



Industry
Canada Industrie
Canada

Canada

strategis.gc.ca

Strategis Index:



Canadian Patents Database

12/20/2001 - 08:16:54

(11) CA 883733

(12) Patent:

(54) PROCESS FOR THE MANUFACTURE OF GASES CONTAINING HYDROGEN AND CARBON MONOXIDE

(54)

(72) Inventor (Country): **GERRIT H. REMAN** (Not Available)

(73) Applicant (Country): **SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ, N.V.**

(71) Filing Date (Country):

(74) Agent:

(45) Issue Date: **Oct. 19, 1971**

(22) Priority:

(43) Publication:

(52) IPC Class: **48/29**

(51) Int. Cl. Class: **N/A**

(53) Int. Cl. Class: **No**

(30) Priority: **None**

N/A

Unknown

*** Note: Data on abstracts and claims is shown in the official language in which it was submitted.

View or Download Images :

- Cover Page Image
- Abstract Image
- Claims Image
- Disclosures Image
- Drawings Image

The invention relates to a process for the manufacture of gases containing hydrogen and carbon monoxide by partial combustion of a free-carbon containing feed, where soot is removed from the gas stream and after being taken up in an auxiliary stream of hydrocarbon oil is re-circulated.

It is common practice to carry out the manufacture of gases containing hydrogen and carbon monoxide in an empty reaction chamber which is essentially cylinder-shaped. The oxygen required for the partial combustion is supplied as substantially pure oxygen or as air to which extra oxygen has been added. Air also can sometimes be used. Often steam is likewise added to the reaction mixture. The ratio by weight between steam and feed may vary considerably. The steam may either be mixed with the oxygen or be introduced together with the feed. The atomization of liquid feed may be promoted by the steam. Sometimes carbon dioxide also is added.

The pressure in the reaction chamber may vary from substantially atmospheric pressure to a pressure of 120 atm. The pressure preferably is chosen to have a value between 20 and 60 atm. The temperature may be 1200-1500°C, a value of approximately 1300°C being preferred.

The product always contains a certain quantity of soot which has to be removed from it. By a frequently employed method the soot-containing gas is first used as a source of heat in a steam generator, as a result of which the gas having a temperature of approximately 1300°C is cooled down to a temperature of, for instance, 250°C. This gas, which still contains soot, is now brought into direct contact with water. Then there is obtained a stream of gas from which soot is virtually absent and a stream of water in which the soot has been taken up.

The gas yield can now be increased by returning the soot to the feed. In that case it is essential, however, that the soot be first removed from the stream of water. A very suitable procedure is that by which the soot-containing stream of water is brought into contact with an auxiliary stream of hydrocarbon oil, owing to which the soot passes into that auxiliary stream. Often, a part of the feed is used as the auxiliary stream of hydrocarbon oil. To the auxiliary stream may be added, if necessary, a substance which is promotive to the soot particles being wetted by the auxiliary stream. The soot may form a suspension in that auxiliary stream. It is also possible for agglomerates to be



formed, which agglomerates, depending on the process employed for this purpose, may be obtained either in the form of hard or soft pellets or as a slurry-like substance. By a less common, but still feasible process, the soot-containing gas is brought into direct contact with the auxiliary stream of hydrocarbon oil without first bringing the soot-containing gas into direct contact with water.

One aims at the use of heavy free-carbon containing feed for the manufacture of the gas because in that case relatively cheap feedstocks are converted into very valuable gases that can be used as base materials for chemical syntheses or as a gaseous fuel. However, a heavy feed for the manufacture of gas has to be heated to a temperature that lies far above 100°C in order to obtain a low enough viscosity to enable that feed to be passed through a burner. This temperature is too high for using the feed as the auxiliary stream of hydrocarbon oil for the removal of soot from water, which removal is preferably effected at a temperature below 100°C in order to avoid the necessity of operating at a pressure higher than 1 kg/cm². However, below 100°C the viscosity of the heavy feed is so high as to preclude the use of this feed as auxiliary stream in which soot is to be taken up. This holds particularly for the agglomeration of soot by the auxiliary stream. In this agglomeration the viscosity of the auxiliary stream preferably should not exceed the value of 2000 cS.

The invention provides an elegant process by which a heavy free-carbon containing feed can be used for the manufacture of gas and by which the above indicated viscosity problems connected with the use of an auxiliary hydrocarbon oil stream are avoided.

