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FRACTIONATION CONTROL METHOD

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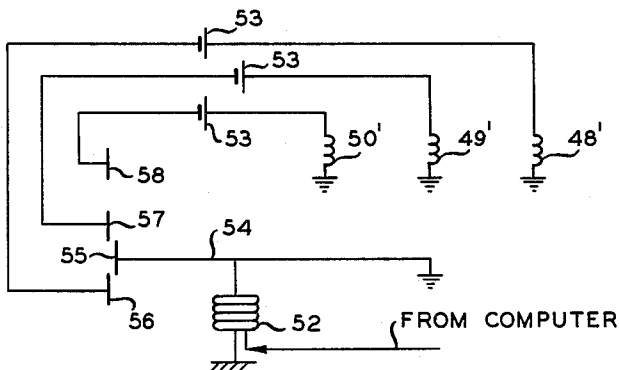
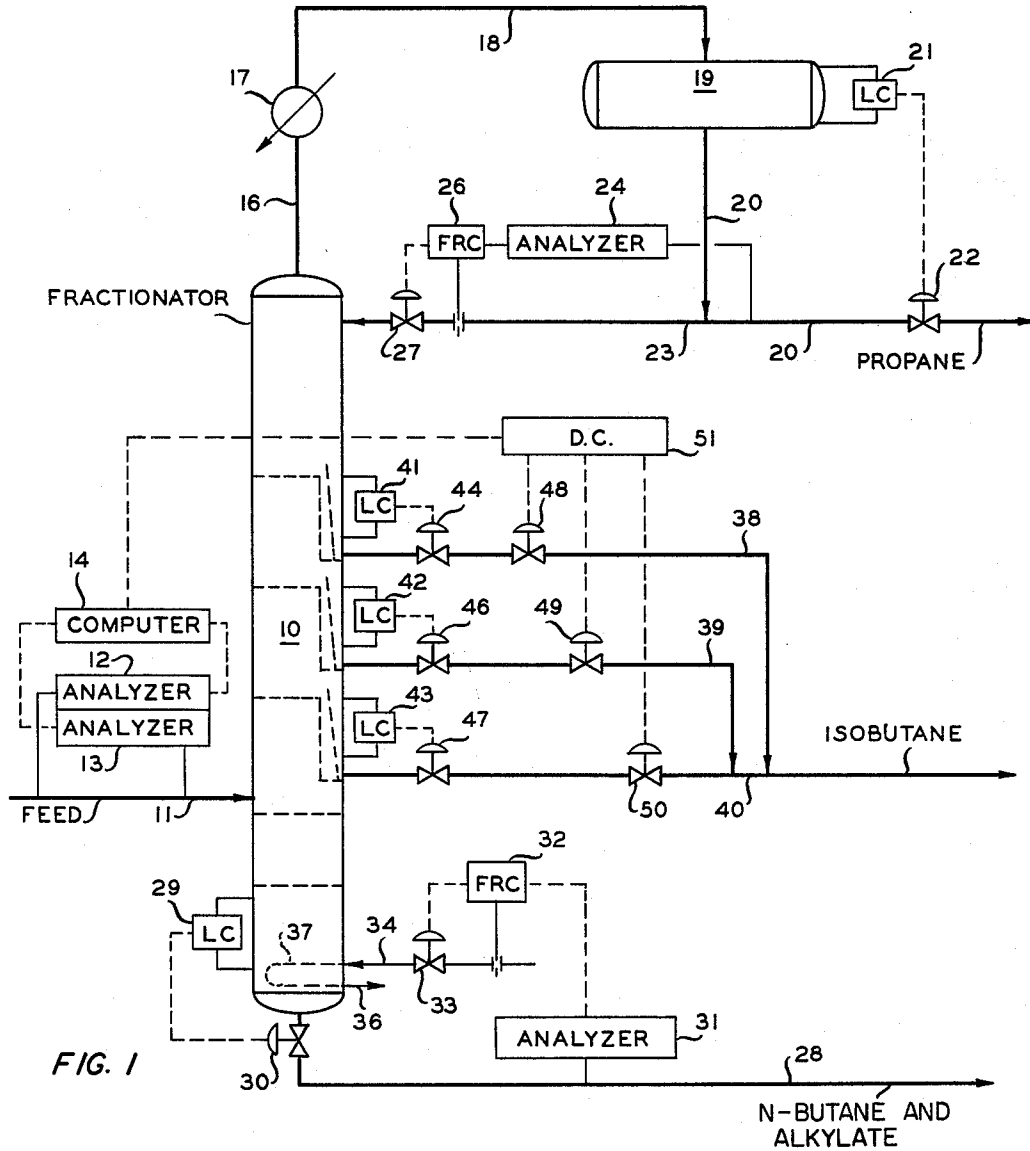


FIG. 2

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FRACTIONATION CONTROL METHOD

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5 Claims. (Cl. 203—40)

This invention relates to a fractionation control method. In another aspect, this invention relates to a method of controlling a fractionation process wherein three product fractions are obtained.

