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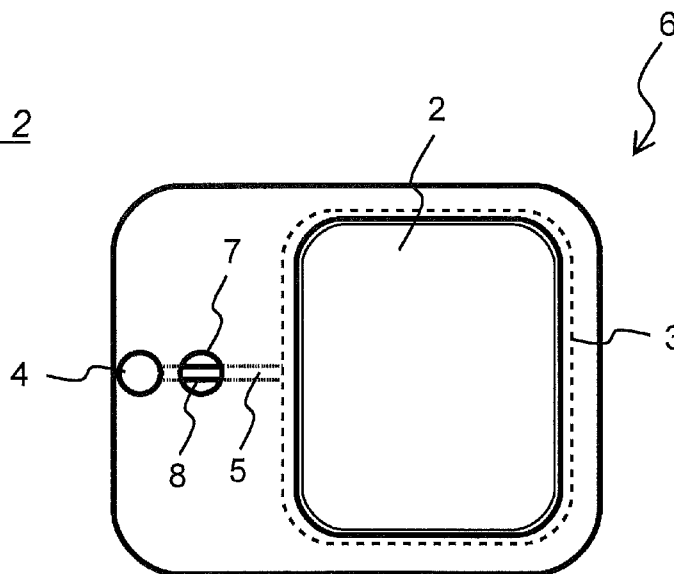
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(54) **Title:** FILTER PLATE

Fig. 2



(57) **Abstract:** The invention relates to a filter plate (6) for use in a filtering device, the filter plate (6) comprising a cavity (2), a moveable membrane (3) disposed over the cavity (2), thereby forming a squeezing chamber defined by the cavity (2) and the membrane (3), and a first port (4) adapted to co-operate with a corresponding port of an adjacent filter plate (6) to form a common pressurizing channel, the pressurizing channel being in communication with the squeezing chamber via a pressurizing conduit (5). According to the invention it is suggested to provide a second port (7) adapted to co-operate with a corresponding port of the adjacent filter plate (6) to form a common actuating channel, and a collapsible sleeve (8) responsive to a pressure increase in the actuating channel, the sleeve (8) being disposed in the second port (7) and forming a part of the pressurizing conduit (5).

TITLE OF INVENTION

Filter plate

TECHNICAL FIELD

The invention relates to a filter plate for use in a filtering device, the filter plate comprising
5 a cavity, a moveable membrane disposed over the cavity, thereby forming a squeezing chamber defined by the cavity and the membrane, and a first port adapted to co-operate with a corresponding port of an adjacent filter plate to form a common pressurizing channel, the pressurizing channel being in communication with the squeezing chamber via a pressurizing conduit.

- 10 A filter device with a plurality of such filter plates as plate stacks and filter chambers, which are respectively configured between adjacent filter plates of the stack, is known e.g. from US 4,844,803 A. In the filter chambers, substantially in the respective separation plane between the filter plate and the associated counter plate, one or two filter cloths and a rubber elastic membrane are disposed depending on the configuration of the filter device.
- 15 During filtering operation of the known filter device, the filter chambers are supplied through filling shoes with the pressurized suspension, which is to be filtered, and the suspension is pressed through the filter cloths. Thus, the solid content of the suspension is deposited on the filter cloth as a filter cake. The filtered suspension from which the solid content is purged flows out from the filter chambers as a filtrate below the filter cloth
- 20 substantially without pressure. After filtration, the one or two movable membranes are acted on by pressurized air or another gaseous medium at a gas pressure between 4 to 16 bar.

BACKGROUND ART

- Whenever a leakage occurs in one of the membranes of the known filter device, the
25 pressurizing medium percolates into the cake side and discharges unperceived from the filter device together with the filtrate. Where the leakage as such may easily be recognized by monitoring the fluid flow of the pressurizing medium supplied to the filter device, it is

merely impossible to identify the actually affected membrane, in particular where the filter device has a large number of filter chambers.

Methods and devices for detecting a leaking membrane are suggested in DE 299 16 427 U1 and in DE 203 07 912 U1: For each filter chamber, a fluid flow sensor is inserted into the pressurizing conduit for the pressurizing medium. In case the pressurizing medium still flows into a chamber, where it has stopped flowing into the others, a leakage of the respective chamber and its membrane is detected.

During squeezing the filter cakes of the known filter devices, values of fluid flow of the pressurizing medium into the respective squeezing chambers spreads over a large interval due to decrease in pressure over the common feed pipe outside the filter chambers, due to heterogeneous load of solid content inside the chambers or due to soiling of the respective pressurizing conduits. Monitoring the fluid flows thus leads to false positive detection of leaking membranes or, more important, to missing actual leakages.

