are passed to the coker fractionator, this method comprising introducing into the coke drum a fluid in an amount sufficient to lower the partial pressure of the heavy oil in the coke drum.

In one preferred embodiment, the heated fluid is sour water, recovered from the coker fractionator.

In another preferred embodiment, the heated fluid is steam, which can be superheated by passing the fluid through the coker furnace.

One of the advantages of this invention is that fluids already present in the delayed coking process, such as sour water recovered from the coker fractionator, or other fluids, can be used to reduce the partial pressure of the oil in the coke drum and thereby achieve decreased coke yields. Another advantage is that heat available within the delayed coking process, which is of low value otherwise, is used to preheat the fluids to be used in the coke drum.

Another consequential advantage of this invention is that a lower than normal coker furnace outlet temperatures can be used by introducing superheated fluid into the coke drum, the superheated fluid obtained by passing the fluid through the coker furnace.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic flowsheet illustrating the basic method of the invention.

Figures 2-6 are schematic flowsheets illustrating preferred embodiments of the basic method of the invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to Figure 1, fresh coker feedstock, which can be preheated from a means not shown, is introduced into the bottom of the coker fractionator through line 1.

The invention is particularly useful when oils having an API gravity of about 15 degrees or heavier are coked. Typical feedstocks to which the invention is especially useful include vacuum residues, asphalts and coal tar pitches.

Feed which has been stored in the coker fractionator is withdrawn via line 3 and fed into the coker furnace where the oil is heated to coking temperature.

Generally, the coker furnace will operate at a temperature ranging from about 475°C to about 525°C and a pressure of about 15 to about 75 psig. Preferably the temperature will range from about 490°C to about 510°C and the pressure will range from about 20 to about 50 psig.

The oil is then transferred via transfer line 5 to one of several coke drums 6 and 7, where the oil is coked.

The coke drums are maintained at a coking temperature generally ranging from about 415°C to about 470°C and a pressure from about 10 psig to about 35 psig. The temperature and pressure preferrably range from about 435°C to about 455 and about 15 psig to about 25 psig, respectively.

More than one coke drum is used so that when one of the coke drums is full of solid coke, the feed can be switched to another drum. The full drum is then cooled and emptied by conventional methods.

Vapors leaving the coke drums via line 8 are returned to the fractionator. These vapors are fractionated to produce desired products including heavy coker gas oil, light coker gas oil, overhead naphtha and overhead gases. Overhead gases are recovered through line 10, heat exchanger 12, knock-out drum 14 and line 15. Coker naphtha is recovered through lines 16 and 17. Light coker gas oil is recovered through line 18. Heavy coker gas oil is recovered through line 20 and sour water is recovered through line 11.

According to this invention, as generally shown in Figure 1, low pressure steam or heated fluid is introduced via line 9, into transfer line 5 and/or directly into coke drums 6 and 7 through lines 21 and 22.

The heated fluid introduced into the coke drums to lower the effective pressure of the oil can be generally be any fluid, including water, sour water, steam, gases, naphtha, or other material which can be vaporized by low level heat. Preferably, the fluid is a gas at 60°F and atmospheric pressure. Most preferably, the fluid is water, sour water, naphtha or steam.

The fluid is preferably heated according to the invention using low level heat from the coker fractionator. This can be accomplished through conventional heat exchange processes known in the art.

The fluid is generally heated so that it will not adversely lower the temperature of the coke drums. Generally, this temperature ranges from about 415°C to about 535°C and preferably from about 480°C to about 510°C. Alternatively, heated fluid product of the fractionator can be used directly. The fluid can also be superheated by being passed through the coker furnace.

Generally, the amount of the fluid introduced into the coke drums depends upon the type of fluid and the processing conditions. Preferably, the amount of fluid introduced into the drum ranges from about 0.2 lbmols/bbl of fresh feed to about 5.0 lbmols/bbl of fresh feed.

In a preferred embodiment of the invention, shown in Figure 2, sour water, recovered from the fractionator, through lines 10, 11 and 23, is heated using reflux from line 13 and then introduced through line 9 into transfer line 5 and/or directly into coke drums 6 and 7 through lines 21 and 22.

In another preferred embodiment of the invention, shown in Figure 3, sour water from line 23 is converted to steam using column 24 with heat from reflux line 13, which exchanges with recycle in line 26.

