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(54) Titre : PROCEDES DE SEPARATION UTILISANT DES COLONNES DIVISEES  
(54) Title: SEPARATION PROCESSES USING DIVIDED COLUMNS

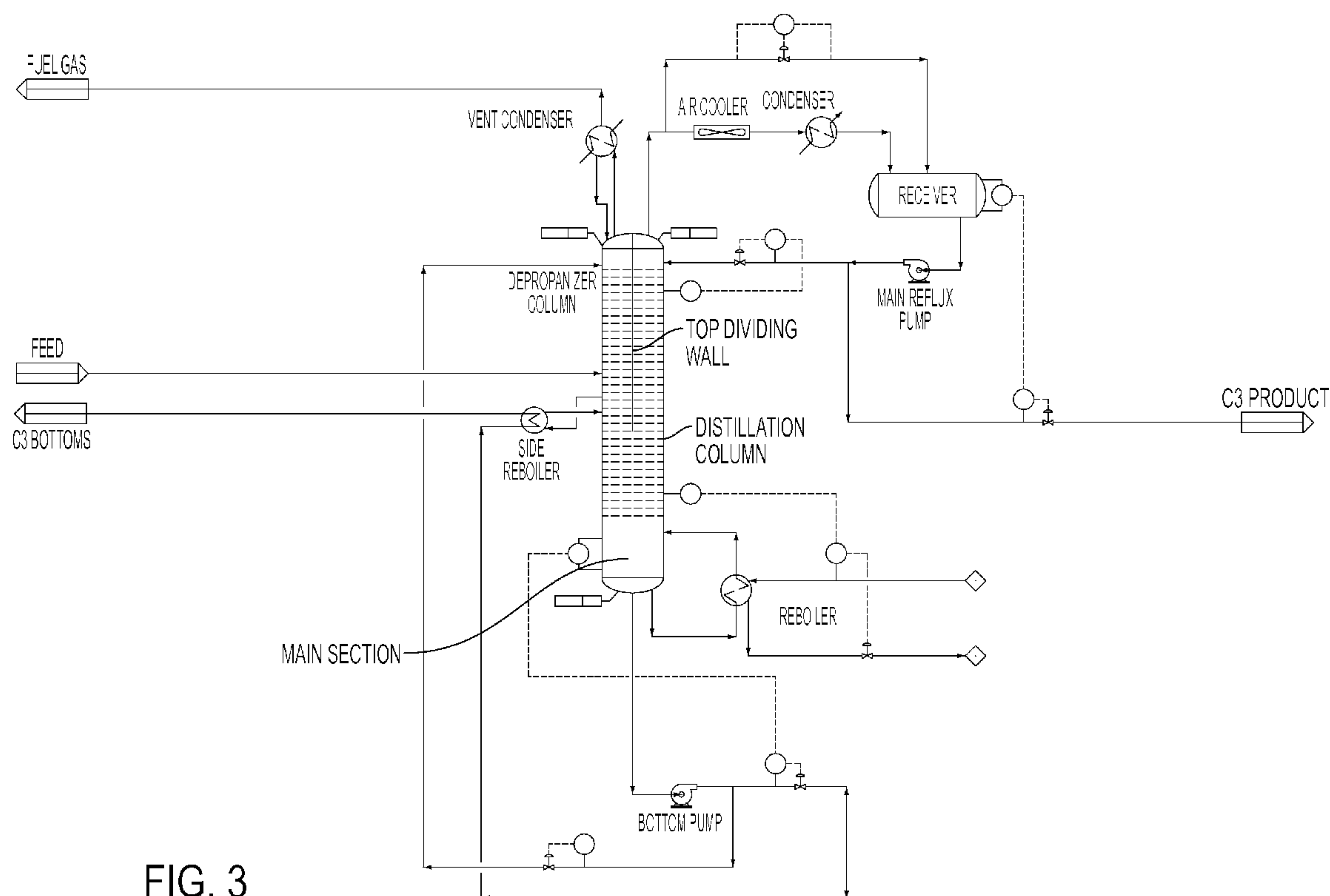


FIG. 3

(57) **Abrégé/Abstract:**

The claimed invention provides a technique wherein the two column system is combined into a single column. The light components are concentrated on the prefractionation side (feed side) of the column, where they are removed as an overhead top product. The middle boiling components are removed as an overhead product on the opposite side of dividing wall. For the same product specifications, top divided column requires substantially lower capital and operating cost than a conventional two-column system.

