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㉛ **Industrial washing machine with improved product concentration control.**

㉜ The invention pertains to industrial washing machines, in particular to single-drum tunnel washers, comprising a device for product-concentration control consisting of a cell capable of measuring a concentration-dependent physical parameter, a device for dosing product into the washing machine, and an electronic control unit which monitors said measuring cell and controls the operation of the dosing device as a function thereof, characterized in that the measuring cell is positioned inside the drum and capable of rotation therewith. Preferably the control unit is such that the product-dosing device is switched off during the emerged position of the cell. By the invention an improved product-concentration control is achieved.

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INDUSTRIAL WASHING MACHINE
WITH IMPROVED PRODUCT CONCENTRATION CONTROL

The present invention relates to industrial washing machines and, in particular, to such washing machines comprising an automatic product-concentration control.

5 In the field of industrial laundry cleaning both batch-type and continuous washing machines are used. In general batch-type washing machines resemble conventional household washing machines, whereas continuous washing machines often are so-called tunnel
10 washing machines, i.e., multi-compartmented continuous laundering machines capable of handling wash loads of 250 to 3000 kgs per hour.

Tunnel washing machines can be divided into single- and
15 double-drum tunnel washers.

A conventional type of single-drum tunnel washer comprises a single elongated rotatable drum, a hollow shaft being disposed along the central axis of the drum
20 and rigidly attached to the drum via a spiral blade which is perpendicular to and winds round the shaft thereby dividing the drum into a plurality of compartments. The hollow shaft normally houses one or more liquid product and water supply lines. As the
25 shaft is rotating during the laundering operation, the liquid supply lines are in free or sliding suspension therewith.

In contrast to the single-drum type double-drum tunnel
30 washers have two co-axial drums, viz. a multi-compartmented rotatable inner drum, and a static outer-drum.

Whatever the type of industrial washing machine, to ensure effective and economic performance it is an

essential requirement that the product concentration in the wash bath and, accordingly, the product dosing operation is continuously monitored and controlled during the washing process. To this purpose generally a
5 cell is incorporated capable of measuring a concentration-dependent physical parameter, such as e.g. the conductivity, transparency or pH of the wash bath solution. The measuring cell is monitored by a control unit which controls the product dosing
10 operation as a function of the value measured for the physical parameter, e.g. by switching on or off a dispensing pump or by regulating the speed or capacity thereof.

15 In this way it is possible to continuously control the product concentration in the wash bath and keep it at the level desired.

Conventionally such cells have been positioned in the
20 static parts of the washing machine outside the rotating drum, i.e. in the wall of the static outer-drum (double-drum machines) below the normal level of the wash bath level or in the outlet reservoir or in a static cavity (single-drum machines) specifically
25 designed for this purpose.

From a maintenance point of view a constantly immersed cell is far from optimal and, in particular with single-drum tunnel washers where such cell is
30 necessarily positioned in a non-circulating part of the wash bath, product-concentration control is adversely influenced and often slow and inaccurate.

It is therefore an object of the present invention to
35 provide an industrial washing machine in which the disadvantages attached to the conventional product-concentration control are overcome.

In its broadest aspects the present invention provides an industrial washing machine having a rotatable drum which comprises a device for product-concentration control consisting of a cell capable of measuring a
5 concentration-dependent physical parameter, a device for dosing product into the washing machine and an electronic control unit which monitors said measuring cell and controls the operation of the said dosing device as a function thereof, characterized in that the
10 measuring cell is positioned inside the rotatable drum and capable of rotation therewith.

Preferably the cell will be suitable for conductivity measurement, but also other techniques may be used
15 suitable for the purpose, such as optical techniques or pH-measurement.

Since the measuring cell is positioned inside the drum, it will rotate therewith during the laundering
20 operation. Only part of the drum being occupied by wash liquor, the cell will be emerged from the wash liquor during part of the total rotation cycle, resulting, at least during this part of the cycle, in a parameter value not related to the instant product concentration.

25 It is therefore an essential feature of the present invention that the dosing operation is interrupted during the emerged position of the cell in order to avoid miscontrol of the dosing operation due to
30 improper measurement by the emerged cell. Accordingly, the control unit is preferably such that the product-dosing device is switched off during the emerged position of the measuring cell. Such temporary switch-off can be by way of mechanical or electrical means.

35 When concentration measurement is based on conductivity, emersion of the cell from the wash liquor will result in a very low conductivity value.

Preferably therefore, the control unit is designed such that it switches off the dosing device when the conductivity value as measured by the cell drops below a certain, pre-set value. When the cell is immersed again, the conductivity is restored to the value corresponding to the wash liquor and the control unit resumes the conventional control of the dosing operation.

10 Preferably the electric connection between the measuring cell and the control unit is established by way of a sliding contact in the shaft. This type of electric connection is already found in a conventional type of single-drum tunnel washing machine in the form of a sliding ring/carbon brush contact connecting the thermometer in the drum to the control unit.

Due to the often damp atmosphere near washing machines sliding contacts suffer from parasitic resistances which significantly influence the parameter values monitored by the control unit. It is therefore preferred to correct the parameter value as monitored by the control unit using a reference value as monitored during the emerged position of the cell. The magnitude of the parasitic resistance is influenced by the degree of moisture and accordingly changes, although slowly relative to the drum rotation time in the laundering process, with time. Preferably therefore, the control units corrects the parameter value as monitored in each cycle of rotation using the reference value as measured in the previous cycle.