In yet another embodiment, shown in Figure 4, the steam from column 24 can be superheated by passing it through line 25 and the coker furnace. The superheated steam allows for the use of a lower outlet temperature from the coker furnace for the oil transfered via line 5.

Figure 5 demonstrates the use of other fluids, such as naphtha, which is withdrawn from the fractionator through lines 10, 16, 17, 23, and 9.

Other embodiments are included within the scope of this invention and this invention is not intended to be limited by the foregoing description but only by the following claims.

Claims

1. A method for reducing coke formation in a delayed coking process carried out in a coker unit comprised of a coker furnace, a coke drum and a coker fractionator, wherein heavy oil is heated to coking temperature in said furnace and then passed to said coke drum where coke and overhead vapors are formed, and wherein said overhead vapors are passed to said fractionator, said method comprising introducing into the coke drum a fluid in an amount sufficient to lower the partial pressure of the heavy oil in said coke drum.

2. The method according to claim 1 where said fluid is heated with heat recovered from the coking process.

3. The method according to claim 2 where said fluid is sour water recovered from said fractionator.

4. The method according to claim 3 where said sour water is converted to steam in a stripping tower.

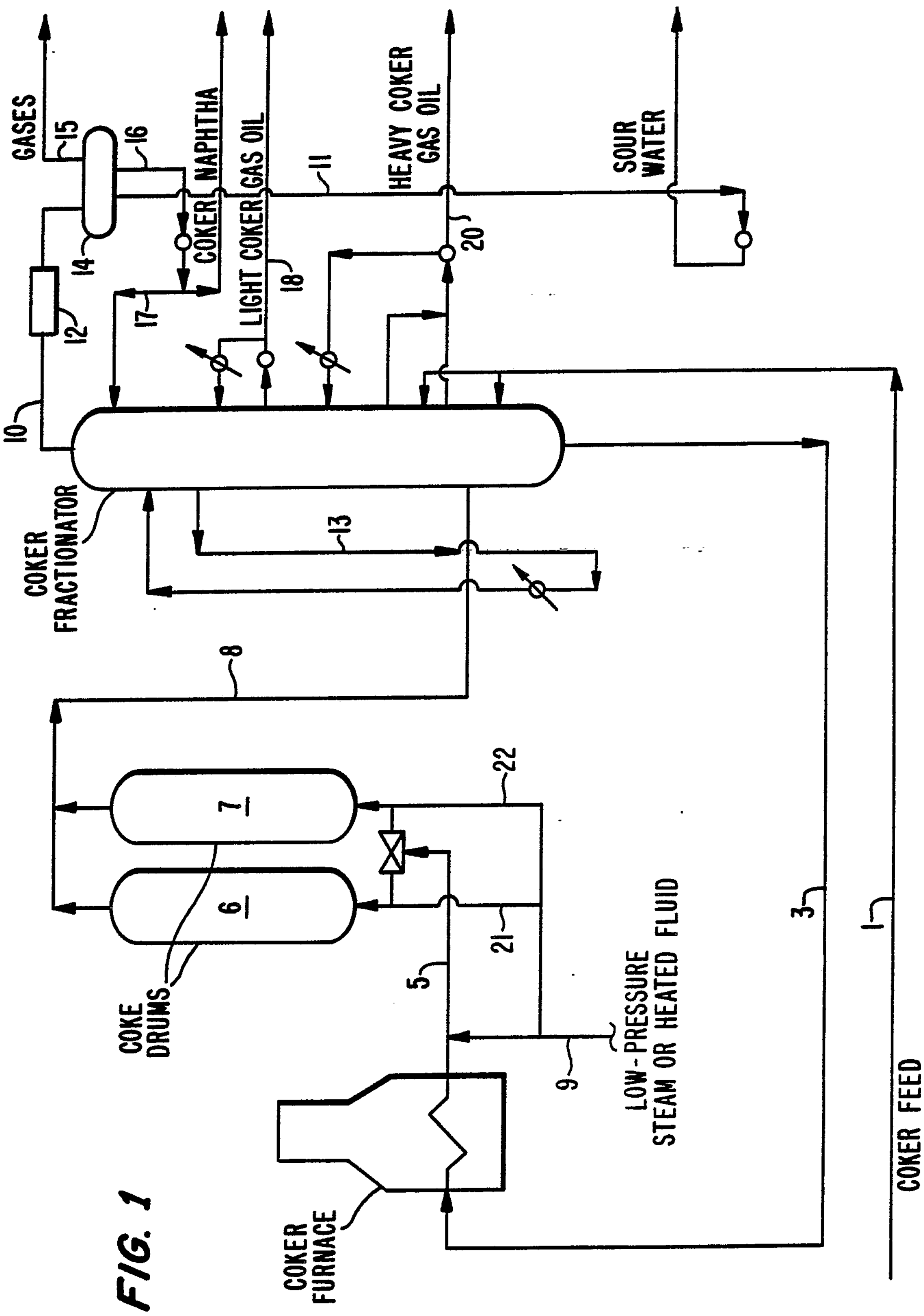
5. The method according to claim 4 where said steam is superheated by being passed through said coker furnace.