According to the invention, for the manufacture of gases containing hydrogen and carbon monoxide by partial combustion of a carbon-containing feed, where soot is removed from the gas stream and after being taken up in an auxiliary stream of hydrocarbon oil is recirculated, the process of partial combustion is combined with a separating process for the manufacture of comparatively light hydrocarbons, primarily intended for a purpose other than the process of partial combustion, which separating process at the same time yields residual material, in such a manner that:

- (a) the soot-containing auxiliary stream is combined with an incoming main stream of hydrocarbon oil to form a mixed stream,

- (b) the mixed stream obtained according to (a) is used as feed for the separating process, by which at least one stream of comparatively light hydrocarbons and a stream of residual material are obtained,
- (c) the stream of residual material obtained according to (b) is used as feed for the process of partial combustion,
- (d) the auxiliary stream of hydrocarbon oil for taking up the soot consists of a hydrocarbon oil that is lighter than the residual material obtained according to (b).

By combining the process of partial combustion with a separating process for the manufacture of comparatively light hydrocarbons, the feed for that separation process, which is of course lighter than the residual stream obtained in that separation process, may advantageously be used as a source for the auxiliary stream of hydrocarbon oil for taking up the soot as explained hereinafter.

A great attendant advantage of the process of the invention is that the lighter auxiliary hydrocarbon oil mentioned under (d) remains entirely or substantially outside the gas preparation proper, since this oil in the separation according to (b) will join the light fraction, because the soot-containing auxiliary stream is combined according to (a) with the incoming main stream before the separation according to (b) is being carried out. In this way it is ensured that by an appropriate choice of the auxiliary hydrocarbon oil stream soot is taken up under optimum conditions without the heavy feed for the manufacture of the gas being mixed with the more expensive light auxiliary stream of hydrocarbon oil, while the soot enters the heavy feed for the gas manufacture.

Another great advantage is that the necessity of a separate process step with associated equipment for separating off the auxiliary stream of hydrocarbon oil is obviated, since by the process according to the invention the separating process for the incoming main stream is likewise used for this purpose.

A suitable auxiliary stream for taking up the soot is formed by a partial stream of the incoming main stream of hydrocarbon oil mentioned under (a). This oil is lighter than the residual material obtained according to (b). It is also possible to use as auxiliary stream a partial stream of the light fraction obtained according to (b) or to use a mixture of partial streams of the incoming main stream mentioned under (a) and the light fraction obtained according to (b).

The possibilities mentioned provide sufficient flexibility for composing an auxiliary stream possessing the desired properties as regards viscosity. An important advantage is that it is not necessary for an auxiliary stream to be obtained elsewhere. Furthermore, it is an important advantage that all constituents of the incoming main stream that are intended for the manufacture of gas are indeed used for that purpose, even when for the auxiliary stream a partial stream of the incoming main stream is used, which partial stream may, or may not, be mixed with a partial stream of the light fraction. Similarly, all the light constituents are kept outside the gas manufacture.

The use of a light fraction as auxiliary stream has the additional advantage that inorganic constituents are urged to the water phase more strongly than in the case of heavier material being employed, as a result of which the discharge of inorganic constituents is facilitated.

If a certain separating process that is suitable for the separation referred to under (b) yields more than two fractions, then for application in the process according to the invention separate fractions may be used or mixtures of fractions may be made, but always in such a manner that residual material is used as feed for the process of partial combustion and that the auxiliary stream is lighter than the residual material.

The combination according to (a) may be promoted by previous mixing of the soot-containing auxiliary stream with a partial stream of the incoming main stream of hydrocarbon oil mentioned under (a). It is also possible to do so by mixing the soot-containing auxiliary stream with a partial stream of the light fraction obtained according to (b), or by mixing with a mixture of partial streams of the incoming main stream mentioned under (a) and the light fraction obtained according to (b). If the soot-containing auxiliary stream has been obtained in the form of hard or soft pellets or as a slurry-like substance, then it is very desirable to combine the auxiliary stream with the incoming main stream by applying the mixing in the manner indicated hereinbefore.

For the purpose of this mixing additional measures may be taken, such as, for instance, crushing the pellets and dispersion of the fragments. The combination according to (a) can then be effected much more easily, owing to the lower viscosity. In addition, it is possible for water that may still be present in the agglomerates to be vaporized

by mixing of the auxiliary stream with a partial stream or partial streams, as indicated.

