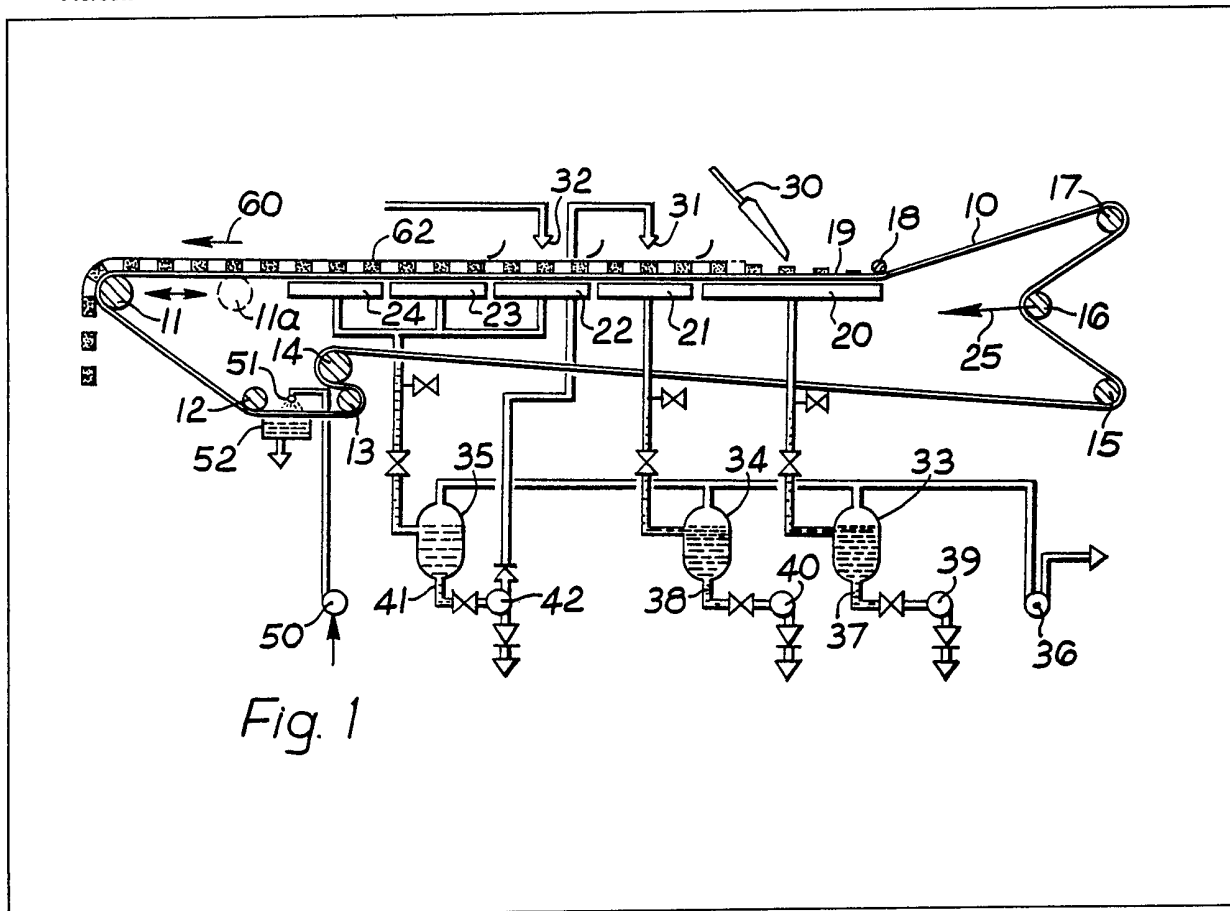


- (21) Application No 8130406
- (22) Date of filing 8 Oct 1981
- (30) Priority data
- (31) 81/00710
- (32) 10 Jan 1981
- (33) United Kingdom (GB)
- (43) Application published 21 Jul 1982
- (51) INT CL<sup>3</sup>  
B01D 33/04
- (52) Domestic classification  
B1D 1405 1604 1606 1610  
1612 1819 2002 2003 2004  
2005 2006 2101 2106 2107  
2108 JA
- (56) Documents cited  
GB 2052290A
- (58) Field of search  
B1D
- (71) Applicants  
Henri Gerhard Willem  
Pierson,  
98 London Road,  
Bozeat,  
Northamptonshire.
- (72) Inventors  
Henri Gerhard Willem  
Pierson

(74) Agents  
Barlow, Gillett & Percival,  
94 Market Street,  
Manchester, M1 1PJ.