Fractionation processes are effectively employed to separate feed mixtures into two product fractions of high purity wherein each of the product fractions has a significantly different volatility. However, when it becomes desirous to separate a feed mixture into three product fractions employing a single fractionation zone, high purity fractions can be readily recovered from the top and bottom of the vertical fractionation zone but the product purity of a third fraction withdrawn from an intermediate region of the fractionation zone is difficult to control. The separation is particularly difficult when the ratios among the three fractions in the feed mixture are subject to change.

For example, in the separation of a hydrocarbon effluent withdrawn from an alkylation zone, the hydrocarbon effluent is passed to a fractionator. A propane fraction is withdrawn from the top of the fractionator and an alkylate fraction is withdrawn from the bottom of the fractionator. An isobutane fraction is withdrawn from an intermediate region of the fractionator and recycled to the alkylation zone. Excessive normal butane or propane in this isobutane fraction loads up the fractionator and the alkylation zone with "inerts," backing out fresh feed to the alkylation zone and thereby decreasing alkylate production. With the ratio of normal butane (recovered from the fractionation zone with the alkylate fraction) to isobutane in the feed to the fractionator subject to change, it becomes difficult to obtain an isobutane product fraction from the fractionator suitable as a recycle feed to the alkylation zone.

Accordingly, an object of my invention is to provide a fractionation control method.

Another object of my invention is to provide a fractionation control method for the separation of a feed mixture into three product fractions.

Another object of my invention is to provide an improved process for separating a hydrocarbon alkylation zone effluent mixture.

Other objects, advantages and features of my invention will be readily apparent to those skilled in the art from the following description, the drawing and the appended claims.

Broadly, my invention comprises passing a feed mixture to a fractionation zone, withdrawing a first fraction from the upper region of said fractionation zone, withdrawing a second fraction from the lower region of said fractionation zone, withdrawing a third fraction from an intermediate region of said fractionation zone, measuring a property of said feed mixture representative of the composition thereof, and manipulating the position of the third fraction withdrawn point within said intermediate zone responsive to said measurement.

In the drawing:

FIGURE 1 is a schematic representation of one embodiment of my invention.

FIGURE 2 schematically represents a decision circuit that can be employed in the process of FIGURE 1.

The invention will hereinafter be described as applied to the separation of an alkylation zone hydrocarbon effluent mixture into three product fractions, although it

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is not intended that the invention should be limited thereto.

Referring to FIGURE 1, an alkylation zone hydrocarbon effluent mixture comprising alkylate, normal butane, isobutane, propane, and lighter hydrocarbons is passed via conduit means 11 to fractionator 10. A conventional analyzer 12 such as a chromatographic analyzer is employed to measure a property of the fluid stream flowing through conduit 11 representative of the concentration of normal butane in the feed mixture. A second analyzer 13 is employed to measure a property of the fluid feed mixture flowing through conduit 11 representative of the concentration of isobutane in the feed mixture. Analyzer 12 transmits a signal to computer 14 representative of the concentration of normal butane in the feed mixture and analyzer 13 transmits a signal to computer 14 representative of the concentration of isobutane in the feed mixture. Although, as herein illustrated, two analyzers are employed, it is within the scope of the invention to employ a single analyzer and, by proper known programming and data read-out methods, transmit signals to computer 14 through suitable signal transducing means such as a conventional electrical to pneumatic relay, not herein illustrated, representative of the concentration of normal butane and isobutane in the feed mixture.

Computer 14 is an instrument, such as a Sorteberg force bridge, which is capable of dividing one input variable or signal by another input variable or signal and providing an output signal responsive thereto. Computer 14 divides the input signal received from analyzer 12 by the input signal received from analyzer 13 to thus provide an output signal representative of the gas volume or mol ratio of normal butane to isobutane in the feed mixture passed to fractionator 10.

An overhead vaporous fraction is withdrawn from fractionator 10 via conduit means 16. The vaporous fraction is condensed by means of a heat exchange means 17 and the condensed fraction passed via conduit means 18 to an accumulator 19. A liquid propane-rich fraction is withdrawn from accumulator 19 via conduit means 20. The rate of propane withdrawal is controlled by a conventional liquid level controller 21 opening and closing valve 22 responsive to the liquid level within accumulator 19.

A portion of the liquid in accumulator 19 is recycled via conduit means 20 and 23 to the top of fractionator 10. The rate of reflux is controlled by a conventional flow-recorder-controller 26 opening and closing valve means 27 responsive to the rate of flow measurement in conduit 23 and a set point signal received from analyzer-controller 24. Analyzer-controller 24 measures a property of the product propane stream representative of the composition thereof and transmits a set point signal responsive to said measurement to flow-recorder-controller 26 so as to effectively control the product purity of the product propane fraction.

A bottoms fraction comprising normal butane and alkylate is withdrawn from fractionator 10 via conduit means 28. The rate of bottoms fraction product withdrawal is controlled by a conventional liquid level controller 29 opening and closing valve 30 responsive to a liquid level measurement within fractionator 10.