6. The method according to claim 1 where said fluid is naphtha recovered from said fractionator.

7. The method according to claim 1 where said fluid is steam.

8. The method accordinq to claim 1 where said fluid is a gas at 60°F and atmospheric pressure.

9. The method according to claim 1 where said fluid is introduced in an amount ranging from 0.2 lbmols/bbl to about 10 lbmols/bbl.


GASES
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14
12
10
17
COKER NAPHTHA
LIGHT COKER GAS OIL
18
11
HEAVY COKER GAS OIL
20
SOUR WATER
COKER FRACTIONATOR
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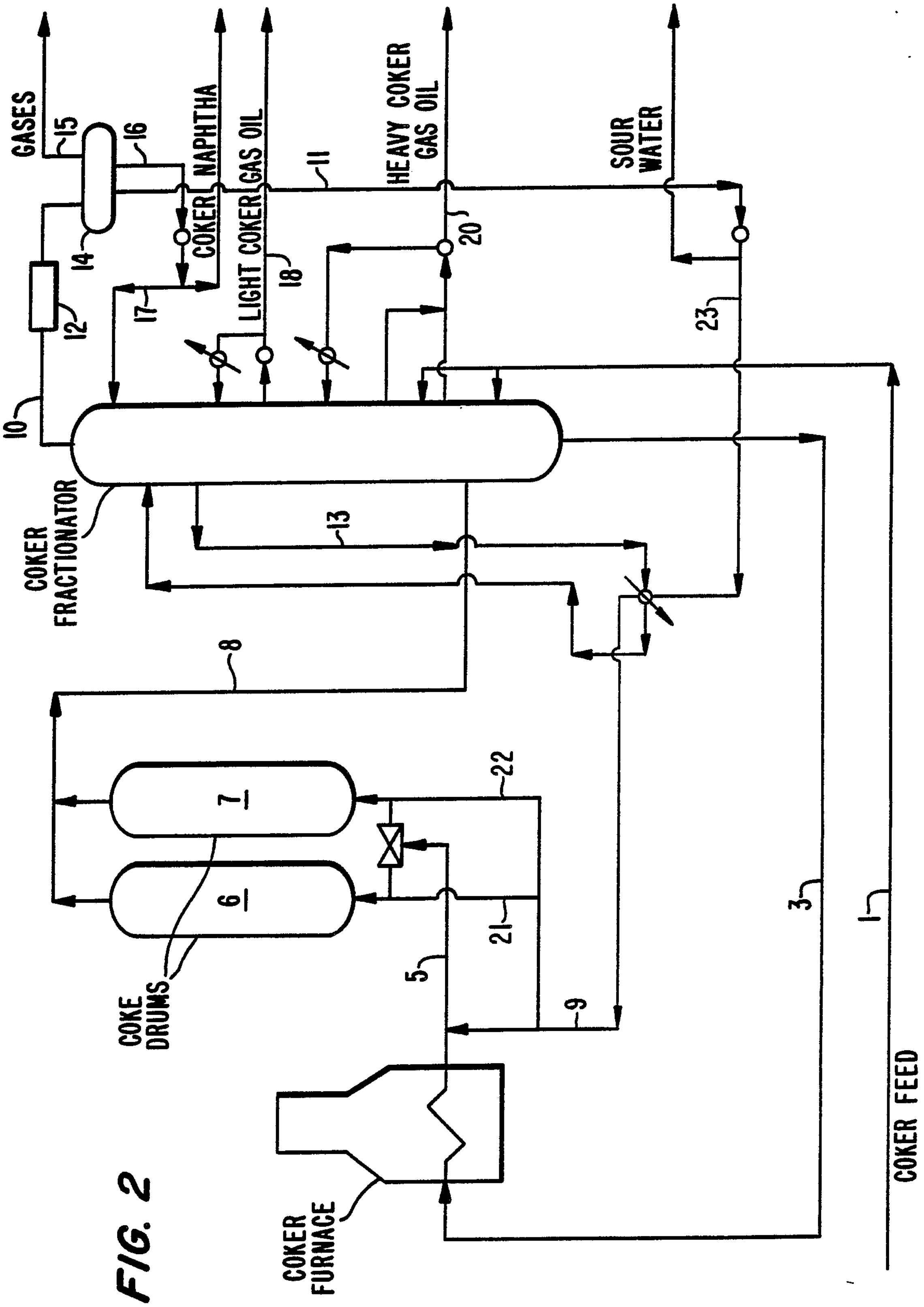
8
7
6
22
21
5
COKE DRUMS
9
LOW-PRESSURE STEAM OR HEATED FLUID
3
1
COKER FEED
COKER FURNACE