(54) Horizontal vacuum belt filter

(57) Belt 10 is progressed stepwise in the direction of arrow 60 over successive vacuum boxes 20 to 24 by guide roller 11 being extended from its retracted position at 11a to its full line position whilst vacuum to the boxes 20 to 24 is shut off. Roller 16 is displaceable to permit this and return movement of the roller 11 is prevented by a uni-directional arrangement in one or the other of rollers 13, 14. Slurry is fed by nozzle 30, optional wash liquor is fed by nozzle 32 and optional recirculated wash liquor is fed by nozzle 31 all under the influence of a control which provides for such feed only for a predetermined period of time during the actual movement of the belt 10.



1/1

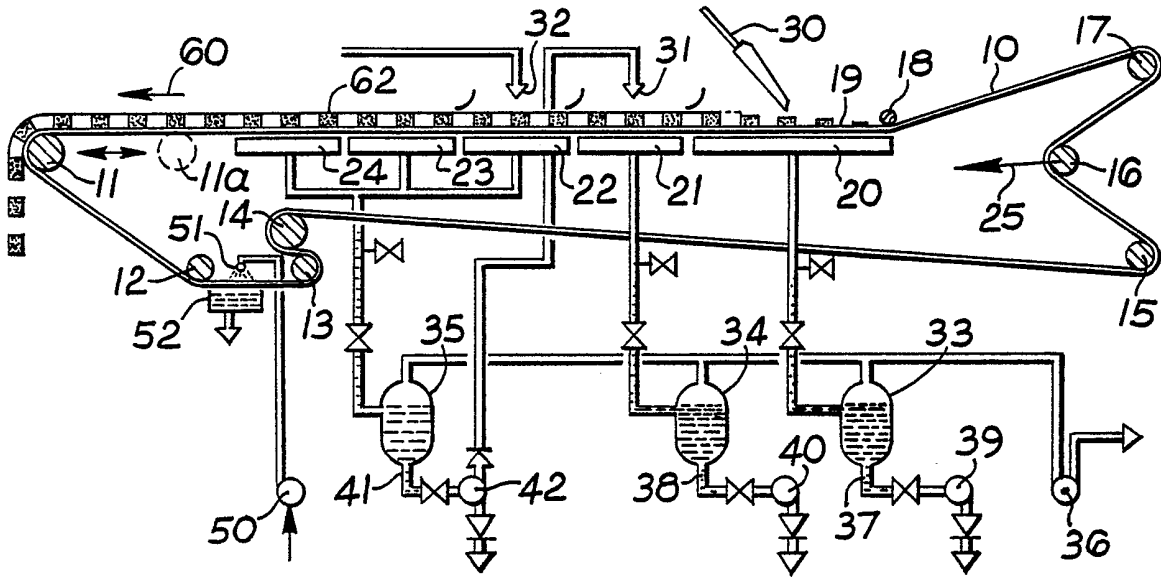


Fig. 1

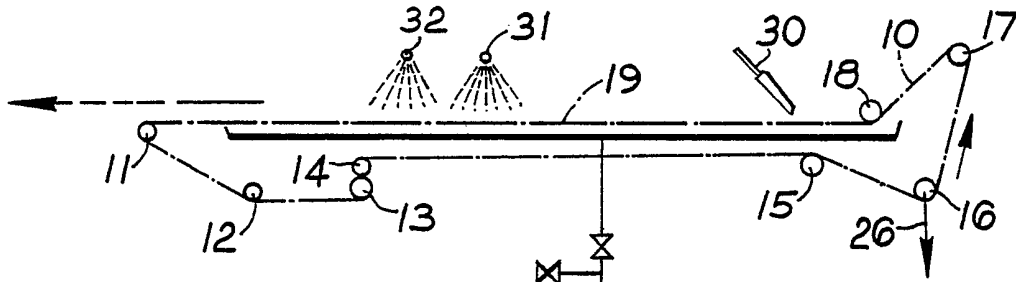


Fig. 2

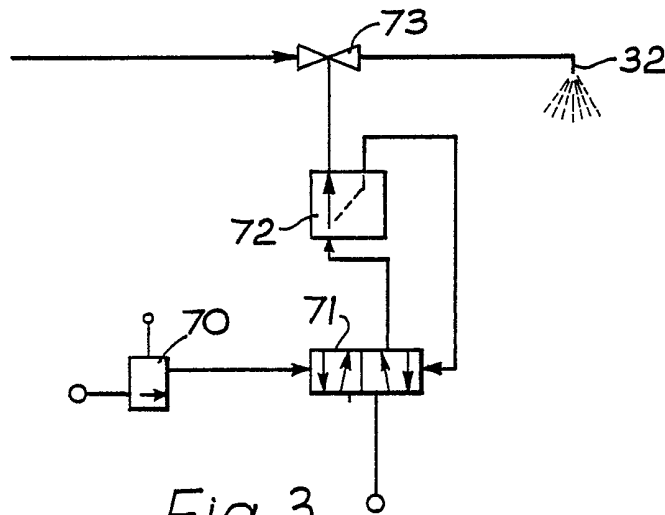


Fig. 3

## SPECIFICATION

**Horizontal vacuum belt filter**

5 This invention concerns a horizontal vacuum belt filter of the kind comprising an endless filter belt or cloth guided to provide a substantially horizontal upper run onto which is fed slurry required to be filtered, the belt or cloth being adapted to be moved  
10 forward stepwise so as to progress successive portions of the upper run over a series of vacuum boxes which serve to suck away liquid from the slurry and to leave solid from the slurry deposited on the belt or cloth as filter cake.

15 In the known types of horizontal vacuum belt filter the filter belt or cloth, and with it the filter cake, is displaced intermittently in discrete increments. In order to permit the displacement, the vacuum system connected to the vacuum boxes is switched  
20 off, and the filter belt or cloth, with the cake and/or slurry thereon, is displaced in a discrete increment, after which vacuum is switched on again, this sequence of operations being repeated continuously.