The heat input to fractionator 10 is controlled by heat exchange means 37 positioned in the lower region of fractionator 10. A heating medium is passed to heat exchange means 37 via conduit means 34 and withdrawn from heat exchange means 37 via conduit means 36. The rate of flow of heating medium to heat exchange means 37 is controlled by a conventional flow-recorder-controller 32 opening and closing valve 33 responsive to a rate of flow measurement in conduit 34 and a set point signal received from analyzer-controller 31. Analyzer-controller 31 measures a property of the fluid

flowing through conduit 28 representative of the composition thereof and transmits a set point signal representative of said composition to flow-recorder-controller 32. Analyzer 31 by measuring a property of the fluid flowing through conduit 28 representative of the isobutane concentration therein and transmitting a signal representative of said concentration can thus control the product purity of the bottoms fraction, holding to a desired level the concentration of isobutane in the bottoms fraction, by manipulating the flow of heat to fractionator 10.

I have discovered that by manipulating the vertical position of the withdrawal conduit within the intermediate zone of fractionator 10 from whence an isobutane product is withdrawn responsive to the feed composition, that an isobutane product fraction of controlled purity and maximum yield can be obtained. As illustrated, three isobutane fraction drawoff points are employed. It is within the scope of this invention to employ additional side draw outlets if desired. Each of the side draw outlets is so positioned as to provide for the withdrawal of a liquid fraction from a different fractionator tray positioned within fractionator 10. Although as herein illustrated, fractionator 10 contains fractionating trays, it is within the scope of this invention to employ other fractionating column packing materials such as Raschig rings and to provide multiple liquid side draw outlets positioned at different levels in the intermediate zone.

The rate of isobutane product withdrawal from fractionator 10 via conduit means 38, 39 and 40 is controlled by liquid level controllers 41, 42 and 43, respectively, opening and closing valves 44, 46 and 47, respectively.

Decision circuit 51 selects the particular conduit and fractionator withdrawal zone through which the isobutane product fraction is withdrawn by transmitting signals to valves 48, 49 and 50, completely opening or closing the valves responsive to a signal received from computer 14. Only one of the valves 48, 49 and 50 is open at any one time, the remaining two valves being closed.

A decision circuit capable of performing the required functions is illustrated in FIGURE 2. In this figure, bellows 52 receives a pneumatic pressure signal from computer 14 representative of the normal butane to isobutane ratio. Bellows 52 moves upwardly as the pressure within the bellows increases, moving arm 54 and brush 55 upwardly. Brush 55 rides upon commutator segments 56, 57 and 58. Each commutator segment is connected through a source of current 53 to solenoids 48', 49' and 50'. These solenoids operate the previously mentioned valves 48, 49 and 50.

An increase in the normal butane to isobutane ratio in the feed stream passed to fractionator 10 results in the automatic selection through decision circuit 51 of a side draw higher up in fractionator 10. Conversely, a decrease in the normal butane to isobutane ratio in the feed mixture passed to fractionator 10 results in the automatic selection through decision circuit 51 of a side draw lower in the fractionator 10.

With an alkylation zone hydrocarbon effluent feed to fractionator 10, fractionator 10 can be operated at a

top temperature in the range of 100–150° F., a bottom temperature in the range of 250–400° F., a top pressure in the range of 180–350 p.s.i.a. and a bottom pressure in the range of 190–360 p.s.i.a.

Although the invention has herein been illustrated as applied to an alkylation zone effluent mixture, the invention is broadly applicable to the separation by fractionation of a feed mixture into three product fractions, a first overhead fraction, a second bottom fraction, and an intermediate third fraction.

Various modifications of this invention can be made, or followed, in view of the foregoing disclosure, without departing from the spirit or scope thereof.

I claim:

1. A process which comprises passing a feed mixture to a fractionation zone, withdrawing a first fraction from the upper region of said fractionation zone, withdrawing a second fraction from the lower region of said fractionation zone, withdrawing a third fraction from an intermediate region of said fractionation zone, measuring a property of said feed mixture representative of the composition thereof, and manipulating the vertical position of the third fraction withdrawal zone within said intermediate zone responsive to said measurement.

2. The process of claim 1 wherein said feed mixture comprises a hydrocarbon effluent mixture from an alkylation zone, said first fraction is a propane-rich fraction, said second fraction is an alkylate fraction containing normal butane, and said third fraction is an isobutane fraction.

3. The process of claim 2 wherein said process variable comprises the normal butane to isobutane ratio.

4. A process which comprises passing a feed mixture to a fractionation zone, withdrawing a first vaporous fraction from the upper region of said fractionation zone, condensing said vaporous fraction, measuring a property of said condensed vaporous fraction representative of the composition thereof, recycling at least a portion of said condensed vaporous fraction to the upper region of said fractionation zone responsive to said measurement, withdrawing a second liquid fraction from the lower region of said fractionation zone, withdrawing a third fraction from an intermediate region of said fractionation zone, measuring a property of said feed mixture representative of the composition thereof, and manipulating the vertical position of the third fraction withdrawal zone within said intermediate zone responsive to said feed mixture measurement.

5. The process of claim 4 to include measuring a property of said second fraction representative of the composition thereof, and manipulating the heat input to said fractionation zone responsive to said second fraction measurement.

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