

[54] **CYCLONE SEPARATOR WITH
UNDERFLOW DILUTER**

[75] Inventor: **Rune Frykhult**, Huddinge,
Switzerland

[73] Assignee: **Aktiebolaget Celleco**, Tumba,
Sweden

[22] Filed: **July 14, 1971**

[21] Appl. No.: **162,447**

[52] U.S. Cl. **209/211**

[51] Int. Cl. **B04c 5/18**

[58] Field of Search..... 209/211, 144;
210/512

[56] **References Cited**

UNITED STATES PATENTS

3,337,050 8/1967 Labecki 209/211

3,259,246 7/1966 Stauenger 209/211 X
3,529,724 9/1970 Maciula et al. 209/211 X

FOREIGN PATENTS OR APPLICATIONS

1,131,734 2/1957 France 209/211
1,057,135 3/1954 France 210/512

Primary Examiner—Frank W. Lutter

Assistant Examiner—Ralph J. Hill

Attorney—Davis, Hoxie, Faithful & Hapgood

[57] **ABSTRACT**

To dilute a heavy fraction separated in a cyclone separator, the latter is provided with a duct for supplying the diluent while maintaining it in rotation around the separator axis, the supply duct having a discharge orifice located at a radial distance from and within a circumferential wall surrounding the separated heavy fraction.

7 Claims, 3 Drawing Figures

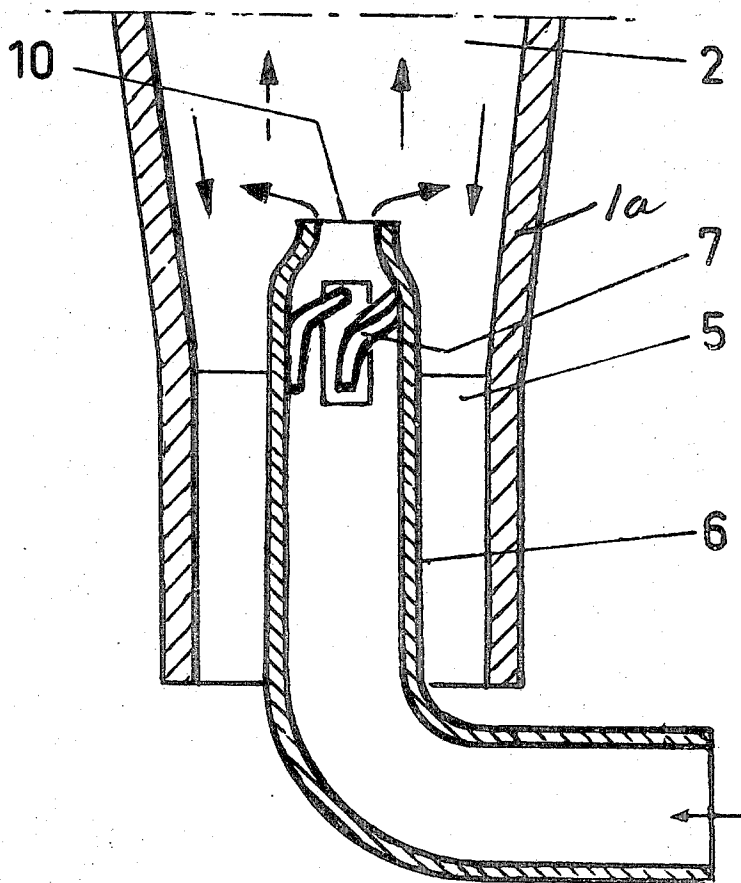


Fig. 1

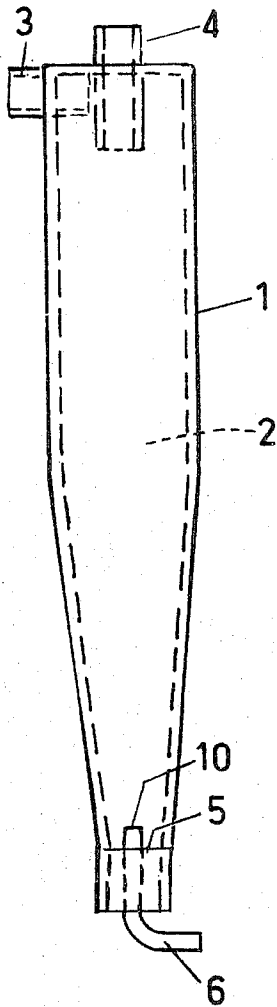
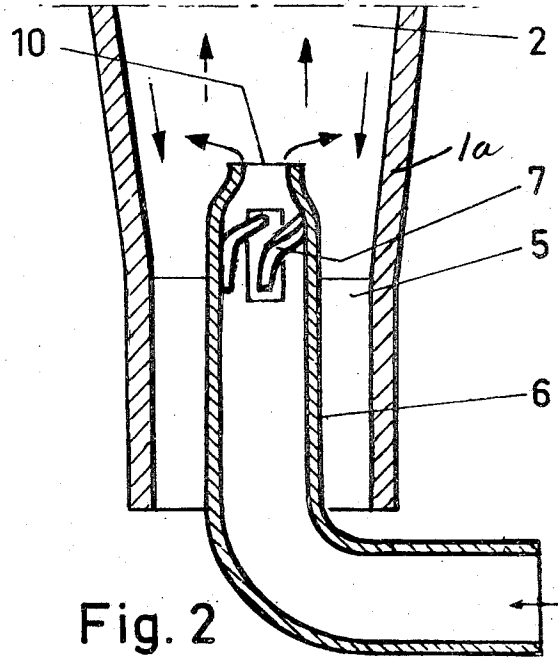