PROBLEM TO BE SOLVED

Thus it is an object of the invention to suggest another device for detecting a leaking membrane that avoids the drawbacks of the known state of the art.

SUMMARY OF INVENTION

Based on the filter plate described supra, this object is achieved by providing a second port adapted to co-operate with a corresponding port of the adjacent filter plate to form a common actuating channel, and a collapsible sleeve responsive to a pressure increase in the actuating channel, the sleeve being disposed in the second port and forming a part of the pressurizing conduit. Sleeves are known to be both simple and effective valves. After shutting the pressurizing conduit and monitoring the pressure of the pressurizing medium inside the squeezing chamber rather than its fluid flow, a decreasing pressure indicates leakage of a respective chamber and its membrane. The sleeve of the present invention functions as a pinch valve.

The invention may equally be applied in filter devices having one or two filter clothes per filter chamber as well as in filter devices using gaseous or fluid pressurizing media. In

particular, water, palm oil or acid sulfur may equally be applied as pressurizing media. The invention may further equally be applied separate from a filtering process, in an empty state of the filter chambers, or it may be applied while squeezing out the filter cake after the filtering process.

- 5 Currently, squeezing pressure (and pressure for detecting membrane leakage) is known to be applicable from 4 up to 30 bar. However, even higher pressure may be applied with future filter devices. In particular, high squeezing pressure is applied in filter devices having the membranes welded to the filter plates. Filter devices having replaceable membranes clamped or screwed to the filter plates are usually charged with lower
10 squeezing pressures.

The membrane leakage may be detected in case the pressure decreases at a rate exceeding a fixed value. As the squeezing chambers can easily be pressurized to a common level, a common maximum rate of decrease in pressure can be defined for all squeezing chambers. This common fixed value greatly simplifies adjusting the related measuring, indicating and
15 signal devices.

The value may be fixed by statistical analysis of pressure data from monitoring a multitude of the squeezing chambers. Monitoring multiple squeezing chambers and statistical analysis provides for automatic setting of the value. The fixed value may further be set by use of an expert system based on previously monitored pressure data.

- 20 Preferably, within the filter plate according to the invention, the measuring device is arranged in the pressurizing conduit. In the pressurizing conduit, the measuring device is not exposed to the suspension, thus avoiding the measuring device to be soiled and shortened in function.

Furthermore preferred, the measuring device is integrated with the sleeve. Integration of
25 the sleeve with the measuring device provides for easy retrofitting and quick replacement of the common item.

In an advantageous embodiment of a filter plate according to the invention, an indicator for indicating the pressure inside the squeezing chamber is provided, the indicator being visible while the filter plate being mounted into the stack. Such indicator provides for easy

reading pressure data measured inside the squeezing chamber from outside the filter device.

In a further advantageous embodiment of a filter plate according to the invention, a signal device for signaling a membrane leakage, in case the measuring device measures a decrease of the pressure. Such signal device provides for quick visual selection of a filter plate having a leaking membrane. The signal device may e.g. have an acoustic element or show a signal color or warning light for signaling leakage.

Further preferred, a filter plate according to the invention has a transmission element for transmitting pressure data measured by the measuring device to a common pressure monitoring device of the filter device. Such transmission element and common monitoring device provides for automatic monitoring for membrane leakage as well as for keeping records and statistical analysis of pressure data for quality control.

BEST MODE FOR CARRYING OUT THE INVENTION

The method according to the invention and the associated device are subsequently described in more detail with reference to a preferred embodiment illustrated in the drawing figures.

Fig. 1 shows a schematic overview of a known filter plate, and

Fig. 2 shows a schematic overview of a filter plate according to the invention.

The known filter plate 1 shown in figure 1 has a cavity 2 and a moveable membrane 3 disposed over the cavity 2, forming a squeezing chamber between the membrane 3 and the cavity 2. A first port 4 is provided that penetrates the known filter plate 1, forming a common pressurizing channel with a corresponding port of an adjacent filter plate. The first port 4 is in communication with the squeezing chamber via a pressurizing conduit 5. (The squeezing chamber, the pressurizing channel, and the adjacent filter plate and it's corresponding port are not shown.)

The filter plate 6 according to the invention shown in figure 2 resembles the known filter plate 1. (Common features are marked with respective numbers, accordingly.) A second port 7 is provided that penetrates the filter plate 6, forming a common actuating channel

with a further corresponding port of the adjacent filter plate. The filter plate 6 according to the invention has a sleeve 8 being disposed in the second port 7, and forming part of the pressurizing conduit 5. (The actuating channel and the further corresponding port of the adjacent filter plate, as well as further features of the filter plate 6 according to the invention mentioned below are not shown in the drawing figures.)