FIG. 1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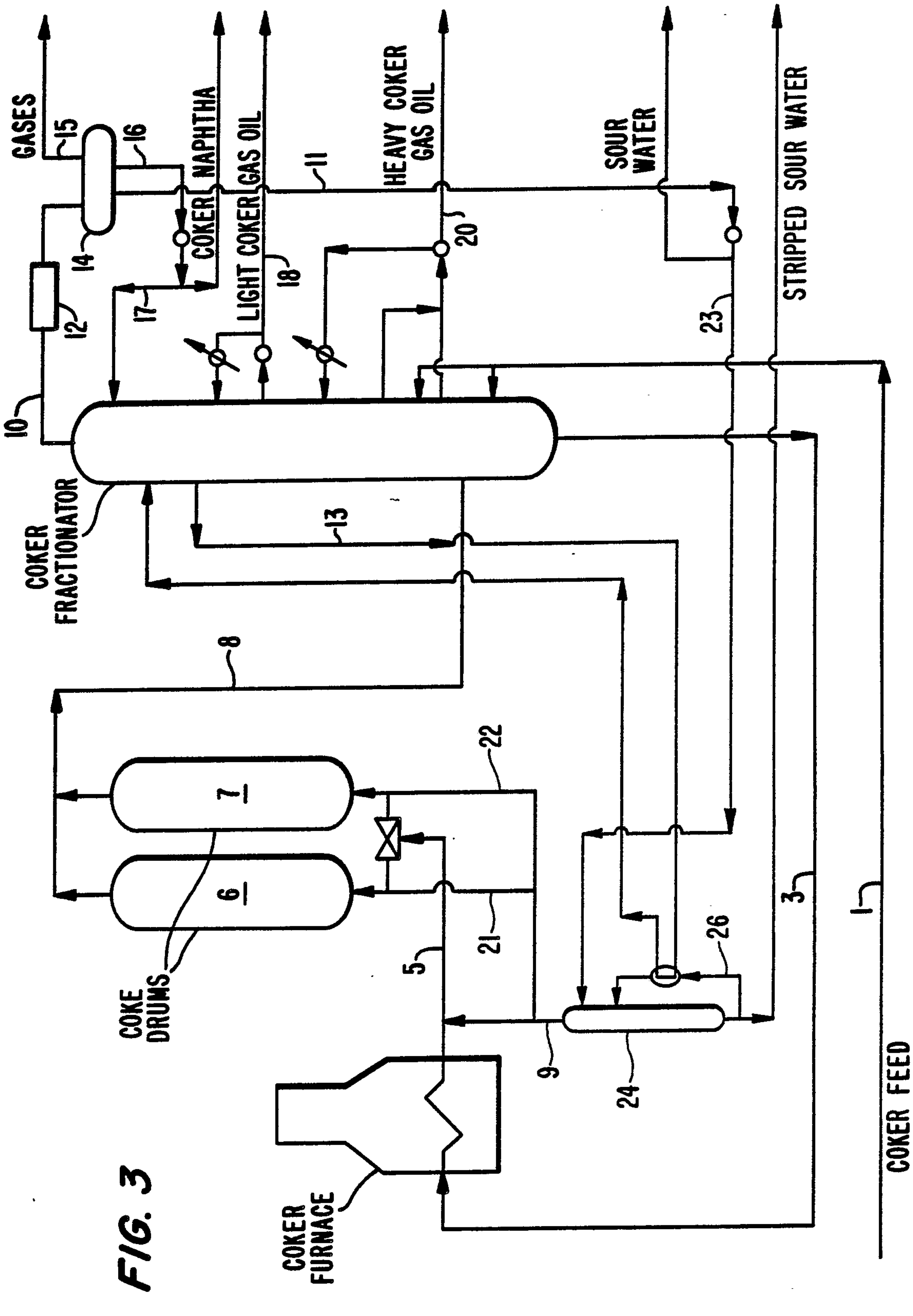
COKER FURNACE
COKER FEED