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(54) Title: SEPARATION PROCESSES USING DIVIDED COLUMNS

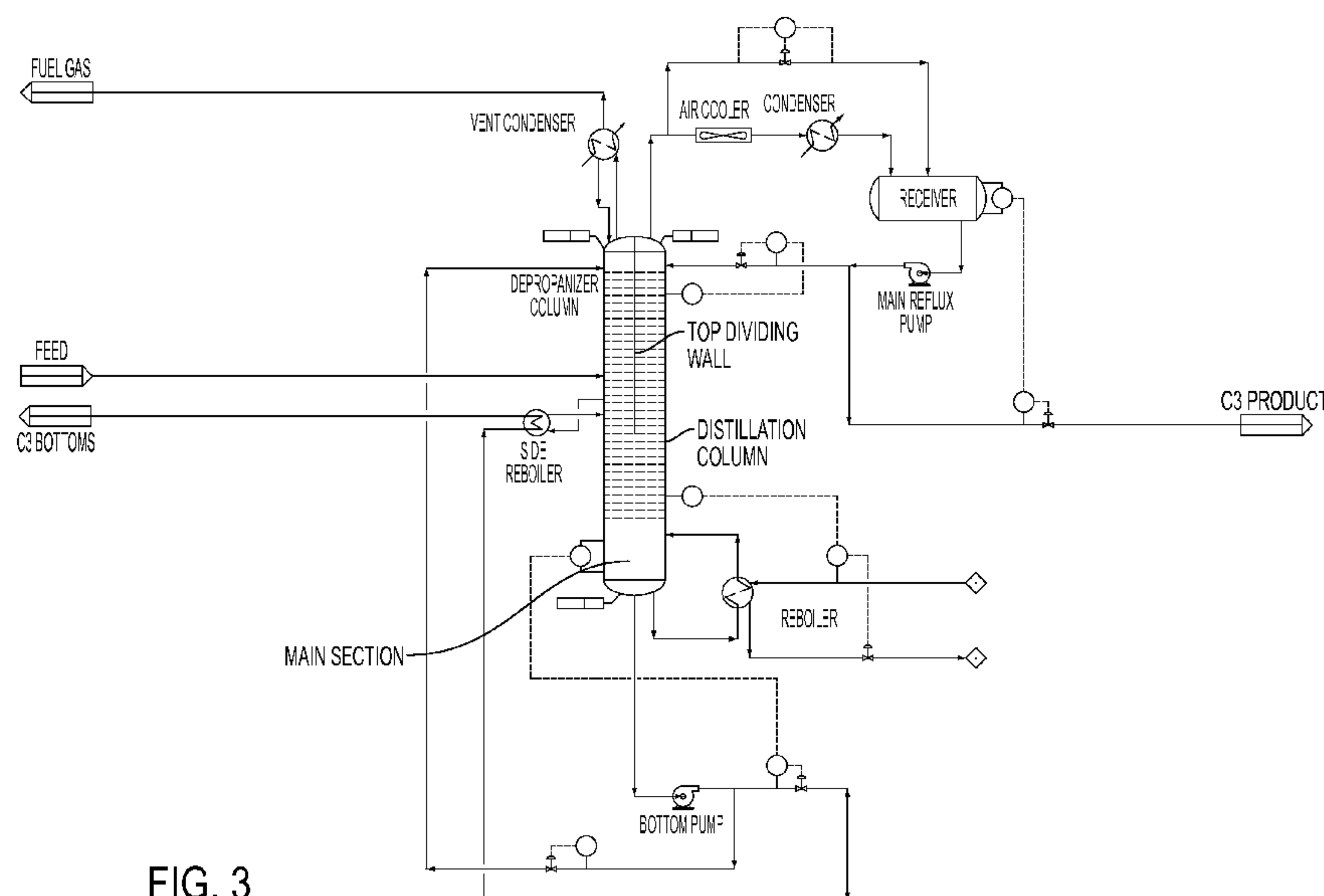


FIG. 3

(57) **Abstract:** The claimed invention provides a technique wherein the two column system is combined into a single column. The light components are concentrated on the prefractionation side (feed side) of the column, where they are removed as an overhead top product. The middle boiling components are removed as an overhead product on the opposite side of dividing wall. For the same product specifications, top divided column requires substantially lower capital and operating cost than a conventional two-column system.

## Separation Processes Using Divided Columns

### CROSS-REFERENCES TO RELATED APPLICATIONS

[0001] This Application claims the benefit under 35 U.S.C. § 119(e) of U.S. Provisional Patent Application Ser. No. 61/767,434 filed February 21, 2013, which is  
5 incorporated herein by reference in its entirety as if fully set forth herein.

### FIELD OF THE INVENTION

[0002] The claimed invention (Top Dividing Wall Column Depropanizer or TDWC) provides an innovative technique wherein the two column system is combined into a single column. The light components are concentrated on the prefractionation side (feed side) of the  
10 column, where they are removed as an overhead top product. The middle boiling components are removed as an overhead product on the opposite side of dividing wall. For the same product specifications, TDWC requires substantially lower capital and operating cost than a conventional two-column system.

### BACKGROUND OF THE INVENTION

15 [0003] Distillation and absorption are very common separation techniques used in the process industries. Both techniques require a large amount of energy due to the heating and cooling involved in the process. These techniques were mostly designed more than a decade ago when the economic, political and societal scenarios were different. It would be desirable to reduce the energy cost in the interest of economy as well as society.

20 [0004] There are complex separation configurations available that offer substantial reduction in energy and capital expenditures. These options include dividing wall columns. Dividing wall columns are normally used in distillation processes. FIG. 1 represents the prior art. The column operates at 390 psig with an overhead temperature of 95°F. This conventional depropanizer aims at separating C<sub>2</sub>/C<sub>3</sub> components as an overhead product and  
25 C<sub>4</sub>/C<sub>4+</sub> components as the bottoms product of the column.