25 On other types of known horizontal vacuum belt filters, the filter cake and slurry move continuously whilst being kept under vacuum. However, in such systems, the filter belt or cloth is supported by a carrier belt, and in yet another system the filter belt  
30 or cloth, with the filter cake, move continuously but the vacuum boxes travel intermittently backwards and forwards therebeneath, each backwards travel occurring during a period whilst the vacuum is switched off.

35 On all horizontal vacuum belt filters, the feeding of slurry to the filter belt or cloth is often a problem; the control of the resultant cake thickness can only be achieved by use of mechanical sensors and in general the even distribution of relatively small  
40 quantities of cake wash liquor over the entire filter cake is almost impossible. Particularly in the pharmaceutical and fine chemical industries, often only small quantities of wash liquor may be used, yet complete coverage is critical. In such cases it is often  
45 impossible to obtain the necessary balance between restricted volume of wash liquor and complete coverage of the filter cake.

An object of the present invention is to provide a construction of intermittently-moving horizontal  
50 vacuum belt filter in which the above-discussed problems are overcome.

With this object in view, the present invention provides a horizontal vacuum belt filter of the kind above referred to having liquid feed means for  
55 supplying liquid (which may be slurry required to be filtered or may be wash liquor for washing filter cake on the belt or cloth) to the belt or cloth characterised in that it comprises a control operative, upon commencement of each forward movement of the  
60 belt or cloth, to actuate the said feed means to supply its liquid to the belt or cloth during a predetermined period of time during its said forward movement.

