MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS - 1965
CONVENTION APPLICATION FOR A PATENT

We (1) REDIANKTI:BOLAGET NORDSTJERNAN,

of 3 Stureplan,

Stockholm,

Sweden

hereby apply for the grant of a Patent for an invention entitled: (1)

METHOD AND APPARATUS FOR SEPARATION OF LIQUID FROM A SUSPENSION.

which is described in the accompanying complete specification. This application is a Convention application and is based on the application numbered (2)

7308340-7

for a patent or similar protection made in (4) Sweden


Our address for service is Messrs. Edwd. Waters & Sons, Patent Attorneys, 30 Russell Street, Melbourne, Victoria, Australia.

DATED this 30th day of May 1974.

By John

To:

THE COMMISSIONER OF PATENTS.
COMMONWEALTH OF AUSTRALIA

Patents Act 1952-1962

DECLARATION IN SUPPORT OF A CONVENTION APPLICATION FOR A PATENT

In support of the application No. (a) made by (b) REDERI AKTIEBOLAGET NORDSTJERNAN

for an invention entitled (c) METHOD AND APPARATUS FOR SEPARATION OF LIQUID FROM A SUSPENSION

I, (d) LARS RÅMqvIST,

of (e) 3 Stureplan, Stockholm, Sweden

do solemnly and sincerely declare as follows:

1. (g) I am authorized by the abovementioned applicant for the patent/REDERI

AKTIEBOLAGET NORDSTJERNAN

to make this declaration on its behalf.

2. The basic application (x) as defined by Section 141 of the Act was/made in the following country countries on the following date(s) by the following applicant(s) namely:

   - in (l) Sweden on (j) 13th June, 1973

     by (k) REDERI AKTIEBOLAGET NORDSTJERNAN

3. (m) BENGT OLOV LUNDIN,

     of (n) Hedemora, Sweden

     is/as the actual inventor(s) of the invention and the facts upon which the applicant(s)
     is/are entitled to make the application are as follows:

     as regards entitlement under Section 34 of the Act: (o)

     The applicant is the assignee of the said actual inventor.

4. The basic application (x) referred to in paragraph 2 of this Declaration was/made in the first application(s) made in a Convention country in respect of the invention the subject of the application.

Declared at Nyköping, Sweden this 20th of May, 1974

PATENT OFFICE

To: The Commissioner of Patents,
Commonwealth of Australia.
Complete Specification for the invention entitled: "Method and Apparatus for Separation of Liquid from a Suspension".

The following statement is a full description of this invention, including the best method of performing it known to us.
This invention relates to a method and an apparatus for separating liquid from a suspension, preferably for dewatering suspensions such as slurry, fibre pulp and the like, and particularly suspensions consisting of flocks of suspended particles.

It is known to dewater a suspension by continuously feeding the suspension in between two belts or webs, which during the separation are driven in the same direction along a feed path, and of which at least one web is pervious to the liquid when the suspension along the feed path is subjected to squeezing pressure. At these known methods and apparatuses the webs are driven with equal speed or, when both webs are driven by a drive roll or drive drum common to the webs, with a limited speed difference in relation to the diameter of the drive roll and the thickness of the suspension. When the webs are driven around such a roll a certain speed difference is automatically obtained. This difference may reach to about 1.5%. Such a speed difference causes a certain shearing effect, which, however, is very small and of little value.

The present invention has as its object to render the dewatering or separation of another liquid phase from a suspension still more effective than it was heretofore possible by using known methods and apparatuses.

The method according to the invention is characterized in that the suspension is subjected to successively increasing squeezing pressure at different positions along the feed path as well as to shearing forces along the feed path by driving the webs at different speeds relative to each other.

It has been proved that by subjecting the suspension to this combined treatment according to the invention a consid-
erably greater dewatering effect is obtained compared with the sum effect obtained by subjecting the suspension to the treatment steps (increasing squeezing pressure and shearing forces respectively) separately. This dewatering effect has for certain suspension amounted to double said sum effect.

By the driving of the belts with different speeds the suspension is continuously revolved whilst being advanced, so that new portions of the suspension come into contact with the belt pervious to the liquid. The pulp, which is compressed by the pressing of the suspension against the belt pervious to liquid, thus, is to a substantial extent removed from said belt. This contributes to a high degree to the improved separation of the liquid obtained by the invention.

According to the invention, furthermore, the suspension is subjected to said squeezing pressure in different places along the feed path and hereby to a number of successively increasing squeezing pressures in said different places. In addition the improved separation of liquid in a favourable manner, hereby also an increased squeezing pressure on the suspension is obtained, as the suspension during its transport on the feed path is increasingly free from the liquid phase.