[0005] However, the prior art possesses several disadvantages. It is not possible to condense the lighter components in the overhead product at 350 psig and using cooling water as the overhead cooling media. The overhead system has a partial condenser. C<sub>2</sub> and lighter components (used as fuel gas) are drawn as the vapor product from the partial condenser. C<sub>3</sub>



product is the liquid stream from the partial condenser. A considerable amount of  $C_3$  components are lost to the fuel gas vapor stream. The loss of  $C_3$  components can be prevented by decreasing the overhead temperature (e.g., by using refrigeration) or increasing the column pressure. However, this increases the operating cost of the column. Although the prior art systems offers a sharp split between  $C_3$  and  $C_{3+}$ , the recoveries of these components is low as they are lost in the fuel gas vapor stream.

[0006] FIG. 2 represents alternative prior art. This process uses a two column design. The first column is a reboiled absorber which aims at separating non-condensed products from the feed. The non condensables (used as fuel gas) are the overhead vapor product from this column. The bottoms from the first column are fed to the second column.  $C_3$  product is withdrawn as an overhead product in the second column and  $C_4/C_{4+}$  is withdrawn as the bottoms product. Although, this prior art system offers high  $C_3/C_{3+}$  recoveries. The disadvantage is higher capital expenditure and higher energy consumption.

[0007] Thus, it would be desirable to have a system that overcomes the disadvantages of the prior art systems.

### SUMMARY OF THE INVENTION

[0008] An embodiment of the invention is directed to a process wherein two different unit operations (absorption and distillation) take place on either side of a top dividing wall column. In an embodiment of the invention, the top divided column is used as a depropanizer that recovers  $C_3$  components from fuel gas.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1 represents a prior art separation process in accordance with an embodiment of the invention;

[00010] FIG. 2 represents a dual column separation process in accordance with an embodiment of the invention; and

[00011] FIG. 3 represents a process scheme in accordance with an embodiment of the invention.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[00012] An embodiment of the invention is directed to a process wherein two different unit operations (absorption and distillation) take place on either side of a top dividing wall column.