A preferred construction of the belt filter of the  
65 invention has its respective liquid feed means for the

slurry and for the wash liquor, with each said feed means having its own said control to supply its slurry and its wash liquor respectively for respective predetermined periods.

70 The or each said control is preferably variable.

The or each said control conveniently comprises, the liquid supply means, a by-pass valve connected to a time delay unit, which may be variable in its setting, which serves, after a predetermined period  
75 of opening of the valve to an outlet of the liquid feed means, to switch off the supply to the outlet.

Where the liquid feed means serves to supply the slurry, in order to control cake thickness the by-pass valve would be fitted in the feed line to the slurry  
80 feed outlet and this by-pass valve is connected to the time delay unit. This time delay unit then takes its impulse from the forward movement of the filter belt or cloth and during a preset time, the valve remains in a position corresponding to the feeding of slurry  
85 to the belt or cloth, until the desired predetermined period has expired and a known volume of slurry has been supplied, whereupon the by-pass valve is activated to enable the slurry to be recirculated. Once the time delay unit has been set to give a  
90 required cake thickness, the frequency of the intermittent forward stepwise movement of the belt or cloth can be adjusted by the operator at will without in any way affecting the cake thickness, which is simply controlled by the time delay unit. In this  
95 manner a completely non-mechanical non-contact system is, for the first time, made available to permit cake thickness control.

The same principle applies where the liquid feed means serves to supply cake wash liquor. The  
100 normal problem lies in the difficulty in applying relatively small quantities, on a continuous basis, in order to achieve complete coverage. Using the time delay principle s discussed above, again the by-pass valve will be located in the wash liquor feed system  
105 and this valve will be actuated so that wash liquor is fed to the belt or cloth for a predetermined period each time when the cloth/cake moves forward. In this manner high pressures and high volumes can be used during the period that the wash liquor is being  
110 supplied and thereby complete coverage of the cake can be ensured, yet the total volume used may be very small, the valve being in a condition providing for wash liquor flow to the belt of cloth only for its short predetermined time.

115 Once the system has been set, increase or decrease in the frequency of the intermittent forward stepping movements of the belt or cloth has no effect on the efficiency of the system which automatically adjusts to the belt-stepping frequency used at  
120 any particular time.

A further optional refinement of the filter of the invention lies in the provision of vibratory means to agitate the belt or cloth, and therewith the filter cake, during the period when the vacuum is switched off.

125 This greatly increases the contact between the wash liquor and the cake and generally adequately achieves complete elimination of cake cracking.

The invention will be described further by way of example, with reference to the accompanying drawing, in which:-  
130

*Figure 1* is a diagrammatic side view illustrating a horizontal vacuum belt filter to which the present invention is applicable;

*Figure 2* is a simplified view comparable with *Figure 1*, showing a slightly modified embodiment, and

*Figure 3* is a simplified circuit diagram illustrating a practical embodiment of control arrangement suitable for the wash liquor supply or the feed slurry supply in the apparatus of *Figures 1* and *2*.

Referring firstly to *Figures 1* and *2*, a practical embodiment of the horizontal vacuum belt filter conforming to the invention comprises an endless belt or cloth 10 guided around rollers 11, 12, 13, 14, 15, 16, 17 and 18 to provide an operative upper run 19 which extends over a succession of vacuum boxes 20, 21, 22, 23 and 24. The foremost guide roller 11 is adapted, at successive intervals of time, to be reciprocated between its extended position illustrated in full lines and a retracted position indicated in dotted lines at 11a. The guide roller 16 is biased resiliently in the direction indicated by arrow 25 in *Figure 1* or in the direction indicated by the arrow 26 in *Figure 2*, to take up slack which would otherwise arise in the belt or cloth 10 when the foremost guide roller 11 moves to its retracted position 11a. Either the one or the other of the guide rollers 13, 14 is fitted with an appropriate mechanism which restricts its direction of rotation such that the belt or cloth 10 may travel only in the direction indicated by the arrow 60.

