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Description

This invention relates to a cyclone separator for separating a denser component of a mixture of liquids from a less dense component thereof, said separator being of the kind having an axially extending separating chamber having towards one end inlet means for admission of the mixture with a tangential flow component, the separating chamber having an axially positioned overflow outlet adjacent said one end and said separating chamber being of generally tapered form with a relatively larger cross-sectional size at said one end and a relatively small cross sectional size at an axially positioned underflow outlet at the end of the separating chamber opposite said one end, wherein in use the denser component is directed to the underflow outlet in a fashion such as to encompass an inner axially positioned core of the less dense component which is subjected at least over a substantial part of its length to a pressure differential causing it to flow to the overflow outlet. Such a cyclone separator is described, for example in AU—B—521 482 (& US—A—4 237 006).

In accordance with EP—A—02030650, which is a prior application only, a cyclone separator as above described is characterised in that said inlet means is defined by a portion of the separating chamber and at least one inlet tract communicating with said portion, said portion being that portion of the separating chamber which is at the same lengthwise position as the or each that said inlet means is defined by a portion of the separating chamber and at least one inlet tract of involute form communicating with said portion, said portion being that portion of the separating chamber which is at the same lengthwise position as the or each inlet tract, and the or each said tract being of a profiled configuration and defined by vectors T and U.

It has been found that the outer profile of a cyclone separator according to a EP—A—0203065 is more important than the inner profile.

According to the invention the or each inlet tract presents inner and outer profiles, when viewed axially of the separator, the outer profile extending from a first location at which it meets the circumference of the aforementioned portion of the separating chamber and at least the inward projection of said inner profile extending from a second location at which the inner profile or its said projection meets said circumference, the outer profile being characterised in that a first vector T describing the location of any particular point on said outer profile and contained in a plane normal to said axis, and having its origin at said first location, is such that at the origin an angle O between the vector T and that tangent to said circumference which passes through said first location lies within the range of from—0.1 to O radians and, as the magnitude of vector T increases, never decreases substantially, at least for all values of T less than ηD, where ηD is as hereinafter defined, the cross-sectional area of the inlet perpendicular to the flow direction contracting in the direction of flow.

In a preferred form of separator the inner profile is characterised by a second vector U, describing the location of any particular point on the inner profile and having its point of origin at said second location is such that an angle L between vector U and that tangent to said circumference which passes through said second location is never less than—0.52 radian and, as the magnitude of vector U increases, never decreases substantially at least for all values of vector U less than αD, where αD is as hereinafter defined.

It has been found that with profiled inlets in accordance with this invention, it is not necessary to provide more than one inlet opening.

Preferably an end wall of the separating chamber, through which said overflow outlet communicates with the separating chamber, is formed of curved configuration such as being concave or convex when viewed in axial section.

The overflow outlet is also preferably in the form of a duct which extends through an end wall of the separating chamber and projects into the separating chamber.

The invention is further described by way of example only with reference to the accompanying drawings, in which:

Figure 1 is a cross-sectional diagram of a separator constructed in accordance with the invention;

Figure 2 is a cross-section substantially on the line 2—2 in Figure 1;

Figures 3 and 4 illustrate alternative forms of an end wall of the separating chamber of Figure 1;

Figure 5 shows an alternative form of the overflow outlet for the separator of Figure 1;

Figure 6 is a detailed axial cross-sectional view of the inlet means of a separator constructed in accordance with the invention;

Figure 7 is a diagram like Figure 6 but showing preferred inlet tract profiles; and

Figure 8 is a fragmentary axial diagram of a modified inlet tract.

The separator 10 comprises a separating chamber 12 having three coaxially arranged separating chamber portions 14, 16, 18. These are of diameters and lengths d_1, 1_1; d_2, 1_2; and d_3, 1_3 respectively. Portion 14 is of greater diameter than portion 16 and portion 18 is of lesser diameter than portion 16. A tapered section 17 may be provided between portions 14 and 16. Although the portion 16 shown exhibits a first section of parallel sided form followed by a tapered section, in practice, it is possible to form a portion 16 as having a constant taper over its length.

An involute inlet pipe 20 is provided to the separating chamber portion 14, this opening onto a side wall of the separating chamber at an inlet opening 23. An overflow outlet 25 is provided on the axis of the separating chamber portion 14, this leading to an axial overflow pipe 27. As shown in Figure 2, the involute

inlet pipe 20 spirals around the periphery of the separating chamber portion 14 and exhibits a gradually decreasing cross-sectional area as it approaches the opening 23. The pipe 20 and opening 23 may be of rectangular cross-section.

In use, the separator 10 functions generally in accordance with past practice in that the fluid mixture admitted into the separating chamber via the inlet pipe 20 is subjected to centrifugal action causing the separated liquid components to be ejected, on the one hand from the outlet 24 and on the other through the outlet 25. Thus, the denser phase material flows to the underflow outlet 24 in an annular cross-sectioned flow around the wall of the separating chamber whilst the lighter phase forms a central core 40 which is subjected to differential pressure action driving the fluid therein out through the overflow outlet 25.

It has been found that using an involute shaped pipe 20, it is possible to use only a single opening 23, whereas in the past multiple inlet openings have been provided. These led to the disadvantage that, particularly where banks of separators are to be assembled together, the assembled installation is of relatively great complexity. Accordingly, by having only a single inlet pipe, the number of pipe connections that need to be made is decreased. Further a, it has been found that the involute shaped pipe 20 facilitates the separating action since incoming liquid mixture is already subjected to some separating action under centrifugal action as it spirals into the separating chamber 14.