5 [00013] The innovation is explained through an example, a conventional depropanizing system

[00014] The claimed invention provides an innovative technique wherein a two column system used in a distillation set up is combined into a single column. In certain embodiments of the invention, the light components are concentrated on the prefractionation  
10 side (feed side) of the column, where they are removed as an overhead top product. The middle boiling components are removed as an overhead product on the opposite side of dividing wall. Thus, for the same product specifications, the top divided wall column of the claimed invention requires substantially lower capital and operating cost than a conventional two-column system.

15 [00015] A working representation of the claimed invention is set forth in FIG. 3. A distillation column having a top dividing wall is shown. The top divided column has a feed side that is located on one side of the dividing wall and a product side on the opposite side of the dividing wall. The bottom portion of the top divided column i.e., the opposite side of the top divided column is the main section.

20 [00016] In an embodiment of the invention, the process scheme of the claimed invention is designed to separate  $C_2$  (Non condensables),  $C_3$  (intermediate component),  $C_{3+}$  (Heavies) in a single top divided column. The feed stream is first sent to the pre-fractionation side of the top divided column. The vertical dividing wall splits the top portion of the column into two halves. The feed side of the wall is called the pre-fractionation section. The non-  
25 condensables (used as fuel gas) is removed as overhead vapor product from a vent condenser. In certain embodiments of the invention, the column overhead pressure is set at 350 psig via a pressure controller on the overhead fuel gas product line. The section above the feed acts as an absorption section that is primarily used to minimize the loss of  $C_3$  components. The pre-fractionation side has reflux coming from two sources: A liquid stream condensed from a  
30 vent condenser; and a heavy stream from a bottoms pump.



[00017] In an embodiment of the invention, the vapor from the overhead of the main section is condensed and cooled to 95°F in air-cooled exchanger followed by the water-cooled condenser. The condenser outlet is collected in an overhead receiver. The C<sub>3</sub> light liquid is pumped out of the drum via reflux pumps. A portion of the light liquid is sent back to the column as reflux and the remainder is withdrawn as C<sub>3</sub> product.

[00018] In an embodiment of the invention, the operating pressure of the column is controlled by a pressure control loop installed on the non-condensable line going to the fuel gas header, while the pressure in the overhead received is controlled by a hot by-pass pressure control loop.

[00019] In an embodiment of the invention, the temperature in top section of the main column is controlled in cascade with the reflux flow control loop. This allows control over the quality of the C<sub>3</sub> product by suppressing the tendency of the heavier components from going to the top of the column.

[00020] In an embodiment of the invention, the reboiler connected to the main section is a thermosyphon steam reboiler that uses steam as heating medium. The heat input to the reboiler is regulated by controlling the steam flow cascaded to the column bottom tray temperature controller.

[00021] The C<sub>3</sub> bottom product is controlled by a level control loop in cascade with the bottom product flow rate.

[00022] Overall aspects of the invention relate to methods for increasing the energy efficiency of a distillation process using a top divided column. Those having skill in the art, with the knowledge gained from the present disclosure, will recognize that various changes could be made to the methods disclosed herein without departing from the scope of the present invention. Mechanisms used to explain theoretical or observed phenomena or results, shall be interpreted as illustrative only and not limiting in any way the scope of the appended claims.

CLAIMS

What is claimed is:

1. A distillation column comprising a wall in a top section of the column having two condensers and a side reboiler
- 5 2. The distillation column of claim 1, wherein the two condensers are a partial condenser and a total condenser.
3. The distillation column of claim 1, wherein the column has been used as a depropanizer that recovers C<sub>3</sub> components from fuel gas.
- 10 4. The distillation column of claim 1, wherein the column has a feed side or prefractionation side and a main side.
5. The distillation column of claim 4 wherein the feed side acts as a reboiled absorber, which separates non condensables from C<sub>3</sub>.
6. The distillation column of claim 4 wherein the prefractionation side contains an absorption solvent.
- 15 7. The distillation column of claim 6 wherein a portion of the absorption solvent is sent back to the column as reflux and the remainder is withdrawn as C<sub>3</sub> product.
8. The distillation column of claim 7 wherein the reflux helps in reducing the C<sub>3</sub> loss to the fuel gas.
- 20 9. The distillation column of claim 1 wherein the side reboiler is used in the prefractionation side of distillation column.
10. The distillation column of claim 9 wherein the heating medium of the side reboiler is the column bottoms.