It has been found that if the belts are driven with a speed difference of at least 3 percent the shearing action will considerably increase and render a considerable more effective dewatering of the suspension. An optimal dewatering effect is achieved if the speed difference of the belts is held between 5 and 20 percent.

The choice of a speed difference with optimal dewatering effect is dependent upon the character of the suspension, the sludge, to be dewatered, e.g., the compress-
ility of the sludge. The choice of the speed difference is furthermore dependent upon the specific load by dewatering, e.g., the thickness of the suspension between the belts. Optimal dewatering effect can mostly be found within the limits of 5 to 20 percent speed difference of the belts for different characters of suspensions at different loads. If the speed difference of the belts is considerably more than 20 percent the belts will slip on the suspension and will not cause any revolution of the suspension and thus no increasing dewatering.

According to the invention, the relative speed difference between the belts is preferably controllable, so that the pressing operation and the separation of liquid can be adjusted to the characters of the suspension in question.

The apparatus according to the invention for carrying out the aforementioned method and for achieving the effective separation of liquid from a suspension comprises in known manner two endless belts or webs arranged to run with their broad sides facing each other and including between themselves the suspension, at least one of said belts being formed to permit therethrough the passage of the liquid in the suspension, and a number of rolls or drums being arranged so that a part of their circumference in enclosed by the belts. The apparatus according to the invention is characterized by the combination of including in the drive direction of the belts rollers with successively decreasing diameter and means for driving the belts at different speeds relative to each other.

The invention is described in greater detail in the following by way of some embodiments, with reference to the accompanying drawings.
In the drawings,

Figs. 1 and 2 show in a schematic manner two different embodiments of wire cloth presses, at which the present invention can be applied,

Fig. 3 shows in a schematic way of portion a wire cloth press according to Fig. 1,

Fig. 4 shows in a schematic way and on a enlarged scale a portion of a zone from Fig. 3 between two squeezing rolls at one application of the invention, and

Fig. 5, finally, shows in a schematic way the same zone in Fig. 4, but at another application of the invention.

In the wire cloth presses shown in Figs. 1 and 2, a lower endless web 1 runs over a drive roll 2, a guide roll 3 and a stretch roll 4. An upper endless web 5 runs over a drive roll 6 and a stretch roll 7. The two webs 1, 5 run in common over a number of rollers or drums 8, 9, 10 and 11 in the direction of the arrow A. The arrows B and C illustrate inlet for wet suspension and, respectively, outlet for dewatered suspension.

Fig. 1 shows a wire cloth press where all squeezing pressures act in the direction from the upper web 5 to the lower web 1. This wire cloth press is particularly adapted when its upper web 5 is made of a material impervious to liquid and the lower web 1 is a wire cloth.

Fig. 2 shows a wire press where the squeezing pressures on the suspension act alternatingly on the lower or upper web. This wire press offers a great number of variations, by choice of the web type, drums, sector angle for web contact with the drum, and the like. For the separation of liquid,
at least one web must necessarily consist of a material, which readily permits the passage of the liquid phase, for example a fine-meshed net, a felt or so-called wire cloth. The second web need not necessarily be pervious to the liquid phase, but may consist, for example, of rubber, metal, plastic or the like. Also both webs may be pervious to the liquid phase and preferably, but not necessarily, consist of the same material. This is particularly the case at the wire cloth press shown in Fig. 2.

The webs may be attached to enclose homogenous rolls for establishing squeezing pressure. The same effect, of course, is obtained with hollow drums. In order to render possible a more effective removal of the squeezed-out liquid phase, the drums preferably are perforated and, besides, means are provided within the drums for evacuating the liquid phase through their axles.

Instead of the single rolls 8-11 with different diameters shown in the wire cloth presses according to Figs. 1 and 2, rolls with equal diameter, for example two rolls, may be arranged in groups with diameters decreasing successively from one group to another. Such groups may also be alternated with single rolls.

The apparatus described above and shown in Figs. 1 and 2 are examples of wire presses at which the present invention can be applied.

In Fig. 3 the present invention is illustrated, for example, at a wire cloth press according to Fig. 1 where only one web, as here shown the upper web 5, will abut the squeezing rolls, of which the squeezing rolls 9 and 10 are selected as examples. Fig. 3, thus, shows only a part of the
wire cloth press and is, for reason of better cleanliness, drafted with another scale.

One of the characterizing features of the present invention is that the webs are driven with different speeds. This is illustrated in Fig. 3 for the webs 1 and 5 by the arrows \( v_y \) and, respectively, \( v_1 \). In the embodiment shown, the webs 1 and 5 are driven by the drive rolls 2 and, respectively, 6. It is further possible, by varying the driving of the rolls 2 and 6, to control the difference in speed between the two webs and thereby to adjust the squeezing operation and dewatering to the properties of the suspension in question.