The separating chamber 12 is constructed somewhat in accordance with the teachings of patent specification AU—A—47105/79. In that specification the separating chamber is described as having the following dimensional relationships:

$$10 \leqslant 1_2/d_2 \leqslant 25$$

$$0.04 \leqslant 4A_i/d_1^2 \leqslant 0.10$$

$$0.1 \leqslant d_o/d_2 \leqslant 0.25$$

$$d_1 > d_2$$

$$d_2 > d_3$$

where A_1 is the cross-sectional area of the feed inlet, provided by inlet opening 23, d_o is the diameter of the overflow outlet 25 and the remaining terms have the meanings ascribed to above. Also, in the specification of Patent Application AU—A—84713/82 a variant construction is described having parameters as above described save for the ratio d_0/d_2 which is specified in that case to be less than 0.1. Separators constructed in accordance with this variant form may also be adapted for use in the present invention. Generally, in any event the separator of this invention may advantageously be characterised by having the ratio $1_2/d_2$ at least equal to 10. Also, for separators intended for separating relatively small quantities of less dense liquid, such as oil, from relatively larger quantities of more dense liquid such as water, the ratio d_1/d_2 may be in the range 1.5 to 3.0, such as 2.0.

However, it has been found in practice that it is not necessary to adhere to the range of overflow outlet dimensions described above.

Referring now to Figure 6 an inlet profile of the invention is shown in more detail. Here, the inlet means of the separator is shown as comprising an inlet tract 80 together with a portion of the separating chamber of the separator which is lengthwise adjacent thereto. In this regard, generally, although the separator shown in Figure 1 is described as having three distinct portions of successively decreasing diameters, it is not essential that the separator be so formed as it could, for example, exhibit any generally tapered configuration extending from a larger diameter end adjacent the overflow outlet to a smaller cross-section end adjacent the underflow outlet. The tract 80 is shown as having an outer profile 82 and an inner profile 84. Here, the diameter D of the cyclone separator as shown in Figure 6 corresponds to the diameter d_1 in Figure 1, since the inlet tract 80 (as in the case of the Figure 1 construction) communicates with separating chamber at the larger diameter end thereof.

The tract 80 is considered as extending from a location indicated generally by reference numeral 85 inwardly towards the separating chamber. The location 85 is defined as a point beyond which, reckoned in the direction inwardly towards the separating chamber the flow of inlet liquid cannot be described by the simple flow equations. More particularly, the points 83, 87 on the outer and inner profiles aligned with location 85 are points where, if the profiles were projected outwardly therefrom in parallel relationship the separator would operate substantially the same as if the profiles were continued in the profiled configurations defined in accordance with this invention. By the term "outwardly projected" is meant a projection from the respective profile which is substantially tangential at the point of meeting the respective profile.

Point 83 will in fact be very much further round the outer profile than shown in the drawings in order that this requirement can be met. From the respective points 83, 87 on the outer and inner profiles respectively the profiles extend in spiral fashion inwardly to meet the circumferential surface 86 of the separating chamber. Locations at which the profiles so meet circumferences 86 are designated respectively by letters "C" and "E". Practically, although the profile 84 is shown as joining circumference 86 by

continuance of the profile inwardly until it meets the circumference 86 at the point "E", for mechanical reasons it is frequently simpler and more effective to round the junction between the profile 84 and the circumference 86 by providing a rounded portion 84a (indicated by broken lines).

The outer profile 82 is such that vector T describing the location of any particular point on outer profile and contained in a plane normal to said axis, and having its origin at location "C", is such that an angle θ between the vector T and a tangent 92 to circumference 86 passing through said location "C" at the origin lies in the range of −0.1 to 0 radians and, as the magnitude of vector T increases, never decreases substantially for all the magnitudes of T less than $D\eta$, where $D\eta$ is the length of the outer profile 82 of the inlet tract, viewed axially of the separating chamber, D being the diameter of the portion of the separating chamber at which circumference 86 prevails. This profile length is that extending between points "C" and 83. Similarly, a vector U, describing the location of any particular point on the inner profile 84 and having its point of origin at location "E" is such that the angle L between vector U and the tangent 93 to said circumference which passes through said location "E" is never less than negative 0.52 radians and, as the magnitude of vector U increases, never decreases for all magnitudes of vector U less than αD, at least for substantial magnitudes of vector U, where αD is the length of the inner profile 84, viewed axially of the separating chamber. This profile length is that extending between points "E" and 87. By substantial magnitude of vector U, we mean that in the vicinity of the location "E", vector U may not be defined because of possible rounding of the inner profile as previously described.

The cross-sectional area A_1 of the tract 80 measured in a radial and axial plane passing through the location where the inner profile 84 actually terminates (location "E", or the extremity of the portion 84a as the case may be) is preferably defined as:

$$0.04<4A_i/\pi D^2<0.1$$

It is also preferred that the following relationship holds between the constants η and α

$$\alpha<\eta<2\pi+\alpha$$

$$0.35<\alpha<2$$

The described relationship between the constants α and η is most appropriate where relatively speaking the separator has a maximum diameter which is considerably greater than the diameter of the underflow outlet. However where this ratio is relatively smaller, such as less than 3 it may be preferable to place greater restrictions on the relative values of the constants α and η.

Referring now to Figure 7, in one construction in accordance with the invention, the angle measured about the axis of the separator between the points "C" and "E" was 86°. The inner profile 84 was terminated by a curved portion 84a co-joining with circumference 86, this portion had a curvature of approximately 0.5 mm and located some 110° around the axis of the separator from the point "C". In this instance, it was found that the following mathematical relationship was appropriate for describing the profiles 82, 84:

$$r_0=0.5\ D+0.0143\ D\ Z_0^{1.4}+0.0057\ D\ Z_0^{1.8}+0.00157\ D\ Z_0^{2.8}+0.00286\ D\ Z_0^{4.5}$$

$$r_i=0.5\ D+0.0714\ D\ Z_i^{2}+0.00714\ D\ Z_i^{3}+0.0143\ D\ Z_i^{4}+0.00714\ D\ Z_i^{5}$$

where r_0 is the distance from the axis of the separator to any particular point on the outer profile 82, r_i is the distance from the axis of the separator to any particular point on the inner profile 84, Z_0 is the angle, reckoned from the line 91 joining the axis of the separator and the point "C", in a clockwise direction around the axis of the separator to any point on the outer profile 82 and Z_i is the angle, reckoned from the line 100 in a clockwise direction to any particular point on the inner profile 84. These equations describing the profiles 82, 84 generally may prevail for angles Z_0, Z_i in the range

$$0<Z_o<5\pi/6$$

$$0>Z_i>\pi/3$$

or at least in the range

$$2\pi/15>Z_i>\pi/3$$

The tract 80 may have a rectangular transverse cross-section such as having longer sides extending parallel to the axis of the separator and of length W and shorter sides contained in planes normal to the axis of the separator and of length t. In this case the following relationships may prevail

$$t \times W = A_i,$$

and

$$D/35 < t < D/6.$$

Generally, W will be greater than t.