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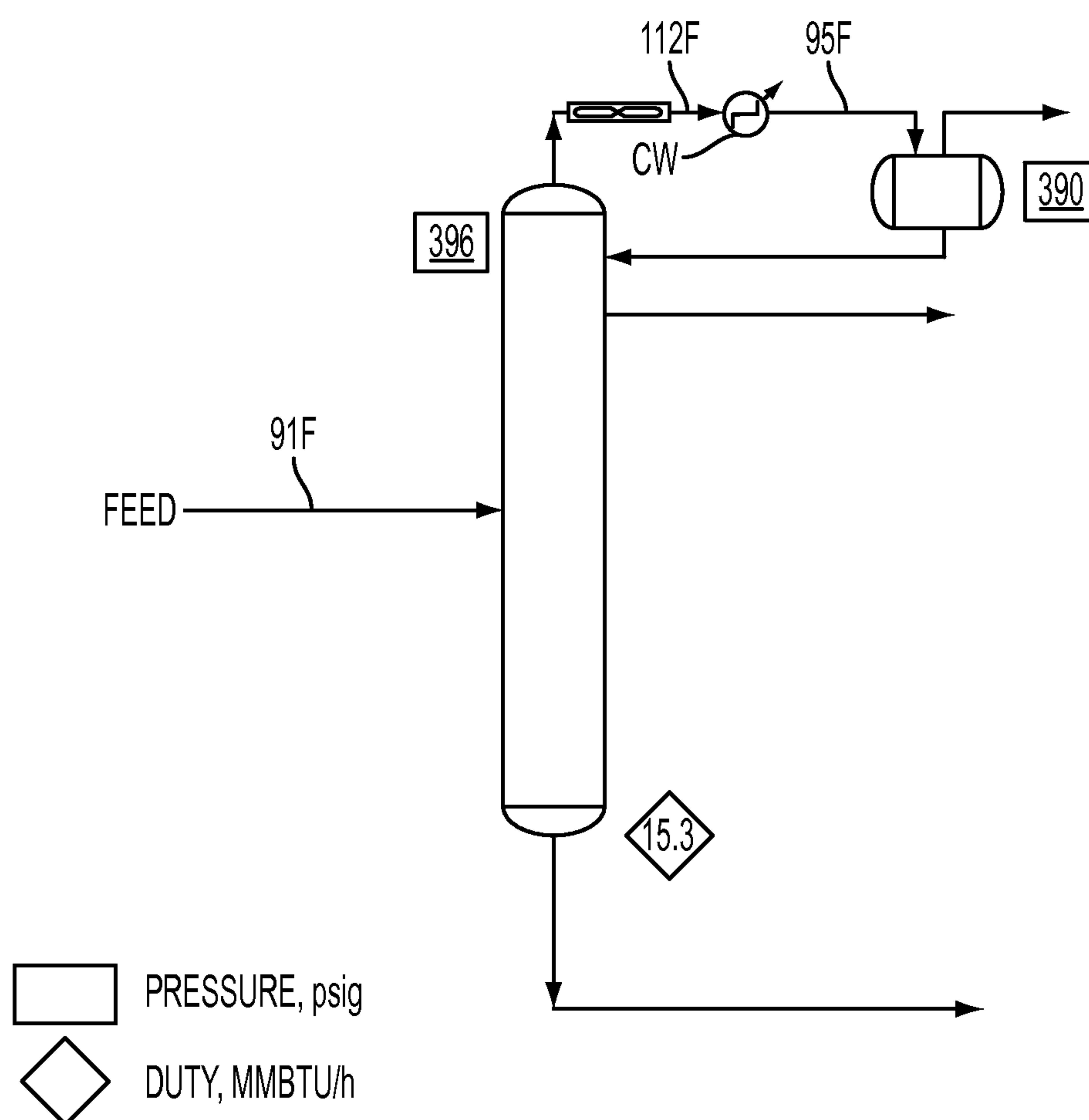