In Fig. 3, furthermore, so-called squeezing zones for the suspension are marked, i.e., the zones in which the web 5 abuts the squeezing roll 9 and, respectively, 10, and a relief zone located between the rolls 9 and 10. Figs. 4 and 5 show a portion of said relief zone on a larger scale.

According to the invention, a wire cloth press as shown in Fig. 1 or 2 or any other of the aforementioned wire cloth presses may be operated according to one or the other of two alternatives. In one case, when at a squeezing roll or drum the web abutting the squeezing roll runs with a higher speed than the outer web, an increase in the shearing or "rolling" of the suspension in the squeezing zone at the squeezing roll is obtained. In the second case, when the outer web running in relation to a squeezing roll has a higher speed than the inner web, a reduced "rolling" of the suspension in the squeezing zone is obtained. In this latter case the difference in speed can be so adjusted that the webs pass the squeezing roll with the same angular speed, which implies that the suspension in the squeezing zone is not
subjected to forces other than the squeezing pressure.

In both of the aforesaid cases the difference in speed is utilized for revolving the suspension between the webs at low pressure in the relief zone between two squeezing rolls, so that new portions of the suspension are brought into contact with the web or webs permitting the passage of the liquid phase in the suspension. This revolving, thus, renders possible an improved separation of the liquid from the suspension.

In Figs. 4 and 5 this revolving is illustrated for the aforesaid cases in a highly schematic way by the arrows entered into the suspension, Fig. 4 illustrating the squeezing operation at $v - v_y$, and Fig. 5 at $v_y > v_1$.

The invention is particularly, but not exclusively adapted for use at the dewatering of slurry resulting from sedimentation in waste water purifying plants.

EXAMPLE

Three different types of sludges A, B and C were dewatered between two belts arranged to subject the sludge to a constant squeezing pressure. The belts were at first driven with the same speed and then with a speed difference of 12% to each other.

The same sludges were then dewatered by subjecting the sludges to successively increasing squeezing pressures between the belts, whereby at first the belts were driven with the same speed and then with a speed difference of 12% to each other. The following improvements in % of the de-watering of the sludge was achieved:
<table>
<thead>
<tr>
<th>Sludge</th>
<th>Percental improvement of dewatering</th>
<th>by only shearing action through 12% speed difference</th>
<th>by only increasing squeezing pressures</th>
<th>by shearing action and increasing squeezing pressures</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.5</td>
<td>14.4</td>
<td>27.0</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>4.8</td>
<td>16.8</td>
<td>26.0</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>1.2</td>
<td>28.0</td>
<td>37.0</td>
<td></td>
</tr>
</tbody>
</table>

As appears from the above figures, a considerably greater dewatering effect was obtained by subjecting the suspension to the combined treatment according to the invention also compared with the sum effect of the treatment steps separately.
CLAIMS
The claims defining the invention are as follows:

1. A method of separating liquid from a suspension, at which the suspension is fed in between two belts, which during the separation are driven in the same direction along a feed path, and of which at least one belt is pervious to the liquid when the suspension along the feed path is subjected to squeezing pressure, characterized in that the suspension is subjected to successively increasing squeezing pressure at different positions along the feed path as well as to shearing forces along the feed path by driving the belts at different speeds relative to each other.

2. A method as defined in claim 1, characterized in that the relative difference in speed between the belts is adjustable.

3. A method as defined in claim 1, characterized in that the relative difference in speed between the belts is at least 3 percent.

4. A method as defined in claim 3, characterized in that the relative difference in speed between the belts is 5 to 20 percent.

5. An apparatus for separating liquid from a suspension according to claim 1, comprising two endless belts arranged to run with their broad sides facing each other and to include the suspension between themselves, at least one of said belts being formed to permit the passage of the liquid.
therethrough, and a number of rollers or drums being
arranged so that part of the circumference is enclosed by
the belts, characterized in the combination of arranging
rollers having successively decreasing diameter in the drive
direction of the belts and means for driving the belts at
different speeds relative to each other.

6. An apparatus as defined in claim 5, characterized
in that said means for driving the belts are provided with
means for adjustably setting the speed difference between
the belts.

7. A method of separating liquid from a suspension,
substantially as hereinbefore described with reference to
and as illustrated by the foregoing Example.

8. An apparatus for separating liquid from a
suspension, substantially as hereinbefore described with
reference to and as illustrated by the accompanying drawings.

DATED this 30th day of MAY 1974.

REDERIAKTIEBOLAGET NORDSTJERNAN,