Figure 8 shows a further modification of the separator in accordance with the invention where the inlet tract 80 is shown as extending with its mean flow path 93 for liquid flowing therein as being at an angle to the axis 95 of the separator rather than being normal thereto as illustrated in Figure 1. In this case the axis 93 of tract 80 makes an angle to axis in the range

$$80° < \rho < 95°.$$

Where the tract is of rectangular cross-section it is preferred that it be of such rectangular cross-section at least over a length qD where q is less than α.

In this specification, all angles are to be understood as being expressed in radians unless otherwise specified.

The described separator inlet configuration may readily be employed where more than one tract 80 is provided.

In this case, the total cross-sectional area of all the tracts measured radially of the separator through respective points "E" should equal the area A_i such as where appearing in a formula $t \times W = A_i$ should be replaced by A_i/n where n is the number of tracts 80. It should also be noted that not all of the tracts need be identical. In particular, where they are not identical the total area A_i is related to the lengths and widths of the feed tracts at the relevant cross-sections as follows:

$$\Sigma t_n \times W_n = A_i,$$

where t_n and W_n are the width and length respectively of the n^{th} tract.

The described separator has been found to provide excellent operating characteristics when separating smaller quantities of oil from larger quantities of water.

Figure 3 shows a modification of the separator of Figure 1. Here, the end wall 50 of the separating chamber portion 14, adjacent overflow outlet 25, is formed of concave form. In Figure 4, the end wall 50 is shown in a further modification as exhibiting a convex form when viewed in axial section. Figure 5 shows a still further modification where the overflow inlet 25 is formed from a pipe 27 having a portion 27a which extends through wall 50 (in this case, shown as being linear in axial section) and into the separating chamber 14 a short distance.

While forming the inlet means of the separator with the described configurations permits only a single inlet to be employed, the described configurations may be advantageously employed even where more than one inlet is provided.

The term "involute" is used in this specification to describe a curve being the locus of the end of a piece of string uncoiled from a base circle. The inner and outer profiles of the or each inlet tract as described are generally formed as involute curves. Each profile may however, have conjoining sections defined by cojoining involute curves having respective defining base circles of differing diameters, or the projected start points on the respective base circles may be relatively circumferentially spaced.

Claims

1. A cyclone separator for separating a denser component of a mixture of liquids from a less dense component thereof, said separator being of a kind having an axially extending separating chamber (12) having towards one end inlet means (20) for admission of the mixture with a tangential flow component, the separating chamber (12) having an axially positioned overflow outlet (25) adjacent said one end and said separating chamber (12) being of generally tapered form with a relatively larger cross-sectional size at said one end and a relatively cross-sectional size at an axially positioned underflow outlet (24) at the end of the separating chamber (12) opposite said one end, wherein in use the denser component is directed to the underflow outlet (24) in a fashion such as to encompass an inner axially positioned core of the less dense component which is subjected at least over a substantial part of its length to a pressure differential causing it to flow to the overflow outlet (25), characterised in that said inlet means (20) is defined by a portion of the separating chamber (12), and at least one inlet tract (80) of involute form communicates with said portion, said portion being that portion of the separating chamber which is at the same lengthwise position as the or each inlet tract (80), and the or each inlet tract (80) presents inner and outer profiles (84, 82) when viewed axially of the separator, said outer profile (82), extending from a first location (C) at which it meets the circumference, (86) of said portion of the separating chamber (12) and at least the inward projection of said inner profile (84) extending from a second location (E) at which the inner profile (84) or its said projection meets said circumference (86), said outer profile, (82) being further characterised in that:

a first vector T describing the location of any particular point on said outer profile (82) and contained in a plane normal to said axis, and having its origin at said first location (C), is such that at the origin an angle

θ between the vector T and that tangent to said circumference (86) which passes through said first location (C) lies within the range −0.1 to 0 radians and, as the magnitude of vector T increases, never decreases substantially for all magnitudes of vector T less than ηD;

D being the diameter of said portion of the separating chamber (12) and

ηD being the length of the outer profile (82) of the inlet tract (80), viewed axially of the separating chamber (12) and being measured from the first location (C) at which the outer profile (82) meets the circumference (86),

the cross-sectional area of the inlet tract (80) perpendicular to the direction of flow generally contracting in the direction of flow.

2. A cyclone separator as claimed in claim 1 wherein a second vector U describing the location of any particular point on the inner profile (84), and having its point of origin at said second location (E) is such that an angle L between vector U and that tangent to said circumference (86) which passes through said second location (E) is never less than −0.52 radians and, as the magnitude of vector U increases, never decreases for all magnitudes of vector U less than αD;

αD being the length of the inner profile (84) of the inlet tract (80) viewed axially of the separating chamber (12), and being measured from the second location (E) at which at least an inward projection of the inner profile (84) meets said circumference (86).

3. A cyclone separator as claimed in claim 1 or claim 2, wherein:

$$0.04<4A_i/\pi D^2<0.1$$

where A_i is the cross-sectional area of said tract (80), or the combined cross-sectional area of all said tracts (80), if there is more than one tract (80), the or each cross-sectional area being measured in a plane substantially perpendicular to tract inlet flow and intersecting the point of termination of said inner profile (84).

4. A cyclone separator as claimed in any one of claims 1 to 3 characterised in that

$$\alpha<\eta<2\pi+\alpha$$

and

$$0.35<\alpha<2$$

5. A cyclone separator as claimed in any one of claims 1 to 4 wherein the or each inlet tract (80) is of rectangular cross-section over at least a length qD for $q<\alpha$, the cross-section having a length W_n and a width t_n, where

$$\Sigma t_n \times W_n = A_i,$$

and

$$D/35<t<D/6$$

where W_n is the length of the cross section of the n^{th} tract (80) and t_n is the width of the n^{th} tract (80).