FIG. 1  
PRIOR ART



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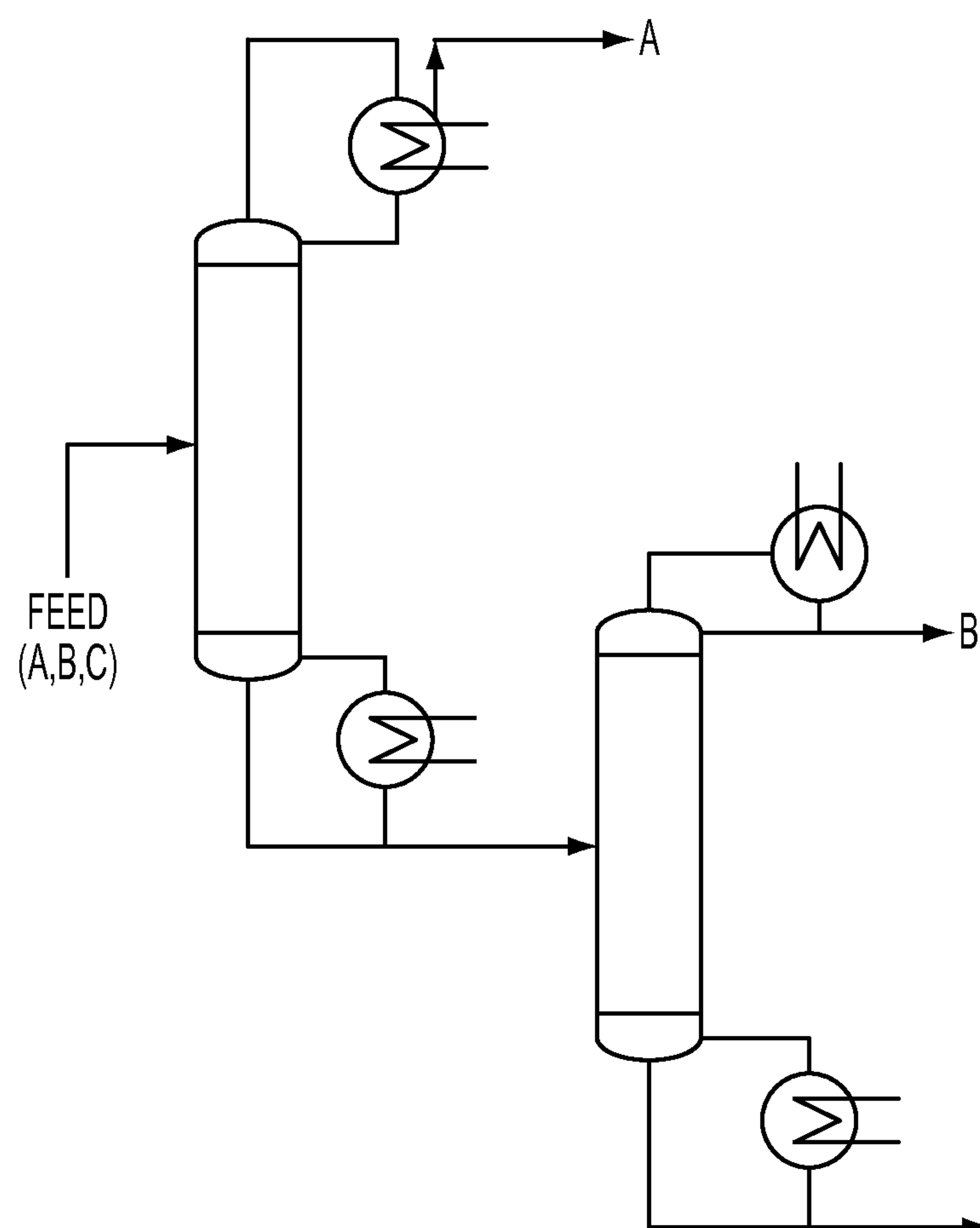