Fig. 2

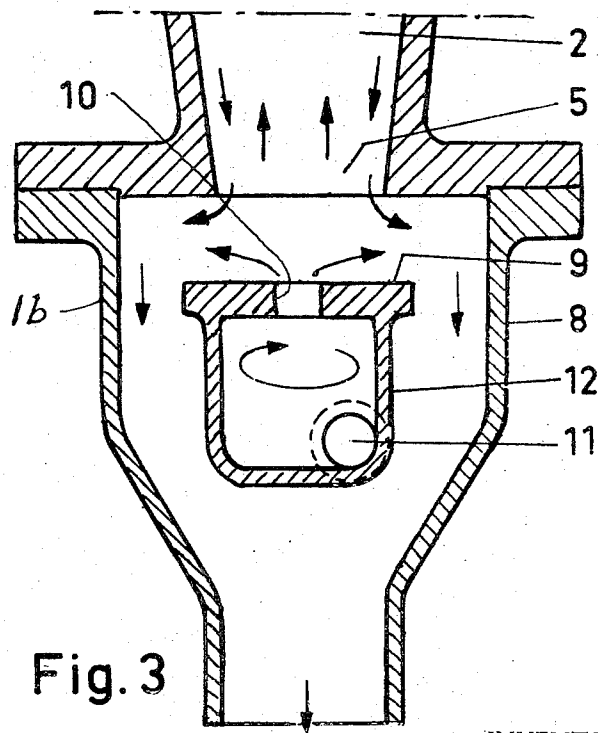


Fig. 3

INVENTOR.
RUNE FRYKHULT

BY

Davis, Hope, Faithfull & Wood
ATTORNEYS

CYCLONE SEPARATOR WITH UNDERFLOW DILUTER

The present invention relates to an arrangement in connection with cyclone separators for the dilution of separated heavy fraction while maintaining a rotating movement of the diluent around the axis of the separator. The arrangement is mainly characterized by a duct for the supply of a diluent, the orifice of said duct being situated at a radial distance from and within a circumferential wall surrounding the separated heavy fraction.

Cyclone separators of the present type are utilized particularly in the paper and cellulose pulp industry for the purification of fiber suspensions. In connection with this purification, the aim is on the one hand to remove various impurities as effectively as possible in the form of a heavy fraction, and on the other hand to collect the useful fibers as effectively as possible in the form of a light fraction. In the course of developing more effective separators, a stage has been reached, however, where the heavy separated fraction has become thickened to such an extent that the heavy fraction outlet has a tendency to become clogged. It has therefore become a necessity to provide the separators with arrangements for dilution of the heavy fraction with water.

For reasons due to technical circumstances in connection with the manufacturing processes, the temperature of the suspensions to be purified has gradually increased before they are fed to the cyclone separators. On account of the resulting decrease of the viscosity of the water in the suspension, it has become more and more difficult to prevent a considerable quantity of the useful fibers from accompanying the separated heavy fraction on its way toward the heavy fraction outlet. In order to keep the number of separation steps in series at a reasonable level, it has become a necessity not only to dilute the heavy fraction, but also to wash it and thereby transfer the accompanying useful fibers to the light fraction.

It has been attempted to solve the said dilution and washing problem by supplying water under pressure to the cyclone separator via one or more tangentially arranged inlets through the separator wall near the heavy fraction outlet or through the wall of an outlet chamber arranged outside the heavy fraction outlet. The thought behind the arrangement is to "break up" the separated heavy fraction while maintaining or increasing the rotational speed of the separated heavy fraction, and thereby effectively dilute the fraction and wash out of the same the accompanying useful fibers so that they can join the light fraction in the inner vortex leaving the separator through the light fraction outlet.

However, this "breaking up" of the separated heavy fraction appears to have the effect that the heaviest portion of the said fraction, which has settled in a vortex close to the periphery of the separator, becomes disarranged. The dilution water injected tangentially and under high pressure will create a considerable turbulence along the wall immediately surrounding the said heaviest portion of the fraction, and the result seems to be that a part of the polluting particles already separated will be thrown into the inner vortex containing the useful fibers flowing toward the light fraction outlet, and carried along with the same. At any rate, it has been found that it is hardly possible, when using the known arrangements for dilution of the separated heavy fraction, to prevent the purified suspension from

containing unwanted dirt particles, at least if it is attempted to wash out effectively and save the useful fibers which otherwise would leave the separator through the heavy fraction outlet.