6. A cyclone separator as claimed in claim 5 wherein the sides of the or each cross section of length W are aligned generally in the axial direction of the separator and those of width t are aligned generally normally to the axis of the separator (12).

7. A cyclone separator as claimed in claim 5 or claim 6 where W>t.

8. A cyclone separator as claimed in any one of claims 1 to 7 wherein the or each tract (80) extends at a respective angle to the axis of the separator, when viewed normally of said axis, wherein the respective angle ρ between said axis and the mean inlet flow direction for liquid mixture when admitted through a respective inlet tract (80), at the point where the mean flow path intersects the said respective tract cross-section at which the area A_i is measured, is

$$80°<\rho<95°$$

where the angle ρ is defined such that for values thereof less than 90° the liquid flow into the separating chamber in use, along said flow path, has a motional component which is directed in the direction from the larger diameter to the smaller diameter end of the separating chamber (12).

9. A cyclone separator as claimed in any one of claims 1 to 8, wherein an end wall (50) of the separating chamber (12), through which said overflow outlet (25) communicates with the separating chamber (12), is formed of curved configuration.

10. A cyclone separator as claimed in claim 8 wherein said end wall (50) is concave.

11. A cyclone separator as claimed in claim 9 wherein said end wall (50) is convex.

12. A cyclone separator as claimed in any one of claims 1 to 11, wherein the overflow outlet (25) is in the form of a pipe (27) which extends through and end wall (50) of the separating chamber chamber (12) and projects into the separating chamber.

13. A cyclone separator as claimed in any one of claims 1 to 12 having a single inlet tract (80):

Patentansprüche

1. Zyklonabscheider zum Trennen einer dichteren Komponente einer Mischung von Flüssigkeiten von einer weniger dichten Komponente von dieser, wobei der Abscheider von dem Typ ist, der eine sich axial erstreckende Trennkammer (12) aufweist, die zu einem Ende Einlaßmittel (20) zur Zuführung der Mischung mit einer tangentialen Strömungskomponente umfaßt, wobei die Trennkammer (12) einen axial positionierten Überströmungsauslaß (25) angrenzend an dies eine Ende aufweist und die Trennkammer (12) von einer im allgemeinen kegelstumpfartigen bzw. sich verjüngenden Form ist mit einer relativ größeren Querschnittsabmessung an diesem einen Ende und einer relativ kleinen Querschnittsabmessung an einem axial positionierten Unterströmungsauslaß (24) an dem zu diesem einen Ende entgegengesetzten Ende der Trennkammer (12), wobei im Betrieb die dichtere Komponente zu dem Unterströmungsauslaß (24) in einer Weise gerichtet bzw. geleitet wird, daß sie einen inneren axial positionierten Kern der weniger dichten Komponente umschließt, die zumindest über einen wesentlichen Teil ihrer Länge einem Druckdifferential bzw. einem Differenzdruck ausgesetzt ist, daß bzw. der sie veranlaßt, zum Überströmungsauslaß (25) zu strömen, dadurch gekennzeichnet, daß die Einlaßmittel (20) durch einen Teil der Trennkammer (12) definiert sind und daß zumindest ein Einlaßtrakt (80) mit Evolventenform mit diesem Teil kommuniziert, wobei dieser Teil derjenige Teil der Trennkammer ist, der sich an derselben Längsposition befindet wie der oder jeder Einlaßtrakt (80), und der oder jeder Einlaßtrakt (80) innere und äußere Profile (84, 82) präsentiert, wobei axial in Bezug auf den Abscheider gesehen sich das äußere Profil (82) von einem ersten Ort (C), an welchem es den Umfang (86) dieses Teils der Trennkammer (12) trifft, erstreckt und sich zumindest der innere Vorsprung dieses inneren Profils (84) von einem zweiten Ort (E) erstreckt, an welchem das innere Profil (84) oder dieser sein Vorsprung den Umfang (86) trifft, wobei das äußere Profil (82) weiterhin dadurch gekennzeichnet ist, daß

ein erster Vektor T, der den Ort jedes einzelnen Punktes auf diesem äußeren Profil (82) beschreibt und in einer Ebene rechtwinklig zu dieser Achse enthalten ist und seinen Ursprung an diesem ersten Ort (C) hat, derart ist, daß an dem Ursprung ein Winkel θ zwischem dem Vektor T und der Tangente zu dem Umfang (86), die durch den ersten Ort (C) verläuft, in dem Bereich von −0,1 bis 0 Radiant und, wenn die Größe des Vektors T zunimmt, nie wesentlich abnimmt für alle Größen des Vektors T kleiner als ηD

D der Durchmesser dieses Teils der Trennkammer (12) ist und

ηD die Länge des äußeren Profils (82) des Einlaßtraktes (80) axial zur Trennkammer (12) gesehen ist und von diesem ersten Ort (C), an welchem das äußere Profil (82) den Umfang (86), trifft, gemessen wird, und sich die Querschnittsfläche des Einlaßtraktes (80) rechtwinklig zur Strömungsrichtung im allgemeinen zusammenzieht in der Richtung der Strömung.

2. Zyklonabscheider nach Anspruch 1, bei welchem ein zweiter Vektor U, der den Ort jedes einzelnen Punktes auf dem inneren Profil (84) beschreibt und seinen Ursprung an diesem zweiten Ort (E) hat, derart ist, daß ein Winkel α zwischen dem Vektor U und der Tangente zum Umfang (86), die durch den zweiten Ort (E) geht, nie kleiner als 0,52 Radiant wird, und, wenn die Größe des Vektors U zunimmt, nie abnimmt für alle Größen des Vektors U kleiner als αD;

αD die Länge des inneren Profils (84) des Einlaßtraktes (80) axial zur Trennkammer (12) gesehen ist, und von dem zweiten Ort (E), an welchem zumindest ein innerer Vorsprung des inneren Profils (84) den Umfang (86) trifft, gemessen wird.