5 The separation referred to under (b) may be effected by flashing. For this purpose the mixed stream, having been preheated under pressure, is introduced into a chamber where the prevailing pressure is lower. Then a vapour fraction and a liquid fraction are formed, which yield, respectively, the light and the residual material. This separation may be carried out continuously. It is also possible to perform this separation in more than one stage. Flashing is frequently employed in oil refineries for the preparation of distilled products where it is not required to reach a high sharpness of separation, such as, for instance, the preparation of feed for a catalytic cracking process. This embodiment of the process according to the invention yields a combination which is attractive economically. It is also possible for the separation referred to under (b) to take place by distillation.

10 The separation referred to under (b) may also be performed by deasphaltizing or deasphaltenizing with the aid of a solvent. For this purpose the incoming stream, comprising for instance a long residue of a crude oil distillation, is treated with a solvent, such as propane. A large part of the oil dissolves in the solvent. After the separation a residue is left. By vaporization of the solvent a light fraction is obtained and after any solvent still present has been removed, the residue may be used as residual material according to (c). Depending on the composition of the incoming stream of hydrocarbon oil, on the solvent and on the conditions for the separating process, the composition of the residue may vary from a soft bitumen to dry asphaltenes in powder form. As a rule it is preferred that for the purpose of the process according to the invention the residue be kept in the liquid condition at, for instance, 350°C. Still suitable for this purpose is a hard bitumen or a concentrate of asphaltenes in oil. Naturally, when employing the process according to the invention the soot having been removed from the gas will likewise enter the residue. Deasphaltizing or deasphaltenizing with the aid of a solvent is also used for the preparation of feed for a catalytic cracking process. This embodiment of the process according to the invention likewise yields a combination that is attractive economically.

The separation referred to under (b) may also be effected by thermal cracking followed by distillation. For this purpose the incoming stream, comprising for instance a long residue of a crude oil distillation, is heated to 500-550°C, which results in light products being formed owing to heavy products being broken down. These can be separated by distillation, which leaves a residue that can be used as the residual material according to (c). The light fraction can be further processed, for instance to gasoline or to middle distillates. This embodiment of the process according to the invention likewise yields a combination that is attractive economically.

The invention will now be further elucidated with the aid of figures 1-3.

Figure 1 gives a diagram for the case where flashing is used.

Figure 2 gives a diagram for the case where deasphaltizing or deasphaltenizing with the aid of a solvent is used.

Figure 3 gives a diagram for the case where use is made of thermal cracking followed by distillation.

In Figure 1 item 1 represents the incoming main stream of hydrocarbon oil. After combination with a stream 2, to be discussed later, the mixed stream is passed through a furnace 3 and is subsequently introduced into a flasher 4. This yields a light fraction 5 as top product and a heavy fraction 6 as bottom product. The residual fraction 6 is introduced into a gasification reactor 7 with simultaneous introduction of oxygen 8. By 9 is indicated that a part of the residual fraction 6 is used, if necessary, for other purposes, such as, for instance, as fuel in another installation. This case will occur if the quantity of residual fraction 6 that becomes available is too large for the gasification reactor 7. The gas formed - 10 - which still contains soot is passed to a unit 11 where the gas is cooled with water 12 and washed. The gas 13 thus obtained is passed to a destination, for instance for chemical processing or combustion. Water with soot 14 is passed to a unit 15 where direct contact with an auxiliary stream of hydrocarbon oil is effected. The unit 15 may be an agglomeration apparatus. The auxiliary stream may be a partial stream 17 of the incoming stream 1. The auxiliary stream may also be a partial stream 18 of the light fraction 5 or a mixture of partial streams of the incoming main stream 1 and the light fraction 5. Soot-containing auxiliary stream 16 is

passed out of the unit 15. This stream may consist of an oil in which soot is dispersed, or of soft or even hard pellets. A stream 22 consisting of water and inorganic constituents leaves the unit 15. It is possible for stream 16, at any rate when it consists of pellets, to be
5 mixed in a unit 19 with a hydrocarbon oil until a suspension of carbon in oil is formed. The mixing can be done with a partial stream 20 of the incoming main stream 1, with a partial stream 21 of the light fraction 5 or with a mixture of partial streams of the incoming main stream 1 and the light fraction 5. The stream 2 thus formed is combined with the incoming
10 main stream 1. The soot that has been taken up is thus passed to the flasher 4 and, when leaving this flasher, enters the heavy fraction 6. Light hydrocarbons, having been introduced into the units 15 and 19, will leave the flasher 4 together with the light fraction 5.