Accordingly, it will readily be understood that upon the foremost guide roller 11 being shifted from its retracted dotted line position 11a to its extended position, the upper run of the belt or cloth 10 is caused to extend by drawing a portion of the belt or cloth 10 out of the bight defined by the respective guide roller 16, the latter yielding to permit this. Upon the roller 11 returning to the dotted line retracted position 11a, the roller 16 shifts as indicated by the arrow 25 or 26 thereby causing the slackening portion of the upper run 19 to be kept taut by the lower run of the belt or cloth being drawn through the nip provided by the rollers 13, 14.

Thus, the combined effect of the roller 16, the movement of the foremost guide roller 11 and the unidirectional effect of one or other of the rollers 13, 14 is to ensure that each extension of the foremost guide roller 11 causes a stepping movement of the upper run 19 of the belt or cloth 10.

A feed slurry supply nozzle or weir box 30 serves, as will be described later, to supply to the belt or cloth 10, just in advance of the guide roller 18 on the upper run 19 above the vacuum box 20, a slurry required to be filtered using the apparatus.

A first wash liquor nozzle 31 is disposed above the upper run 19 above the vacuum box 21; a second wash liquor nozzle 32 is correspondingly disposed above the vacuum box 22.

The vacuum box 20 is connected to a vacuum receiver 33; the vacuum box 21 is connected to a vacuum receiver 34; the three vacuum boxes 22, 23 and 24 are connected together and to a common vacuum receiver 35. All three vacuum receivers 33, 34 and 35 are connected, by their upper parts, to a

common vacuum pump 36.

Outlets 37 and 38 from the lower parts of the vacuum receivers 33 and 34 are connected to respective pumps 39, 40 for liquid therefrom to be directed away from the apparatus, e.g. for subsequent treatment or for discharge. On the other hand outlet 41 from the common receiver 35 leads to a pump 42 whose outlet is valved to enable its output to be directed away from the apparatus (as above discussed) or to be directed to the first wash liquor nozzle 31.

A pump 50 serves to supply washing liquid to a belt or cloth washing nozzle 51 disposed above the belt or cloth 10 between the guide rollers 12 and 13 so that washing liquid sprayed onto the belt or cloth 10 by the nozzle 51 washes all residue from the belt or cloth 10 into a tank 52.

As so far described, the apparatus operates as follows. For slurry deposition and filtration, with the roller 11 in the withdrawn or retracted dotted-line position at 11a, the slurry is supplied by way of the nozzle or weir box 30 whilst the belt or cloth 10 is stationary and vacuum is applied to the vacuum boxes 20 to 24 by the pump 36. Liquid from the receivers 33, 34 and 35 is drawn away as described. During the slurry feed, the nozzle or weir box 30 may be vibrated and/or displaced either transversely or longitudinally of the belt or cloth 10, as may be appropriate for the material being treated. After a predetermined period of time, a mechanism, not shown, is triggered to switch off the vacuum to the vacuum boxes 20 to 24, and to actuate a pneumatic ram (not shown) to cause the roller 11 to be moved to the extended full line position in *Figure 1*, thereby stepping the upper run 19 of the belt or cloth 10 forward by one step in the direction of the arrow 60. The vacuum is then switched on again, whilst the ram retracts the roller 11 so that filtration continues, with solid material from the slurry building up as filter cake indicated diagrammatically at 62 on the operative upper run 19 of the belt or cloth 10.

For washing the filter cake 62, an appropriate wash liquor is supplied to the nozzle 32 from which it sprays onto the filter cake 62 through which it passes to be taken up by the vacuum boxes 22, 23 and 24. According to the setting of the valve controlling the output of the pump 42, the liquid from the boxes 22 to 24 can either be directed away from the apparatus or can be recirculated to the first wash liquor nozzle 31.

