feed streams that produce gas / liquid mixtures when pressure of the feed stream is reduced to that of the column. One example utilizes a chamber where the flashing takes place. In a second example, a circular channel along the walls of the column has been provided and the feed is directed above and into that channel. Both examples are being applied to columns with small diameter.

Some specific examples where the above described conditions concerning flashing feed streams are particularly prevalent are in oil refineries and petrochemical plants; particularly in atmospheric and pressure distillation columns, and specifically in the vacuum distillation columns. More generally, a specific location in some vacuum distillation columns is the reboiler return to the column, where the gas/liquid mixture is introduced to the column from a reboiler, where the reboiler serves as vaporization means.

One of ordinary skill in the art will recognize that the above described conditions and associated problems are present to at least some degree in all contacting devices where a flashing feed is present in the system.

SUMMARY OF THE INVENTION

In accordance with a first aspect of the present invention, there is provided a contacting column section comprising; a feed inlet configured to contain a feed at a first pressure which is substantially liquid, a section of the column configured to be operated at a second pressure different from the first pressure, and a feed flow path device located inside the section of the column and coupled to the feed inlet, the feed flow path device configured to receive feed from the feed inlet and said feed flow path device having a series of openings for the feed to enter the section of the column, each opening having an opening area, wherein the opening area of each of the series of openings is such that the substantially liquid feed flow, as it flows through all of the series of openings, simultaneously vaporizes and is in choked condition.

In accordance with a second aspect of the present invention, there is provided a method of operating a contacting column section comprising the steps of, feeding a feed which is substantially liquid to the contacting column via a feed inlet at a first pressure, and operating a section of the contacting column at a second pressure, causing the feed to enter the contacting column, from the feed inlet, through a series of openings in at least one feed flow path device, and causing the substantially liquid feed to simultaneously vaporize and be in choked condition as it enters the contacting column through a series of openings due to a selected opening area of each of the series of openings.

Some embodiments~~An object~~ of the present invention may~~is to~~ facilitate the introduction and distribution of a flashing feed stream to a contacting device column.

Some embodiments of the present invention may~~It is an object to~~ provide a feed distribution device which substantially prevents the flashing of the feed stream until it exists the feed distribution device by maintaining the pressure of the feed stream high enough. The maintaining of the pressure is achieved by arranging holes with sufficient pressure drop to the said feed distribution device in which the flashing or vaporization takes place. More specifically, the flashing of the feed stream substantially occurs when the stream flows through the holes and the flow through the holes is in choked (or critical) conditions.

Some embodiments~~Additionally, it is an object~~ of the present invention may~~to~~ provide a feed distribution device which can be used to distribute the gas produced by flashing of the feed more evenly along the cross-sectional area of a separation section above the feed location compared to the distribution with no or other feed distribution devices.

Some embodimentsAn additional object of the present invention mayis, alone or in conjunction with distributing the feed more evenly, to use the feed distribution device to reduce the maximum magnitude of local velocity of at least a portion of the gas flashed from the feed as it is introduced to a separation section above the feed location.

Some embodimentsA further object of the present invention mayis to facilitate ideal mixing of the gas produced by flashing of a feed uniformly with gas coming from a separation section below the feed inlet section.

The objects of the present invention are achieved by the apparatus and method which is described in more detail below.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig 1 is a schematic of a distillation column.
Fig 2A is a top-down view of a section of a column with a feed distribution device including a chimney tray.
Fig 2B is a side-view representation of the section in Fig 2A.
Fig 3A is a top-down view of a section of a column with a feed distribution devices located in a lower section of a contacting column.
Fig 3B is a side-view representation of the section in Fig 3A.

DETAILED DESCRIPTION OF EXEMPARY EMBODIEMENTS

There are numerous types and variations of contacting device columns. Some of the standard contacting device columns are distillation columns, stripping columns and absorption columns. In addition to columns with a single purpose, many contacting columns are combinations of two or more standard processes (i.e. distillation and absorption). Further, there are categories such as packed columns and vacuum columns. One of ordinary skill in the art will recognize the applicability for the present invention in all of the types and variations of contacting devices enumerated above in addition to those not specifically enumerated but art recognized, where such flashing feed conditions have at least the potential to exist.

CLAIMS

1. A contacting column section comprising;

- a feed inlet ~~capable of containing~~configured to contain a feed at a first pressure which is ~~at least partially~~ substantially liquid,
- a section of the column configured to be operated at a second pressure different from the first pressure, and
- ~~C H A R A C T E R I Z E D by,~~
- a feed flow path device located inside the section of the column and coupled to the feed inlet, the feed flow path device configured to receive feed from the feed inlet and said feed flow path device having a series of openings for the feed to enter the section of the column, each ~~of the~~ openings having an opening area ~~selected to cause feed flow through the opening to be in choked condition and simultaneously to at least partially vaporize~~,
- wherein the opening area of each of the series of openings is such that the substantially liquid feed flow, as it flows through all of the series of openings, simultaneously vaporizes and is in choked condition.

2. The~~A~~ contacting column section according to claim 1, wherein there is a separation section above, below or above and below the contacting column section and the separation section is for separation, distillation, heat transfer, extraction, wash operation or absorption.

3. ~~A~~The contacting column section according to claim 1 or 2, wherein the feed flow path device comprises two or more feed flow paths organized in series or in parallel or both parallel and series.