In Figure 2 item 23 represents the incoming main stream of hydrocarbon oil. After combination with a stream 24, to be discussed later, the mixed stream is introduced into a deasphaltenizing unit 25. A stream of solvent 26 effects a separation into a solution 27 of light fraction in the solvent and a residue 28. In unit 29 solvent being carried along with the residue 28 is separated off, so that a residual fraction 30 and
20 a stream of solvent 31 are formed. In unit 32 solvent is separated from stream 27, so that a light fraction 33 is formed as well as a stream of solvent 26 also containing the solvent from stream 31. Thus the solvent is being recirculated. The residual fraction 30 is introduced into a gasification reactor 34 with simultaneous introduction of oxygen 35. By
25 36 is indicated that a part of the residual fraction 30 is used, if necessary, for other purposes, for instance as fuel in another plant, if the quantity of residual fraction that becomes available is too large for the gasification reactor 34. The explanation given in relation to items 10-22 in Figure 1 likewise holds for the streams and units denoted
30 by items 37-49, respectively. The presence of the stream of solvent 26 may be used to advantage by passing a partial stream 50 of this stream to the partial streams 47 and 44 if, by doing so, those properties of those partial streams that are of importance for taking up soot are improved.

35 In Figure 3 item 51 represents the incoming main stream of hydrocarbon oil. After combination with a stream 52, to be discussed later, the mixed stream is passed through a thermal cracking plant 53 and is

subsequently introduced into a fractionating column 54. In this column a stream of cracking gas 55, light fractions 56 and 57 and a residue 58 are obtained by distillation. More than two light fractions may be obtained. The residue 58 may be suitable for introduction into the gasification reactor 59 without any pretreatment. Sometimes it may be desirable for the residue to be first passed to a flasher 60 where another light fraction 61 is obtained. The residue 62 then obtained is passed to the gasification reactor 59. By the valves 63, 64 and 65 it is indicated that the use of the flasher 60 is optional. By 66 and 67 it is indicated that a part of the residual fraction may be used, if necessary, for other purposes, for instance as fuel for another plant if the quantity of heavy fuel that becomes available is too large for the gasification reactor 59. With oxygen (68), gas 69 is formed. The explanation given in relation to items 10-22 in Figure 1 likewise holds for the streams and units denoted by items 69-81, respectively. The partial streams 77 and 80 may be derived from the light fractions 56, 57 and 61 separately or may be composed from those light fractions by mixing.

Sometimes it may be advantageous for the soot-containing stream 52 to bypass the thermal cracking plant 53, because in that plant the soot is not subjected to any further change. The soot-containing stream may be combined with the product stream from the cracking plant or may be introduced separately into the fractionating column 54. By the valves 82, 83, 84 and 85 it is indicated which route is chosen for the soot-containing stream. However, the soot will always enter the residue of the fractionating column 54 and, hence, enter the gasification reactor 59.

C L A I M S

1. A process for the manufacture of gases containing hydrogen and carbon monoxide by partial combustion of a carbon-containing feed, where soot is removed from the gas stream and after being taken up in an auxiliary stream of hydrocarbon oil is recirculated, in which the process of partial combustion is combined with a separating process for the manufacture of comparatively light hydrocarbons primarily intended for a purpose other than the process of partial combustion which separating process at the same time yields residual material, in such a manner that:

- (a) the soot-containing auxiliary stream is combined with an incoming main stream of hydrocarbon oil to form a mixed stream,
- (b) the mixed stream obtained according to (a) is used as feed for the separating process, by which at least one stream of comparatively light hydrocarbons and a stream of residual material are obtained,
- (c) the stream of residual material obtained according to (b) is used as feed for the process of partial combustion,
- (d) the auxiliary stream of hydrocarbon oil for taking up the soot consists of a hydrocarbon oil that is lighter than the residual material obtained according to (b).

2. A process according to claim 1, in which process the auxiliary stream mentioned under 1-(d) consists of a partial stream of the incoming main stream of hydrocarbon oil mentioned under 1-(a).

3. A process according to claim 1, in which process the auxiliary stream mentioned under 1-(d) consists of a partial stream of the stream of the stream of comparatively light hydrocarbons obtained according to 1-(b).

4. A process according to claim 1, in which process the auxiliary stream mentioned under 1-(d) consists of a mixture of partial streams of the incoming main stream of hydrocarbon oil mentioned under 1-(a) and the stream of comparatively light hydrocarbons obtained according to 1-(b).