The problem to which the present invention is directed is therefore to dilute the separated heavy fraction in such a manner that, on the one hand, the heaviest fraction will flow out without clogging the heavy fraction outlet, and, on the other hand, the useful fibers will be effectively recovered and led to the light fraction outlet of the separator while avoiding that polluting particles will at the same time mix into the light fraction.

This problem has surprisingly been solved by an arrangement in which the duct or ducts supplying the dilution water, while maintaining it in rotating movement around the axis of the separator, open at a distance from and within the circumferential wall enclosing the fraction to be diluted. Cyclone separators provided with the arrangement according to the invention have, in other words, a surprisingly good separating effect.

The inventive concept may be put into practice in such a manner, for instance, that one or more tubes for the supply of dilution water through said circumferential wall open out at a distance from the inside of this wall. Those tubes should then be directed or bent so that the axis of the orifice will be a tangent to a smaller circle than the one described by the circumferential wall. Preferably, however, the orifice of the duct is arranged to open out coaxially with the separator and provided with a device which will give the desired rotating movement to the dilution water.

The invention will be described more in detail below with reference to the drawing, in which FIG. 1 is an elevational view of a cyclone separator having one embodiment according to the invention; FIG. 2 is an enlarged vertical sectional view of part of the separator shown in FIG. 1; and FIG. 3 is a view similar to FIG. 2 but showing another embodiment.

In the drawing, the cyclone separator 1 has a vortex chamber 2 provided with a tangential inlet 3, a light fraction outlet 4 and a heavy fraction outlet 5. In FIGS. 1 and 2, the separator is provided with a coaxial supply tube 6 having its discharge end opening within the vortex chamber 2 immediately inside the heavy fraction outlet 5. Tube 6 forms an inlet duct for diluent and is provided internally with vanes 7 which give a rotating movement (around the separator axis) to the dilution water being injected under pressure. On account of this movement, the water after having left the orifice of the duct will be given a flow direction by the centrifugal force as indicated by the arrows. If the water did not have the rotational movement, it would join the inner vortex of the separator going upward and containing the light fraction. Now the water will flow toward the wall of the vortex chamber, instead, and dilute the separated heavy fraction, which is here flowing downward in an outer vortex. Thus, the separation process will be activated so that the heaviest separated particles, the polluting particles, will remain collected in a vortex flowing downward close to the wall of the separator, this down-flowing vortex being highly liquid on account of the dilution, whereas the useful fibers forming a part of the thickened fraction have been washed out and suspended in a part of the dilution water. This suspension forms a lighter phase rotating close to the axis and is seized gradually by the inner vortex going upward

3

and is thus added to the light fraction leaving through the light fraction outlet 4. This arrangement for addition of dilution water has a less tendency to influence, in a disturbing way, the heavy phase of impurities already separated out.

In the embodiment shown in FIG. 3, an outlet chamber 8 is arranged outside the heavy fraction outlet 5 of the cyclone separator. In the outlet chamber there is an impingement plate 9 coaxial with the separator. On its side facing the separator, the impingement plate has a central mouth 10 of a duct for the supply of dilution water. The dilution water is led through a tangential inlet 11 to a cylindrical chamber 12 communicating with the said mouth and is thus given a rotating movement. The arrows indicate the direction of flow which presumably prevails in connection with this arrangement. The embodiment of the invention shown in FIG. 3 has proved to be specially favorable.

It will be apparent that in FIG. 2 as well as FIG. 3 the diluent discharge orifice 10 is located at a radial distance from and within a circumferential wall 1a (FIG. 2) or 1b (FIG. 3) which surrounds the separated heavy fraction and adjacent which this heavy fraction rotates in an annular body around the cyclone axis. Thus, the device 7 (FIG. 2) or 11-12 (FIG. 3) serves as a means for rotating the diluent around this axis as it discharges through orifice 10 and within said rotating annular body.

I claim:

1. In combination with a cyclone separator having an axis and forming a vortex chamber having an inlet for a suspension to be separated, said chamber also having outlets for a separated heavy fraction and for a sepa-

4

rated lighter fraction, respectively, the separator including a circumferential wall adjacent said outlet for the separated heavy fraction and adjacent which said heavy fraction rotates in an annular body around said axis, means for supplying a diluent to dilute said separated heavy fraction and having a discharge orifice located at a radial distance from and within said circumferential wall, said means for supplying a diluent including means for rotating the diluent around said axis as the diluent discharges through said orifice and within said annular body.

2. The combination of claim 1, in which said discharge orifice is coaxial with the separator.

3. The combination of claim 2, in which said discharge orifice is located within said outlet for the separated heavy fraction.

4. The combination of claim 2, in which the separator also forms an outlet chamber located outside the vortex chamber and to which said separated heavy fraction outlet leads, said discharge orifice being located in said outlet chamber.

5. The combination of claim 4, comprising also an impingement plate located in said outlet chamber and having one side facing said vortex chamber, said discharge orifice opening through said side of the plate.

6. The combination of claim 2, in which said means for rotating the diluent includes vanes.

7. The combination of claim 2, in which said means for rotating the diluent includes means forming a cylindrical chamber and having a tangential inlet for the diluent.

* * * * *

35

40

45

50

55

60

65