3. Zyklonabscheider nach Anspruch 1 oder 2, bei welcher gilt

$$0.04<4A_i/\pi D^2<0.1$$

wobei A_i die Querschnittsfläche dieses Traktes (80) oder die kombinierte Querschnittsfläche aller dieser Trakte (80), wenn mehr als ein Trakt (80) vorhanden ist, ist, wobei die oder jede Querschnittsfläche in einer Ebene gemessen wird, die im wesentlichen senkrecht zu der Trakteinlaßströmung liegt und den Endpunkt des inneren Profils (84) schneidet.

4. Zyklonabscheider nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß gilt

$$\alpha<\eta<2\pi+\alpha$$

und

$$0.35<\alpha<2$$

5. Zyklonabscheider nach einem der Ansprüche 1 bis 4, in welchem der oder jeder Einlaßtrakt (80) von einem rechtwinkligen Querschnitt über zumindest eine Länge qD für q<α ist, wobei der Querschnitt eine Länge W_n und eine Breite t_n aufweist mit

$$\Sigma t_n \times W_n = A_i,$$

und

$$D/35<t<D/6$$

wobei W_n die Länge des Querschnittes des n/ten Traktes (80) und t_n die Breite des n-ten Traktes (80) ist.

6. Zyklonabscheider nach Anspruch 5, in welchem die Seiten des oder jedes Querschnittes der Länge

W im allgemeinen in der axialen Richtung der Trennkammer ausgerichtet sind bzw. fluchten und diejenigen der

Breite T im allgemeinen rechtwinklig zu der Achse der Trennkammer (12) ausgerichtet sind bzw. fluchten.

7. Zyklonabscheider nach Anspruch 5 oder 6, bei welcher W>t ist.

8. Zyklonabscheider nach einem der Ansprüche 1 bis 7, bei welcher der oder jeder Trakt (80) sich unter einem zugeordneten Winkel zu der Achse der Trennkammer, rechtwinklig zur Achse gesehen, erstreckt, wobei der zugeordnete Winkel ρ zwischen dieser Achse und der Haupteinlaßströmungsrichtung für die Flüssigkeitsmischung, wenn sie durch einen zugeordenten Einlaßtrakt (80) zugeführt wird, an dem Punkt, wo der Hauptströmungspfad den entsprechenden Traktquerschnitt, bei welchem die Fläche A_i gemessen wird, schneidet,

$$80° < \rho < 95°$$

ist, wobei der Winkel derart definiert ist, daß für Werte von diesem von weniger als 90° die Flüssigkeitsströmung in die Trennkammer im Betrieb entlang dem Strömungspfad eine Bewegungskomponente hat, die in der Richtung von dem größeren Durchmesser zu dem Ende mit dem kleineren Durchmesser der Trennkammer (12) gerichtet ist.

9. Zyklonabscheider nach einem der Ansprüche 1 bis 8, bei welchem eine Stirnwand (50) der Trennkammer (12), durch welche der Überströmungsauslaß (25) mit der Trennkammer (12) kommuniziert, mit einer gekrümmten Konfiguration geformt ist.

10. Zyklonabscheider nach Anspruch 8, bei welchem die Stirnwand (50) konkav ist.

11. Zyklonabscheider nach Anspruch 9, bei welchem die Stirnwand (50) konvex ist.

12. Zyklonabscheider nach einem der Ansprüche 1 bis 11, bei welchem der Überströmungsauslaß (25) in der Form eines Rohres bzw. einer Leitung (27) vorgesehen ist, der bzw. die sich durch die Stirnwand (50) der Trennkammer (12) erstreckt und in die Trennkammer vorspringt.

13. Zyklonabscheider nach einem der Ansprüche 1 bis 12, der einen einzigen Einlaßtrakt (80) aufweist.

Revendications

1. Séparateur à cyclone destiné à séparer un constituant relativement dense d'un mélange de liquides d'un constituant moins dense du mélange, le séparateur étant d'un type ayant une chambre axiale de séparation (12) munie, vers une extrémité, d'un dispositif d'entrée (20) destiné à l'admission du mélange avec une composante tangentielle, la chambre de séparation (12) ayant une sortie axiale de débordement (25) qui est adjacente à la première extrémité, la chambre de séparation (12) ayant une forme évasée de façon générale de section relativement grande à la première extrémité et de section relativement plus faible à une sortie inférieure axiale (24) placée à l'extrémité de la chambre de séparation (12) qui est opposée à la première extrémité, afin que, pendant l'utilisation, le constituant relativement lourd soit dirigé vers la sortie inférieure (24) d'une manière telle qu'il entoure une âme interne axiale du constituant moins dense qui est soumise, au moins sur une partie importante de sa longueur, à une pression différentielle provoquant son écoulement vers la sortie de débordement (25), caractérisé en ce que le dispositif d'entrée (20) est délimité par une partie de la chambre de séparation (12) et au moins une région d'entrée (80) ayant une forme en développante communique avec cette partie, cette partie étant la partie de la chambre de séparation qui se trouve à la même position longitudinale que la région ou chaque région d'entrée (80), la région ou chaque région d'entrée (80) ayant des profils interne et externe (84, 82), en vue suivant l'axe du séparateur, le profil externe (82) partant d'un premier emplacement (C) auquel il se raccorde à la circonférence (86) de ladite partie de la chambre de séparation (12), et la projection vers l'intérieur au moins du profil interne (84) partant d'un second emplacement (E) auquel le profil interne (84) ou sa projection se raccorde à la circonférence (86), le profil externe (82) étant en outre caractérisé en ce que:

un premier vecteur T décrivant l'emplacement d'un point particulier quelconque placé sur le profil externe (82) et contenu dans un plan perpendiculaire à l'axe, le vecteur ayant son origine au premier emplacement (C), est tel que, à l'origine, l'angle θ formé par le vecteur T et la tangente à la circonférence (86) qui passe par le premier emplacement (C) est compris entre −0,1 et 0 radian, et, lorsque la dimension du vecteur T augmente, l'angle ne diminue jamais notablement pour toutes les dimensions du vecteur T inférieures à ηD,

D étant le diamètre de ladite partie de la chambre de séparation (12), et

ηD étant la longueur du profil externe (82) de la région d'entrée (80) en vue suivant l'axe de la chambre de séparation (12) et étant mesurée à partir du premier emplacement (C) auquel le profil externe (82) se raccorde à la circonférence (86),

la section de la région d'entrée (80) perpendiculaire à la direction d'écoulement diminuant de façon générale dans la direction d'écoulement.