FIG. 2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HEAVY COKER GAS OIL
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SOUR WATER
STRIPPED SOUR WATER
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COKER FRACTIONATOR
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COKE DRUMS
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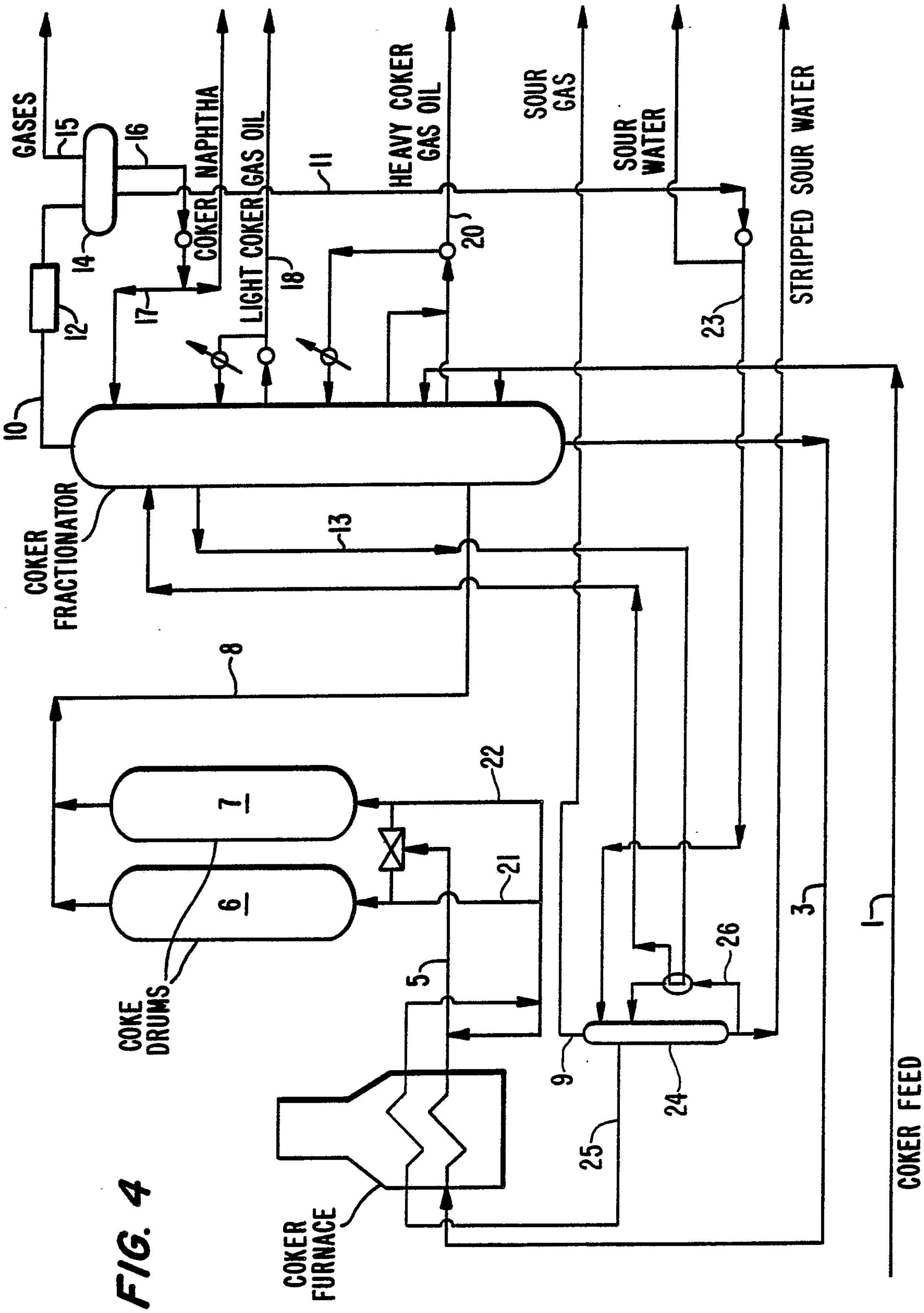
COKER FEED
COKER FURNACE