Turning now to *Figure 3*, this *Figure* illustrates diagrammatically, a control arrangement. A respective one of these may be provided for controlling the slurry supply to the nozzle or weir box 30, and/or the wash liquor supply to the second wash liquor nozzle 32 and/or the recirculated wash liquor supply to the first wash liquor nozzle 31. The *Figure* shows the control arrangement applied to the nozzle 32 and as illustrated includes a valve 70 which is arranged so as to be actuated simultaneously with the triggering of the pneumatic ram which displaces the roller 11. Upon such triggering, the valve 70 supplies an impulse to a control valve 71 which serves, through a timer 72, to open a shut-off valve 73 which controls the supply of wash liquor to the nozzle 32. Accord-

ingly, wash liquor is supplied to the nozzle 32 only for a predetermined period of time, as set by the timer 72, which is adjustable, which thereupon is operative to actuate the control valve 71 and shut-off the wash liquor.

Accordingly, by setting the timer 72, one can provide for a predetermined amount of wash liquor to be supplied to the filter cake 62, upon each stepping movement of the belt or cloth 10, and this wash liquor feed will vary automatically and in proper proportion with increase in and decrease of the frequency of the stepping movement of the belt or cloth 10 and does not need individual adjustment upon such increase or decrease being effected.

A comparable arrangement can readily be incorporated in the feed line for recirculated liquor supplied to the first wash liquor nozzle 31.

Most important, however, is the fact that the slurry supply to the nozzle or weir box 30 can also incorporate a comparable arrangement, and this will, once it is appropriately adjusted, ensure that the slurry feed to the belt or cloth 10 is directly related to the progressing or stepwise movement of the belt or cloth 10 regardless of any adjustment of the frequency of movement thereof.

The invention is not confined to the precise details of the foregoing example, and variations may be made thereto. Thus, for instance, in the illustrated cases, the control arrangement is pneumatic.

However, it could equally well be mechanical, hydraulic, electrical or electronic, or a combination thereof. Naturally it is not essential that the control should be applicable only to machines having means for supplying both slurry and wash liquor and it can be employed in cases where only a slurry supply is present.

#### CLAIMS

1. A horizontal vacuum belt filter of the kind comprising an endless filter belt or cloth guided to provide a substantially horizontal upper run onto which is fed slurry required to be filtered, the belt or cloth being adapted to be moved forward stepwise so as to progress successive portions of the upper run over a series of vacuum boxes which serve to suck away liquid from the slurry and to leave solid from the slurry deposited on the belt or cloth as filter cake, having liquid feed means for supplying liquid (which may be slurry required to be filtered or may be wash liquor for washing filter cake on the belt or cloth) to the belt or cloth characterised in that it comprises a control operative, upon commencement of each forward movement of the belt or cloth, to actuate the said feed means to supply its liquid to the belt or cloth during a predetermined period of time during its said forward movement.

2. A belt filter as claimed in claim 1 and which has its respective liquid feed means for the slurry and for the wash liquor, with each said feed means having its own said control to supply its slurry and its wash liquor respectively for respective predetermined periods.

3. A belt filter as claimed in claim 1 or 2 in which the or each said control is variable.

4. A belt filter as claimed in claim 1, 2 or 3 in which the or each said control comprises, in the liquid supply means, a by-pass valve connected to a time delay unit which serves, after a predetermined period of opening of the valve to an outlet of the liquid feed means, to switch off the supply to the outlet.

5. A belt filter as claimed in claim 4 wherein the time delay unit is variable in its setting.

6. A cake filter as claimed in any preceding claim further characterised by the provision of vibratory means to agitate the belt or cloth, and therewith the filter cake, during the period when the vacuum is switched off.

7. A belt filter substantially as hereinbefore described with reference to and as illustrated in Figures 1 and 3 or in Figure 2 of the accompanying drawing.

Printed for Her Majesty's Stationery Office, by Croydon Printing Company Limited, Croydon, Surrey, 1982.  
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.