2. Séparateur à cyclone selon la revendication 1, dans lequel un second vecteur U qui décrit l'emplacement d'un point particulier quelconque placé sur le profil interne (84) et ayant son origine au second emplacement (E) est tel qu'un angle L formé par le vecteur U et la tangente à la circonférence (86) qui passe par le second emplacement (E) n'est jamais inférieur à −0,52 radian et, lorsque la dimension du vecteur U augmente, ne diminue jamais pour toutes les dimensions du vecteur U qui sont inférieures à αD,

αD étant la longueur du profil interne (84) de la région d'entrée (80) en vue suivant l'axe de la chambre de séparation (12), et étant mesurée à partir du second emplacement (E) auquel une projection vers l'intérieur au moins du profil interne (84) se raccorde à la circonférence (86).

3. Séparateur à cyclone selon la revendication 1 ou 2, dans lequel:

$$0{,}04<4A_i/\pi D^2<0{,}1$$

A_i étant la section de la région (80) ou la section combinée de toutes les régions (80), lorsque plusieurs régions (80) sont présentes, la section ou chaque section étant mesurée dans un plan sensiblement perpendiculaire au courant d'entrée dans la région et recoupant le point de terminaison du profil interne (84).

4. Séparateur à cyclone selon l'une quelconque des revendications 1 à 3, caractérisé en ce que:

$$\alpha<\eta<2\pi+\alpha,$$

et

$$0{,}35<\alpha<2$$

5. Séparateur à cyclone selon l'une quelconque des revendications 1 à 4, dans lequel la région ou chaque région d'entrée (80) a une section rectangulaire sur au moins une longueur qD telle que $q<\alpha$, la section ayant au moins une longueur W_n et une largeur t_n telles que

$$\Sigma t_n \cdot W_n = A_i,$$

et

$$D/35<t<D/6$$

W_n étant la longueur de la section de la $n^{ième}$ région (80) et t_n étant la largeur de la $n^{ième}$ région (80).

6. Séparateur à cyclone selon la revendication 5, dans lequel les côtés de la section ou de chaque section de longueur W sont alignés de façon générale dans la direction axiale du séparateur, et les côtés de largeur t sont alignés de façon générale en direction perpendiculaire à l'axe du séparateur (12).

7. Séparateur à cyclone selon la revendication 5 ou 6, dans lequel $W>t$.

8. Séparateur à cyclone selon l'une quelconque des revendications 1 à 7, dans lequel la région ou chaque région (80) est disposée suivant un angle respectif formé avec l'axe du séparateur, en vue perpendiculaire à l'axe, l'angle respectif ρ, formé entre l'axe et la direction moyenne du courant d'entrée de mélange de liquides lorsqu'il est admis par la région respective d'entrée (80), au point auquel le trajet moyen d'écoulement recoupe la section de la région respective pour laquelle la section A_i est mesurée, est tel que:

$$80°<\rho<95°$$

l'angle ρ étant défini afin que, pour des valeurs inférieures à 90°, l'écoulement du liquide dans la chambre de séparation pendant l'utilisation, le long du trajet de circulation, possède une composante qui est dirigée de l'extrémité de plus grand diamètre vers l'extrémité de plus petit diamètre de la chambre de séparation (12).

9. Séparateur à cyclone selon l'une quelconque des revendications 1 à 8, dans lequel la paroi d'extrémité (50) de la chambre de séparation (12), par laquelle la sortie de débordement (25) communique avec la chambre de séparation, (12) est formée avec une configuration courbe.

10. Séparateur à cyclone selon la revendication 8, dans lequel la paroi d'extrémité (50) est concave.

11. Séparateur à cyclone selon la revendication 9, dans lequel la paroi d'extrémité (50) est convexe.

12. Séparateur à cyclone selon l'une quelconque des revendications 1 à 11, dans lequel la sortie de débordement (25) est sous forme d'une tuyauterie (27) qui traverse la paroi d'extrémité (50) de la chambre de séparation (12) et dépasse dans cette chambre.