FIG. 2  
PRIOR ART

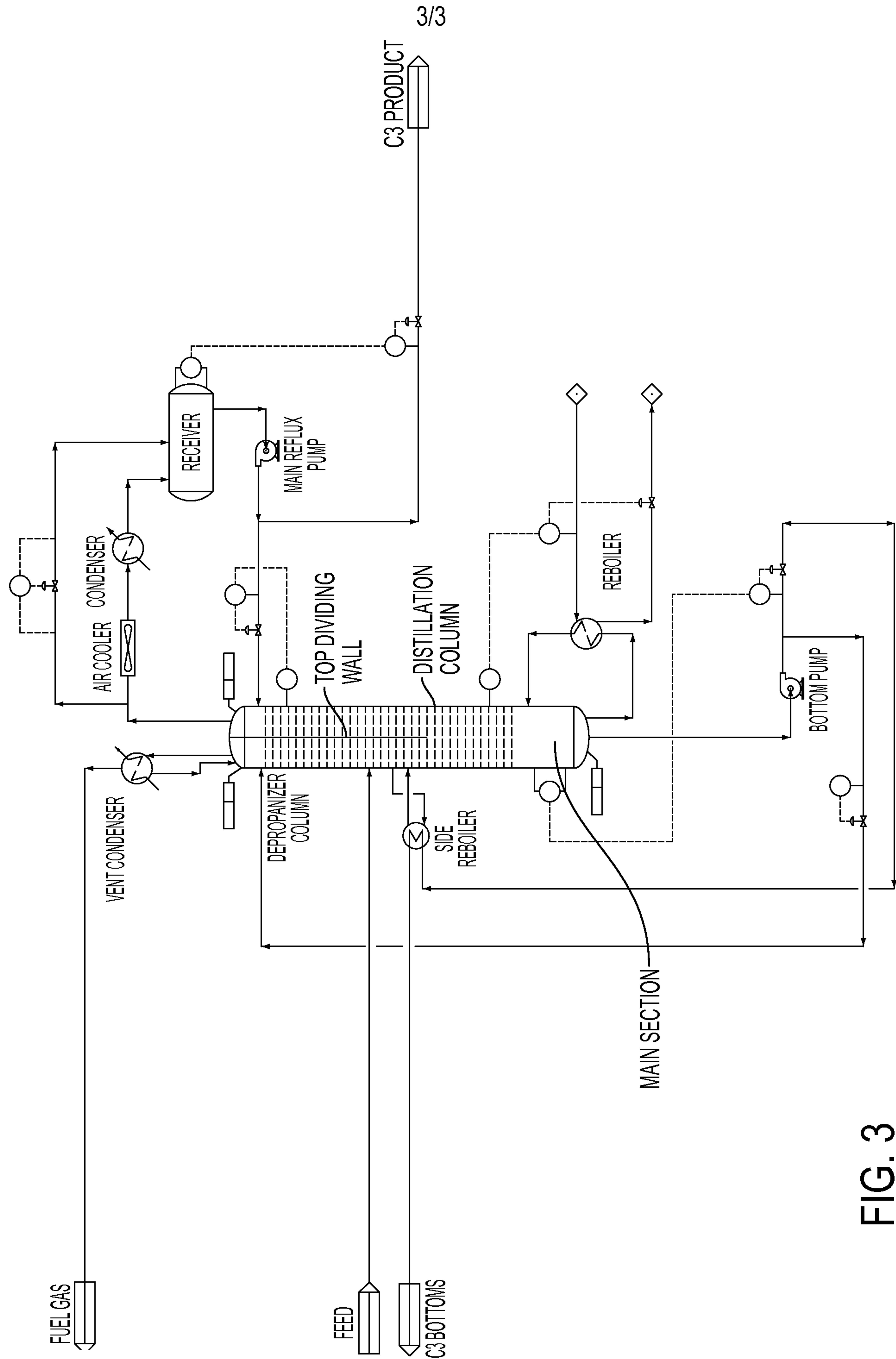


FIG. 3