~~4. A contacting column section according to claims 1 to 3, wherein the feed flow is divided into at least two feed flow parts and each feed flow part is introduced via its own feed inlet and feed flow path device.~~

~~5.~~4. ~~A~~The contacting column section according to any one of the previous claims further comprising:~~;~~

- at least one additional feed inlet, each additional feed inlet ~~containing~~ configured to contain a second feed which is liquid or at least partially liquid at a certain pressure, and

——each additional feed inlet is coupled to its own feed flow path device having a series of openings for the feed to enter the section of the column, each opening having an opening area.~~is compositionally different from the said feed of any of the previous claims~~

– ~~wherein each additional feed inlet is coupled to its own feed flow path device as characterized in claim 1 and in any of the previous claims~~

– wherein the opening area of each opening is configured so that the feed flow, as it flows through all of the series of openings, simultaneously both vaporizes partially or totally and is in choked condition.

~~6.~~ 5. ~~A~~The contacting column section according to any one of the claims 1 to 43 further comprising;

——at least one additional feed inlet, each additional feed inlet configured to contain a second feed which is liquid or at least partially liquid at a certain pressure~~containing feed which is liquid or at least partially liquid at a certain pressure~~, and

– ~~each additional feed is compositionally different from the said feed of any of the claims 1 to 4~~

– wherein each additional feed inlet is coupled to the feed flow path device ~~belonging to feed inlet as characterized in claim 1 and in any of the claims 1 to 4~~.

~~7.~~ 6. ~~A~~The contacting column section according to claim ~~5~~ 4 further comprising;

– at least one additional feed inlet, each additional feed inlet configured to contain an additional feed which is liquid or at least partially liquid at a certain pressure~~containing feed which is liquid or at least partially liquid at a certain pressure~~, and

~~– each additional feed is compositionally different from the said feed of any of the previous claims~~

– wherein each additional feed inlet is coupled to at least one of the feed flow path devices as defined in claim 4 ~~as defined and characterized in claim 5~~.

~~8.~~ 7. ~~A~~ The contacting column section according to any one of the previous claims, further comprising,

– a liquid collecting device located at least partially below a feed flow path device ~~capable of~~ and configured to redirect~~ing~~ ~~the~~a liquid portion of the feed entering the column section

–

– wherein the liquid collecting device is a chimney tray, vane collector or similar device with at least one of the purpose being of collecting liquid.

~~9.~~ 8. ~~A~~ The contacting column section according to claim 87, wherein the liquid collecting device is conformed to the feed flow path of the feed flow path device and is configured to redirect~~s~~ at least a portion of a gas stream from below the liquid collecting device to a point above the feed flow path device.

~~10. A contacting column section according to either claim 8 or 9, wherein the liquid collecting device design and feed flow path device design is based on computational fluid dynamics calculations.~~

~~11. A contacting column section according to any of the preceding claims, wherein the total opening area of all openings of the feed flow path device is selected so that flow though each and every of the openings is in choked condition.~~

~~12. A contacting column section comprising;~~

~~a feed inlet containing a feed at a first pressure which is liquid or at least partially liquid, and~~

~~a section of the column operated at a second pressure,~~

~~C H A R A C T E R I Z E D by,~~

~~– a feed flow path device located inside the section of the column and coupled to the feed inlet, the feed flow path device containing feed from the feed inlet and having a series of openings for the feed to enter the section of the column, each opening having an opening area, and~~

~~– a difference between the first and second pressure,~~

~~wherein the feed flow as it flows through all of the openings simultaneously both vaporizes partially or totally or vaporizes more and is in choked condition.~~

~~13.~~ 9. A method of operating a contacting column section comprising the steps of,

– feeding a feed which is substantially liquid ~~or at least partially liquid~~ to the contacting column via a feed inlet at a first pressure, and

– operating a section of the contacting column at a second pressure,

– causing the feed to enter the contacting column, from the feed inlet, through a series of openings in at least one feed flow path device, and

~~C H A R A C T E R I Z E D by,~~

~~–~~causing the substantially liquid feed to simultaneously vaporize and be in choked condition as it enters the contacting column~~, from the feed inlet,~~ through ~~a feed flow path device having~~ a series of openings~~,~~

– ~~wherein the feed flow as it flows through the openings is in choked condition~~ due to a selected opening area of each of the series of openings.

~~14.~~ 10. ~~A~~ The method of operating a contacting column according to claim ~~9~~13, wherein the feed flow path device comprises two circular pipe arcs, each of said two circular pipe arcs comprising a series of openings each opening having an opening area, wherein the opening area of each opening, and the total number of openings, is configured so that the feed flow, as it flows through all of the series of openings, simultaneously both vaporizes partially or totally and is ~~through each and every opening is~~ in choked condition.

~~15.~~ 11. ~~A~~The method of operating a contacting column according to claim ~~13 or 14~~9, ~~wherein the contacting column section is the contacting column section according to any one of claims 1 to 12.~~further comprising:

– redirecting a liquid portion of the feed via a liquid collecting device located at least partially below the feed flow path device, and

- redirecting at least a portion of a gas stream from below the liquid collecting device to a point above the feed flow path device.

12. The method of operating a contacting column according to claim 9, wherein the feed through each and every opening is in choked condition.

13. The method of operating a contacting column according to claim 9, wherein the feed flow path device comprises two or more feed flow paths organized in series of in parallel or both series and parallel.

14. The method of operating a contacting column according to claim 9, wherein the contacting column further comprises:

- at least one additional feed inlet, each additional feed inlet configured to contain a second feed which is liquid or at least partially liquid at a certain pressure,
- wherein each additional feed inlet is coupled to its own feed flow path device having a series of openings for the feed to enter the section of the column, each opening having an opening area, and
- wherein the opening area of each opening is configured so that the feed flow, as it flows through all of the series of openings, simultaneously both vaporizes partially or totally and is in choked condition.

15. The method of operating a contacting column according to claim 9, wherein the contacting column is a distillation column, stripping column or absorption column.