The filter plate 6 according to the invention has an attachment part, that features two filtrate channels, forming two filtrate pipes together with filtrate channels of further such filter plates 6 inside a stack of filter plates 6 in a filter device. Through the filtrate pipe, the filtrate is discharged from a filter chamber, formed between the filter plate 6 and an adjacent filter plate of the stack.

The attachment part is connected to a main part of the filter plate 6 by screws guided by through-holes formed in the attachment part. The filter plate 6 is split into main part and attachment parts at two sides in order to overcome a restriction in size defined by common moulding presses used for manufacturing filter plates. Of course, the invention is not restricted to filter plates assembled from main parts and attachment parts, but may also be applied with filter plates moulded in one.

Through the pressurizing channel and a pressurizing conduit 5, the pressurizing medium is supplied into the squeezing chamber.

The filtrate pipes, the pressurizing channel as well as suspension channels of the filter device are each formed by corresponding channels into the attachment part and into another attachment part at the opposite side of the filter plate 6. The filtrate pipes, pressurizing channels and suspension channels are thus in existence only while the filter plates are stacked and interrupted while the filter plates are separated e.g. for discharging the filter cake from the filter chambers.

The filter plate 6 has a measuring device for measuring a pressure inside the squeezing chamber. The measuring device is integrated into a valve cartridge that is provided as an integral spare part for the filter plate 6. At its outer visible edge, the filter plate 6 has a signal device for signaling a membrane leakage. The signal device is driven by pressurized air, supplied through a separate control channel, forming a control pipe and flexible tubes.

For checking for possible membrane leakages, prior to operation with the suspension, the squeezing chambers of the stacked filter plates are automatically supplied with compressed air as pressurizing medium through the pressurizing channel. After pressure inside the first port 4 reaches a steady state, pressurized air is supplied to the actuating conduit for closing the sleeves 8.

The signal device is connected to the squeezing chamber and exposed to the pressure inside the squeezing chamber. While exposed to the pressure supplied from the pressurizing channel, a display shows a green signal. Where the pressure decreases below a fixed critical value, the display switches from green to red and the signal device emits an audible beep for signaling leakage of the membrane 3.

As the actuating pressure of the pressurized air inside the second port 7 exceeds the pressure of the pressurizing medium inside the sleeve 8 and overpowers the resistance of the rubber sleeve 8, the latter collapses and closes the first port 4. Continuing flow of pressurized air into the second port 7 after collapsing of the sleeve 8 indicates a sleeve failure.

In the figures

- 1 filter plate
- 2 cavity
- 3 membrane
- 4 first port
- 5 pressurizing conduit
- 6 filter plate
- 7 second port
- 8 sleeve

CLAIMS

1. Filter plate (6) for use in a filtering device, the filter plate (6) comprising a cavity (2),
 - a. a moveable membrane (3) disposed over the cavity (2), thereby forming a squeezing chamber defined by the cavity (2) and the membrane (3), and
 - b. a first port (4) adapted to co-operate with a corresponding port of an adjacent filter plate (6) to form a common pressurizing channel, the pressurizing channel being in communication with the squeezing chamber via a pressurizing conduit (5),

characterized by a second port (7) adapted to co-operate with a corresponding port of the adjacent filter plate (6) to form a common actuating channel, and a collapsible sleeve (8) responsive to a pressure increase in the actuating channel, the sleeve (8) being disposed in the second port (7) and forming a part of the pressurizing conduit (5).
2. Filter plate (6) according to the preceding claim, *characterized by* a measuring device for measuring pressure inside the squeezing chamber.
3. Filter plate (6) according to the preceding claim, *characterized in that* the measuring device is arranged in the pressurizing conduit (5).
4. Filter plate (6) according to the preceding claim, *characterized in that* the measuring device is integrated with the sleeve (8).
5. Filter plate (6) according to one of the preceding claims, *characterized by* an indicator for indicating the pressure inside the squeezing chamber, the indicator being visible while the filter plate (6) being mounted into the stack.
6. Filter plate (6) according to one of the preceding claims, *characterized by* a signal device for signaling a membrane leakage, in case the measuring device measures a decrease of the pressure.
7. Filter plate (6) according to the preceding claim, *characterized in that* the signal device has an acoustic element for signaling the leakage.

8. Filter plate (6) according to one of the preceding claims, *characterized by* a transmission element for transmitting pressure data measured by the measuring device to a common pressure monitoring device of the filter device.

