

SYSTEM AND APPARATUS FOR THE SEPARATION OF MULTI-PHASE
MIXTURES

This invention relates generally to the separation of multi phase mixtures and more particularly though not exclusively, to the separation of oil/water mixtures.

It is an object of the present invention to provide an improved system and apparatus for use in the system which is more efficient and more compact than the prior art devices.

According to the invention there is provided apparatus for separating multi-phase liquid mixtures or at least partially separating a more dense liquid component of the mixture from a less dense liquid component thereof, comprising an outer casing having a cavity therein, an intake port through which, in use, the mixture is fed to the apparatus, a first outlet port from which the less dense liquid component can be discharged from the apparatus and a second outlet port from which the more dense liquid component can be discharged from the apparatus, the apparatus further including a cyclone separating means located within said casing and which comprises a plurality of separating chambers, each chamber having a primary portion which has a greater cross-sectional dimension at one end than at its other end and comprising a tangential inlet, an overflow outlet at said one end of the separating chamber of greater cross sectional dimension and an under flow outlet at the other end, a block-like element extending transversely across the casing in sealing relationship with the wall thereof to define the cavity, the underflow outlets of the separating chambers communicating with the cavity so that the more dense component of the mixture can pass into the cavity to be discharged through the

second outlet port, and the over flow outlet from each separator chamber leading to an overflow outlet passage at least partially formed in said block-like element and thence to the first outlet port, said overflow outlet passage being located in a position between the intake port and the second outlet port.

Preferably the outer casing comprises an elongated tubular member having its ends closed by plugs or caps.

Preferably the intake port is disposed above the block-like element, the first outlet port is disposed adjacent the block-like element and the second outlet port is spaced from and below the block-like element.

Preferably the apparatus includes a head portion operatively connected to each separating chamber and defining the inlet and the overflow outlet for each separating chamber and having a passage or passages leading from the overflow outlet of each separating chamber to the overflow outlet passage.

Preferably, the head portion comprises a major inlet passage in fluid communication with the intake port. The head portion may comprise a second block-like element having the major inlet passage formed therein and a series of tangentially directed feed inlets associated therewith which feed the mixture to respective primary portions of the separating chamber.

Preferably, four separating chambers are provided, each having a feed inlet which is of involute form.

The head portion includes outlet passages communicating with the outlet passage or passages within the block-like element for conveying the less dense component through the first outlet port. The outlet passage(s) may include a peripheral groove in the outer surface of the block-like element which communicates with the first outlet port, the groove being disposed near the end of the block-like element adjacent the separating chambers.

The block-like element may further have a tapered forward end which is adapted to seat on a complementary tapered portion on the outer casing, the groove being provided on this tapered portion.

According to another aspect of the present invention there is provided a system for separating multi-phase mixtures comprising an input line through which the multi-phase mixture is delivered, an output line through which at least one of the separated phases of the mixture is discharged and a plurality of apparatus as defined above arranged in parallel between the input and output lines, valve means being provided so that each apparatus can be selectively operable or inoperable.

Preferred embodiments of the invention will hereinafter be described with reference to the accompanying drawings and in those drawings:

Figure 1 is a sectional side elevation of the apparatus according to the present invention;

Figure 2 is a sectional side elevation of the outer casing of the apparatus according to the present invention;

Figure 3 is a sectional side elevation of the block-like element and cyclone separating device;

Figure 4 is a sectional view of the head portion of the apparatus on line A-A in Fig.1;

Figure 5 is a top plan view of the head portion of the apparatus;

Figure 6 is a section on line B-B of Fig.4.

Figure 7 is a section on line C-C of Fig.4; and

Figure 8 is a schematic view of a system according to the invention.

Referring to the drawings, the apparatus generally indicated at 1 comprises an outer casing 2 having a cavity 4 therein. An intake port 20 is provided through which, in use, the mixture is fed to the apparatus, there further being a first outlet port 21 from which a less dense component can be discharged from the apparatus and a second outlet port 22 from which a more dense component can be discharged from the apparatus. The apparatus further includes a cyclone separating device 40 which comprises a plurality of chambers 42 each chamber having a primary portion which has a greater cross sectional diameter at one end than at its other end and further having an overflow outlet 45 at one end thereof, and an underflow outlet 46 at the other end thereof.

The underflow outlets 46 communicate with the cavity 4, so

that the more dense component can pass into the cavity and then be discharged through the second outlet port 22.

As shown the outer casing 2 comprises an elongate tubular member 6, having its ends closed by suitably fitting plugs or caps 10 and 11.

The intake port 20 may be in the form of an intake pipe at towards one end of the elongate member 6 and the second outlet port 22 for discharge of the more dense component of the mixture may be in the form of a pipe also towards the aforementioned one end or spaced therefrom. Preferably the first outlet port 21, from which the less dense component is discharged from the apparatus is also disposed at the aforementioned one end.