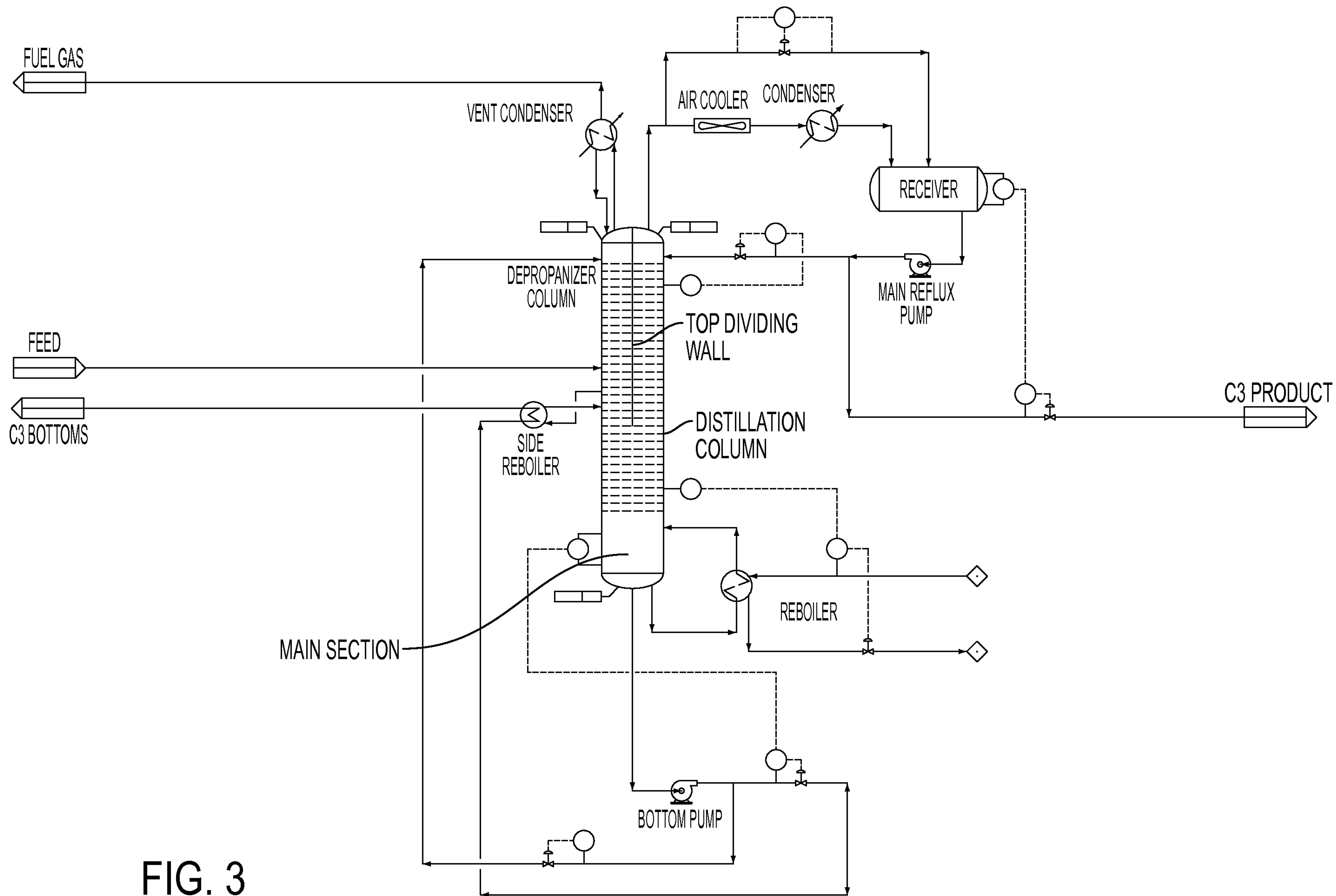


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