Fig. 1 (SdT)

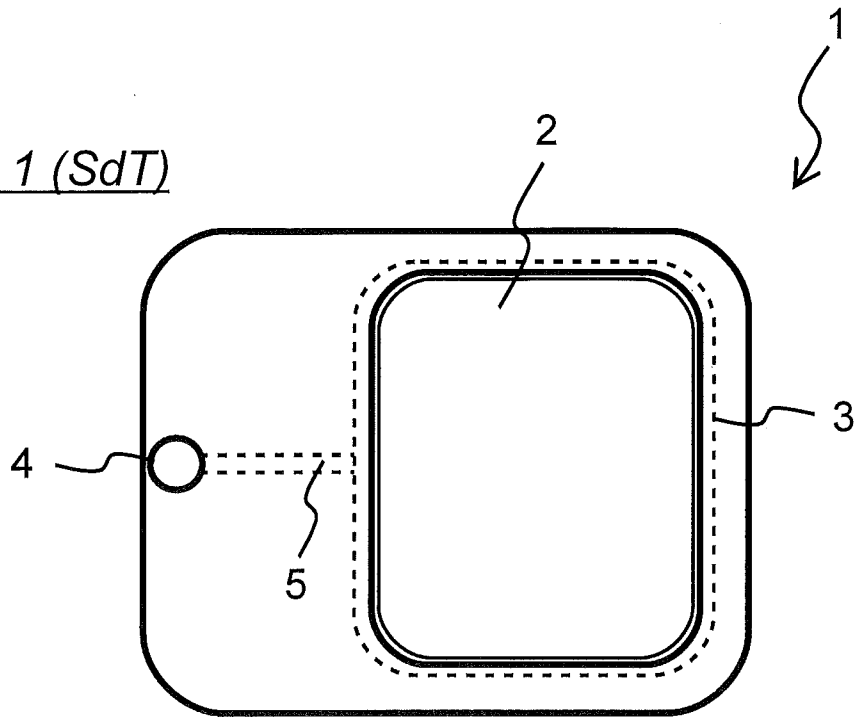
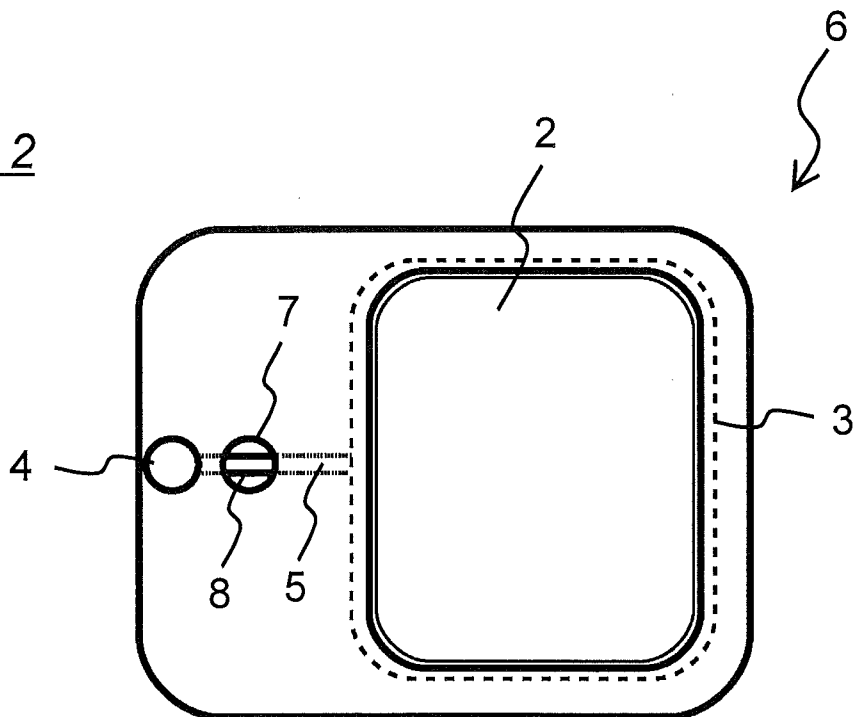


Fig. 2



INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
INV. B01D25/12 B01D25/28 B01D35/143
ADD.

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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	DE 299 16 427 U1 (LENSER FILTRATION GMBH) 9 December 1999 (1999-12-09) cited in the application the whole document	1-8
A	JP H10 296009 A (KURITA MACHINERY MANUF) 10 November 1998 (1998-11-10) the whole document	1-8
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See patent family annex.

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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