13. Séparateur à cyclone selon l'une quelconque des revendications 1 à 12, ayant une seule région d'entrée (80).

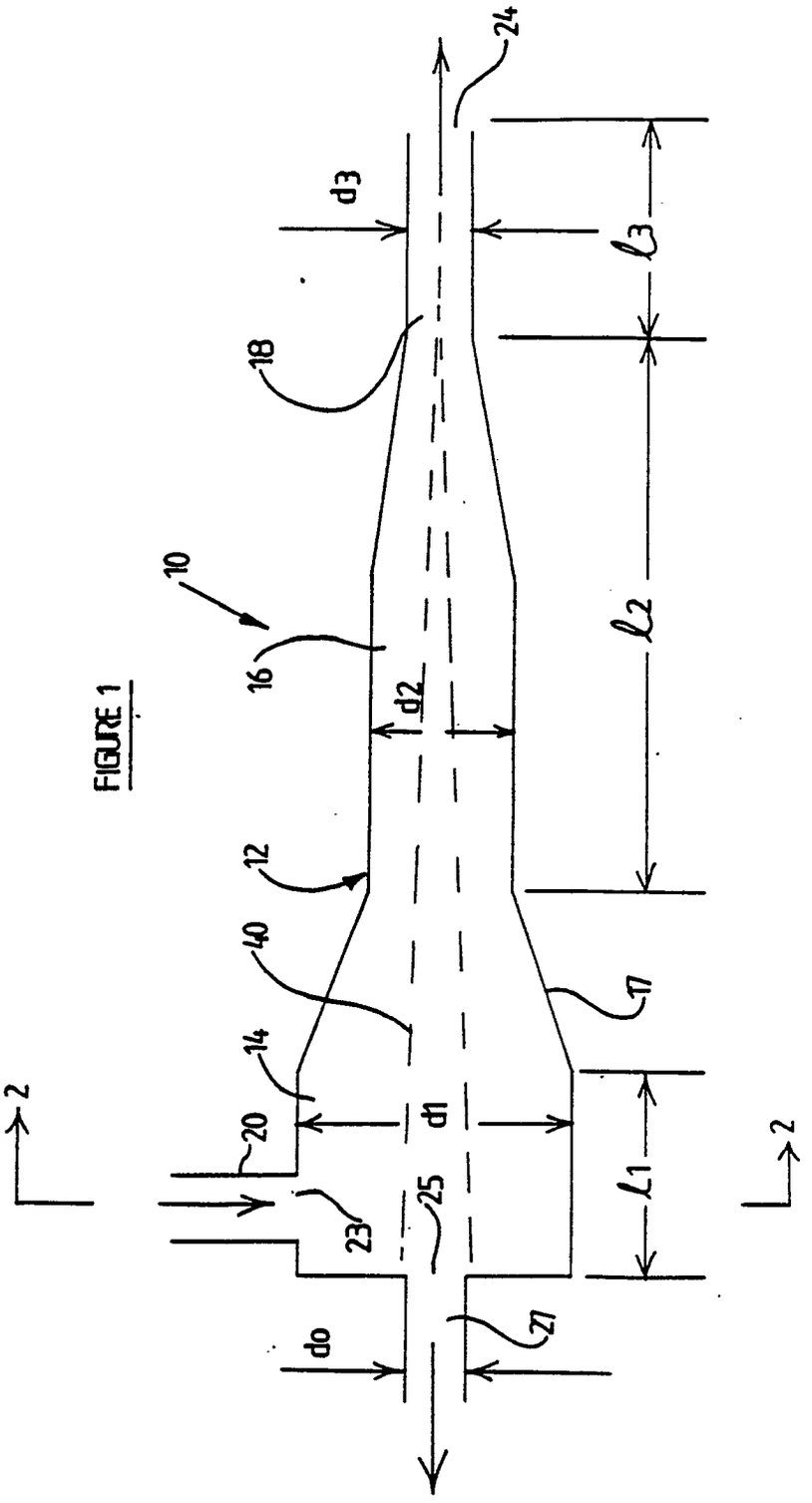


FIGURE 1

FIGURE 5

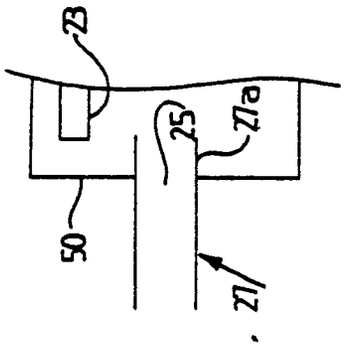


FIGURE 4

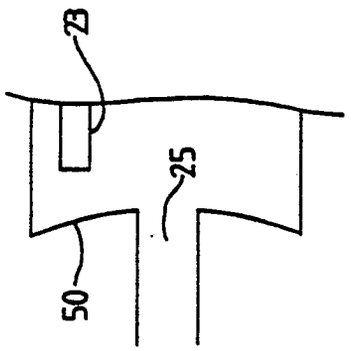


FIGURE 3

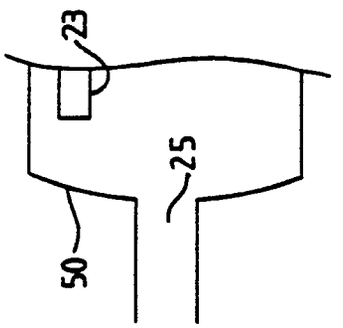


FIGURE 2

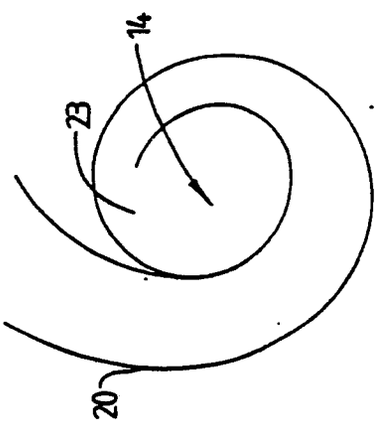
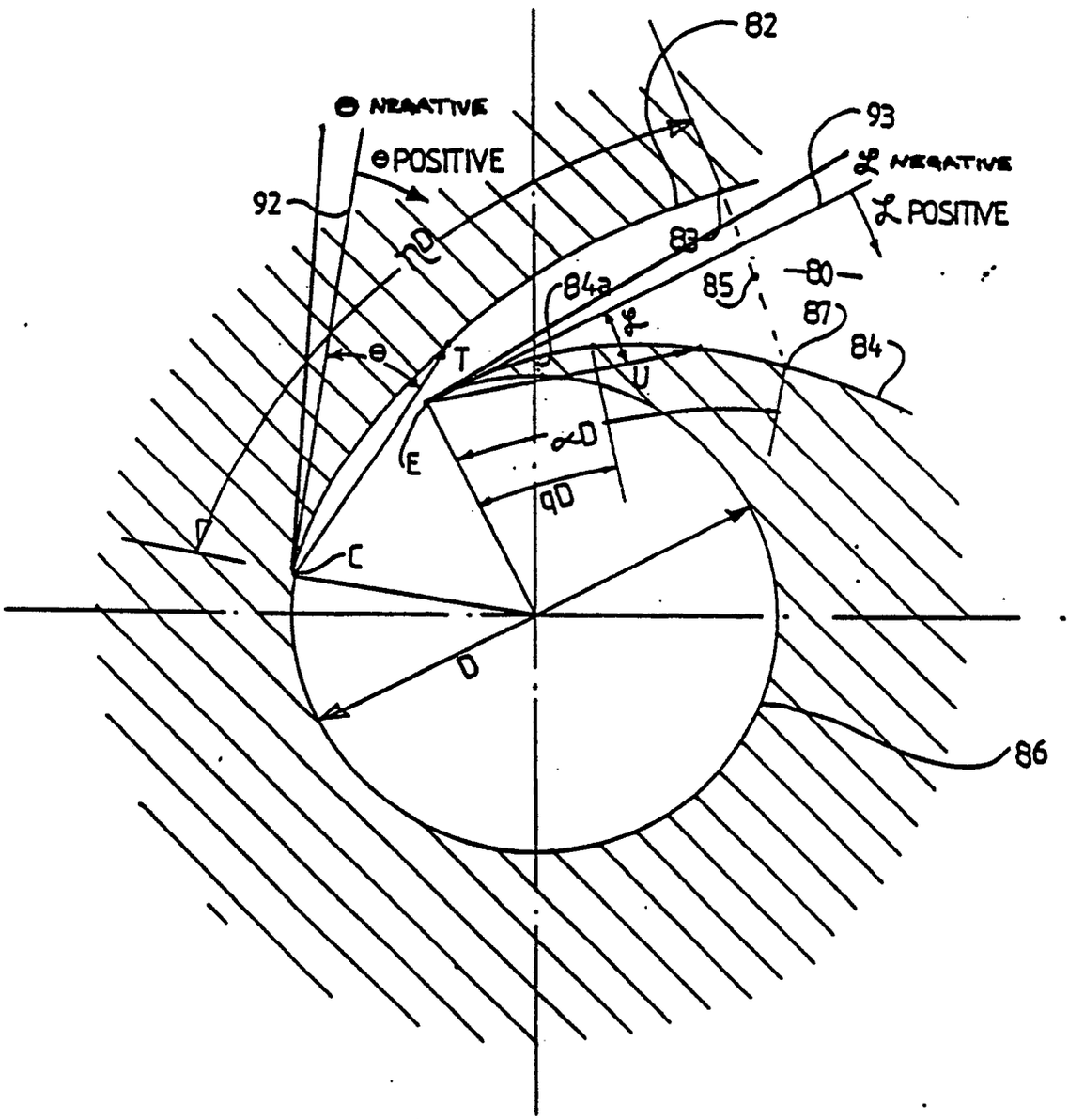