FIG. 3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SOUR GAS
SOUR WATER
STRIPPED SOUR WATER
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COKER FRACTIONATOR
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COKE DRUMS
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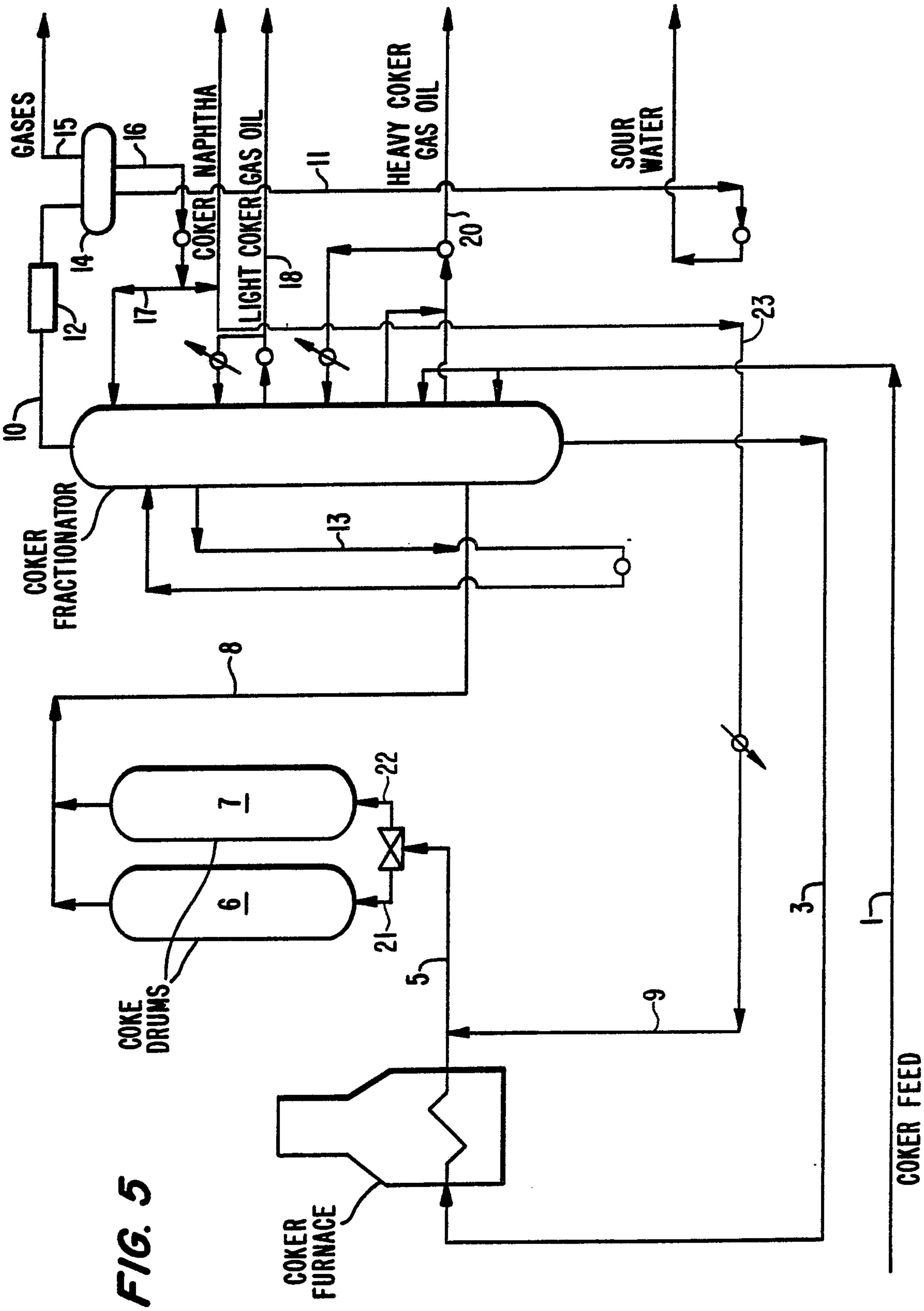
25
COKER FEED
COKER FURNACE

FIG. 4



GASES
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SOUR WATER
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COKER FRACTIONATOR
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COKE DRUMS
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1
COKER FURNACE
COKER FEED

FIG. 5