5. A process according to claim 2, 3 or 4, in which process, previously to effecting the combination mentioned under 1-(a), the soot-containing auxiliary stream is mixed with a partial stream of the incoming main stream of hydrocarbon oil mentioned under 1-(a).
6. A process according to claim 2, 3 or 4, in which process, previously to effecting the combination mentioned under 1-(a), the soot-containing auxiliary stream is mixed with a partial stream of the stream of comparatively light hydrocarbons obtained according to 1-(b).
7. A process according to claim 2, 3 or 4, in which process, previously to effecting the combination mentioned under 1-(a), the soot-containing auxiliary stream is mixed with a mixture of partial streams of the incoming main stream of hydrocarbon oil mentioned under 1-(a) and the stream of light hydrocarbons obtained to 1-(b).
8. A process according to claim 2, 3 or 4, in which process the separation mentioned under 1-(b) is effected by flashing.
9. A process according to claim 2, 3 or 4, in which process the separation mentioned under 1-(b) is effected by deasphaltizing or deasphaltenizing with the aid of a solvent.
10. A process according to claim 2, 3 or 4, in which process the separation mentioned under 1-(b) is effected by thermal cracking followed by distillation.



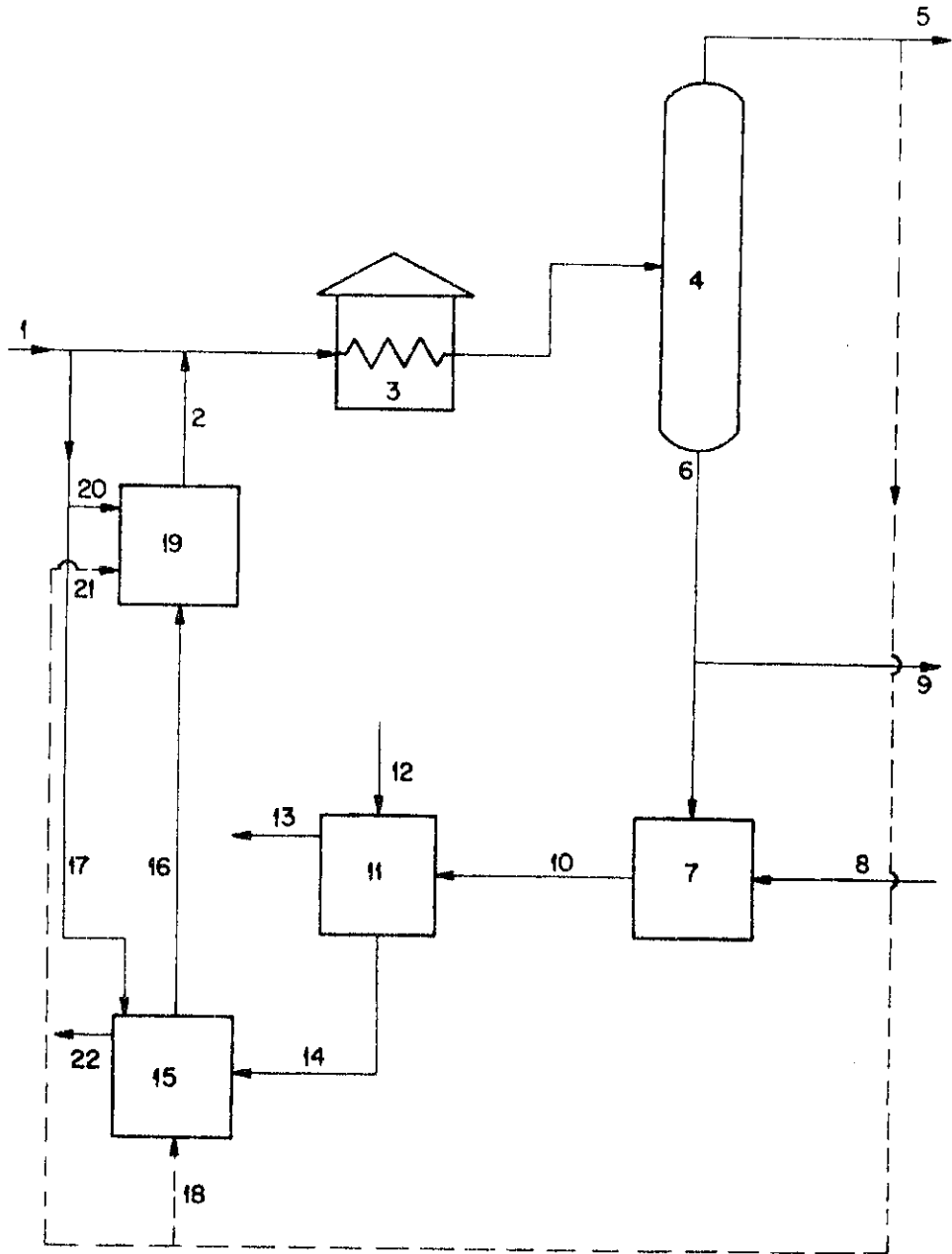


FIG. 1

INVENTOR
J. W. Reman

PATENT AGENTS
Smart & Biggar

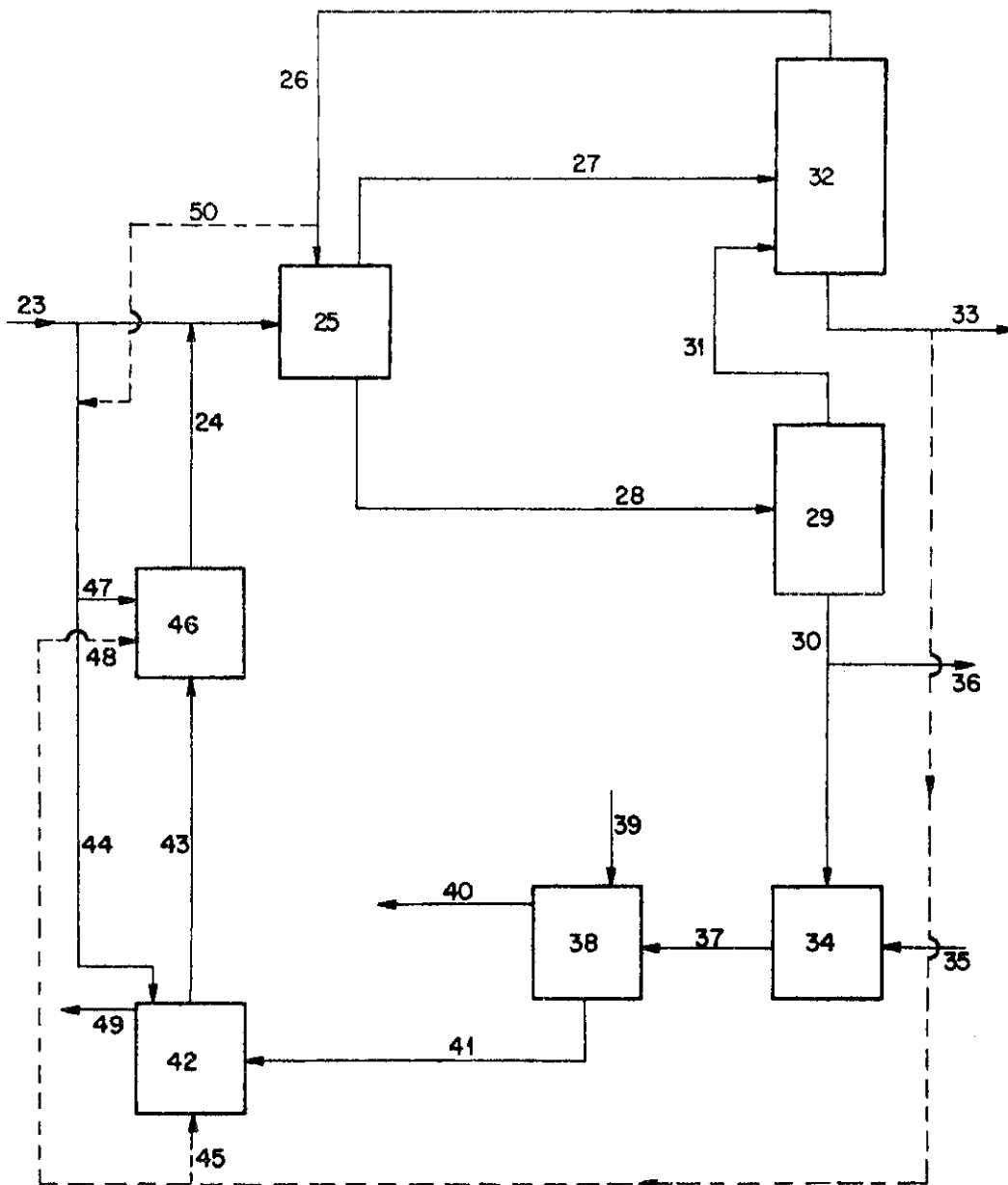


FIG. 2

INVENTOR

G. W. Reman

PATENT AGENTS

Smart & Biggar

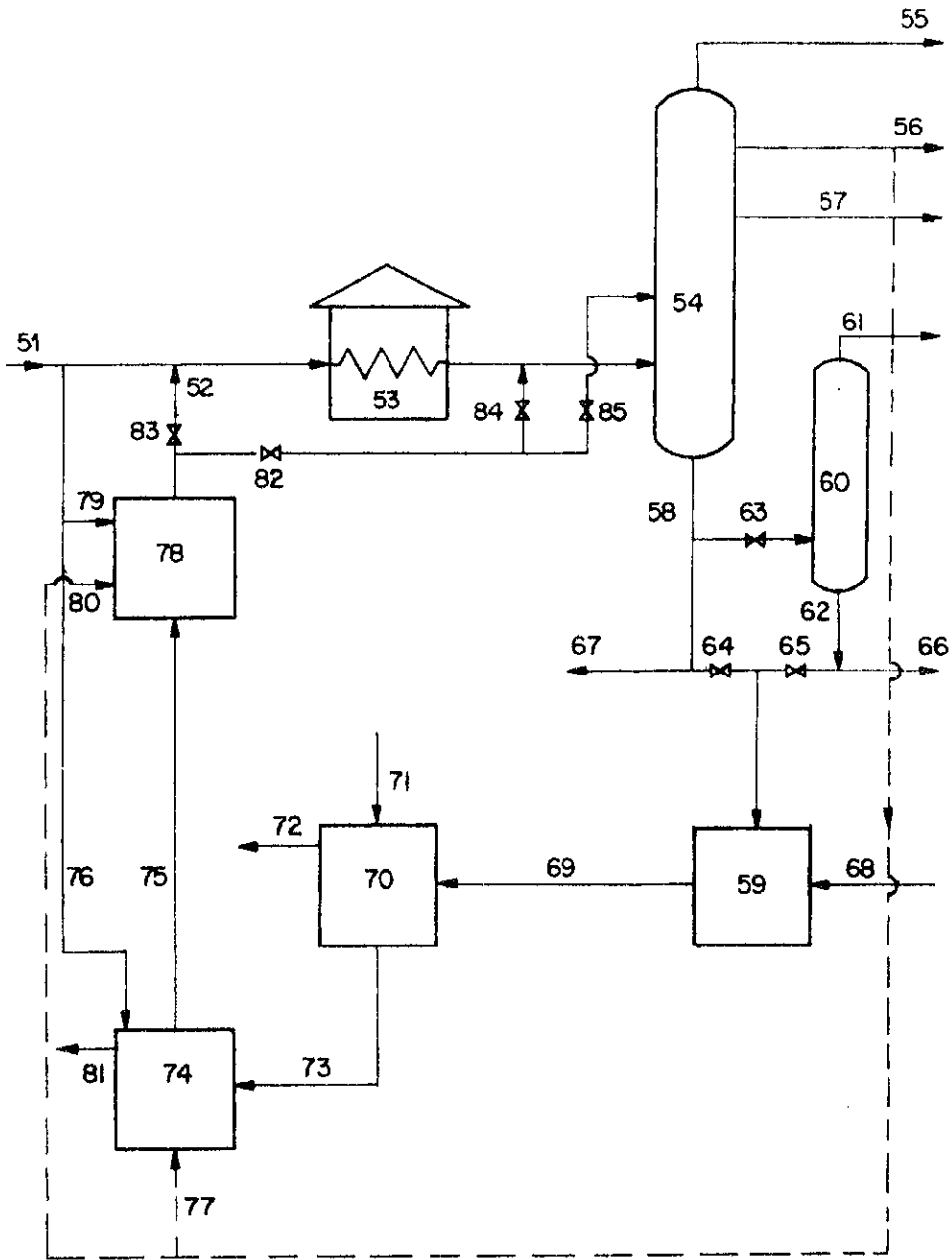


FIG. 3

INVENTOR

J. V. Roman

PATENT AGENTS

Smart & Biggar