FIGURE 6


82
⊖ NEGATIVE
⊖POSITIVE
93
NEGATIVE
POSITIVE
92
83
85
80
84a
87
84
e
T
U
E
qD
C
D
86

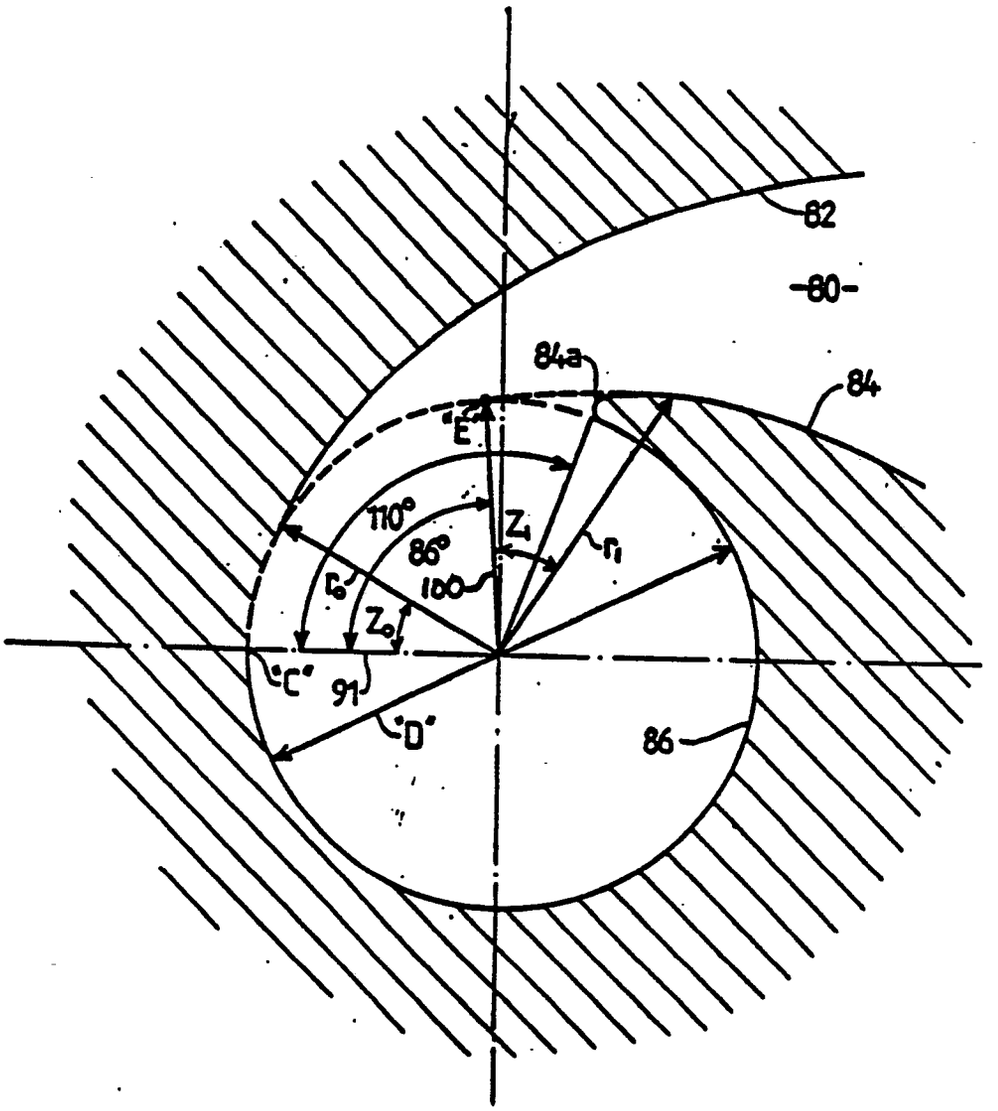


FIG 1

FIGURE 8