As mentioned, the cyclone separating device 40, comprises a plurality of separating chambers 42 which conveniently may be of the type described in any one of applicant's many patents and patent applications relating to cyclone separators for separating liquid mixtures.

The separating device further includes a head portion 44a and a block like element 44b. The head portion 44a is operatively connected to or formed integral with the overflow outlet end of each of the separating chambers 42. The head portion 44a includes a major inlet passage 48 in fluid communication with the intake portion of the apparatus and a plurality of tangentially directed feed inlets 50, communicating with the major inlet passage 48 and directing fluid to respective ones of the separating chambers. In the case shown, where four separating chambers are provided, four feed inlets 50 are provided and desirably these feed inlets 50

are of involute form.

The head portion 44a further includes an outlet passages 51, 52, 53 for collection of the less dense component (e.g. the oil) from the overflow outlets 45 of the separating chambers 42. The outlet passage 53 in the head portion 44a leads into a passage 53a in the block-like element 44b and thence into a peripheral groove 54 in the outer surface of the block like element 44b from which the less dense component is discharged through first outlet port 21. Preferably the groove 54 is disposed near the end of the block-like element 44b, adjacent the under flow outlet end of the separating chambers 42.

Although, as shown the overflow outlets of the separating chamber 42 feed into a common outlet passage 52, 53, a number of collecting passages may also be provided for receiving the separated component from the overflow end of each chamber and transferring it to the outlet groove 54.

Preferably the block-like element 44b has a tapered forward end 47a which is adapted to seat in a complementary tapered portion 47b on the outer casing 2. Preferably the groove 54 is provided on this tapered portion and suitable sealing means such as O-rings (not shown) are disposed on either side of the groove 54. As the groove 54 is disposed at the forward end of the block like element 44b, the pressure of the incoming mixture into the head portion 44a, tends to force the tapering sides together to assist in sealing of the block like elements 44b against the casing 2.

As shown in Figure 8, a system for separating multi-phase mixtures comprising an input line through which the multi-phase mixture is delivered, an output line through which at least one of the separated phases of the mixture is

discharged and a plurality of apparatus as described above arranged in parallel between the input and output lines.

Preferably, valve means is provided so that each apparatus can be made selectively operable or inoperable.

CLAIMS

1. Apparatus for separating multi-phase liquid mixtures or at least partially separating a more dense liquid component of the mixture from a less dense liquid component thereof, comprising an outer casing having a cavity therein, an intake port through which, in use, the mixture is fed to the apparatus, a first outlet port from which the less dense liquid component can be discharged from the apparatus and a second outlet port from which the more dense liquid component can be discharged from the apparatus, the apparatus further including a cyclone separating means located within said casing and which comprises a plurality of separating chambers, each chamber having a primary portion which has a greater cross-sectional dimension at one end than at its other end and comprising a tangential inlet, an overflow outlet at said one end of the separating chamber of greater cross sectional dimension and an under flow outlet at the other end, a block-like element extending transversely across the casing in sealing relationship with the wall thereof to define the cavity, the underflow outlets of the separating chambers communicating with the cavity so that the more dense component of the mixture can pass into the cavity to be discharged through the second outlet port, and the over flow outlet from each separator chamber leading to an overflow outlet passage at least partially formed in said block-like element and thence to the first outlet port, said overflow outlet passage being located in a position between the intake port and the second outlet port.



2. Apparatus according to claim 1 including a head portion operatively connected to each separating chamber and defining the inlet and the overflow outlet for each separating chamber and having a passage or passages leading from the overflow outlet of each separating chamber to the overflow outlet passage.

3. Apparatus according to claim 2 wherein the head portion also comprises a block-like element and includes a major inlet passage in fluid communication with the intake port of the apparatus and a plurality of individual tangentially directed feed inlets communicating with the major inlet passage for directing liquid to respective ones of the separating chambers.

4. Apparatus according to any one of claims 1 to 3 wherein the outer casing comprises an elongate tubular member having its ends closed by plugs or caps.

5. Apparatus according to any one of claims 1 to 4 wherein said intake port is disposed above said block-like element, said second outlet port is disposed below said block-like element and said first outlet port is adjacent said block-like element.

6. Apparatus according to any one of claims 1 to 5 wherein the feed inlets from said head portion to the separating chambers are of involute form.

7. Apparatus according to any one of claims 1 to 6 wherein the overflow outlet passage, includes a peripheral groove in



the outer surface of the block-like element and communicating with the first outlet port.

8. Apparatus according to claim 7 wherein the block-like element has a tapered forward end which seats in a complementary tapered portion on the outer casing, the groove being provided on the tapered portion.

9. Apparatus according to claim 1, substantially as described herein with reference to the drawings.

10. A system for separating multi phase mixtures comprising an input line through which the multi phase mixture is delivered, an output line through which at least one of the separated phases of the mixture is discharged and a plurality of apparatus according to any preceding claim arranged in parallel between the input and output lines, valve means being provided so that each apparatus can be selectively operable or inoperable.



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