It will be appreciated that in laundering processes where more than one product is used or the same product is dosed at more than one compartment of the tunnel washer, a plurality of separate product-concentration control devices in accordance with the present invention can be used.

The invention will now be illustrated with reference to the accompanying drawing, in which:

Figure 1 shows, in a schematic way, a single drum
5 tunnel washing machine in accordance with the present invention, for reasons of clarity the drum being drawn partly cut away and partly cut open, the end of the shaft being drawn in an enlarged window.
A drum 1 is shown divided into a plurality of
10 compartments 2 by way of a spiral blade 3 perpendicular to a hollow shaft 4 along to the total length of the drum. The outer edge 5 of blade 3 is fixed to drum wall 6, the inner edge 7 to shaft 4. In the shaft liquid product lines and water supply lines (of which lines
15 8,9,10 are illustrations), are disposed having outlets at appropriate dosing positions in shaft 4. To enable throughlet of water and product through shaft 4 into the drum mesh type openings 11 are incorporated in the shaft at positions corresponding to the compartments
20 where specific products have to be dosed. Effluent wash liquor leaves drum 1 via drains 12.

Drum 1 is rotated by motor driven rollers 13, 14.
Washloads enter drum 1 at the inlet side 15 and are
25 transported from compartment to compartment by way of rotary movement of drum 1 and the spiral shape of blade 3. After having passed all compartments each of which corresponds to a specific step of the laundering process, wash loads are collected at the outlet side 16
30 of drum 1.

In accordance with the invention a conductivity cell 20 capable of measuring the conductivity inside drum 1 is incorporated in drum wall 6 at a position corresponding
35 to a compartment where product concentration control is desired. By means of electric wiring (not drawn) along the outside of drum wall 6 cell 20 is electrically

connected to connection points 21 of sliding carbon rings 22. Via a sliding ring/carbon brush connection at end 23 of shaft 4 cell 20 is electrically connected to an electronic control unit outside drum 1, which as a function of the conductivity as measured by cell 20 controls a product pump (the electric wiring, control unit and product pump are not drawn).

Concentration control by way of conductivity measurement takes place in a conventional manner. If the conductivity of the wash liquor is lower than a operator-set standard valve product dosing is started and continued until the conductivity has been raised to above the standard value.

During the laundering operation drum 1 rotates over 360° around its central axis. Since the drum is not completely filled with wash liquor, the level being well below the central axis of the drum, cell 20 is emerged from the wash liquor during part of the 360° rotation cycle, and accordingly, the conductivity as measured during this part of the rotation cycle drops to a value far below the conductivity of the wash liquor. The control unit is such that it switches off the dosing operation when the conductivity value as monitored drops below a certain value which is pre-set well below the normal range of conductivity values of the wash liquor but above the conductivity value as monitored during the emerged position of cell 20. When cell 20 is re-immersed the monitored conductivity is restored to the normal range of values of the wash liquor, i.e. well above the pre-set value, and the control unit resumes the control of the dosing operation.

Due to parasitic resistances in the sliding ring/carbon brush connection the conductivity value as monitored by the control unit may be off-set to a significant extent. To compensate this off-set the conductivity

- value as monitored by the control unit is corrected using the reference value as monitored during the emerged position of cell 20. As the absolute magnitude of the reference value may change slowly in time e.g.
- 5 due to changes in humidity, the reference value as monitored in the previous rotation cycle is used for the correction of the conductivity value in the subsequent rotation cycle.
- 10 The position of the measuring cell inside the drum enables accurate and sensitive product concentration control. The switch-off of the dosing operation during the emerged cell position and the correction of the parameter value as monitored by the control unit
- 15 minimizes the interference of spurious measurements or parasitic off-sets.

CLAIMS

1. An industrial washing machine having a rotatable drum which comprises a device for product-concentration control consisting of a cell capable of measuring a concentration-dependent physical parameter, a device for dosing product into the washing machine, and an electronic control unit which monitors said measuring cell and controls the operation of the dosing device as a function thereof, characterized in that the measuring-cell is positioned inside the drum and capable of rotation therewith.
2. A washing machine according to claim 1 wherein the control unit is such that the product-dosing device is switched off during the emerged position of the cell.
3. A washing machine according to claim 1 or 2 wherein the cell is suitable for conductivity measurement.
4. A washing machine according to claim 3 wherein the dosing device is switched off when the parameter value as monitored drops below a pre-set value.
5. A washing machine according to any one of the preceding claims which is a single-drum tunnel washing machine.
6. A tunnel washing machine according to claim 5 wherein the measuring cell is electrically connected to the control unit by way of a sliding contact between rotating and static machine parts.
7. A tunnel washing machine according to claim 5 or 6 wherein the control unit corrects the parameter value as monitored using a reference value as measured during the emerged position of the cell.

8. A tunnel washing machine according to claim 7 wherein the control unit corrects the value of the physical parameters using the reference value as measured in the previous cycle of rotation.

9. A device for product concentration control suitable for use in a washing machine according to any one of the preceding claims.

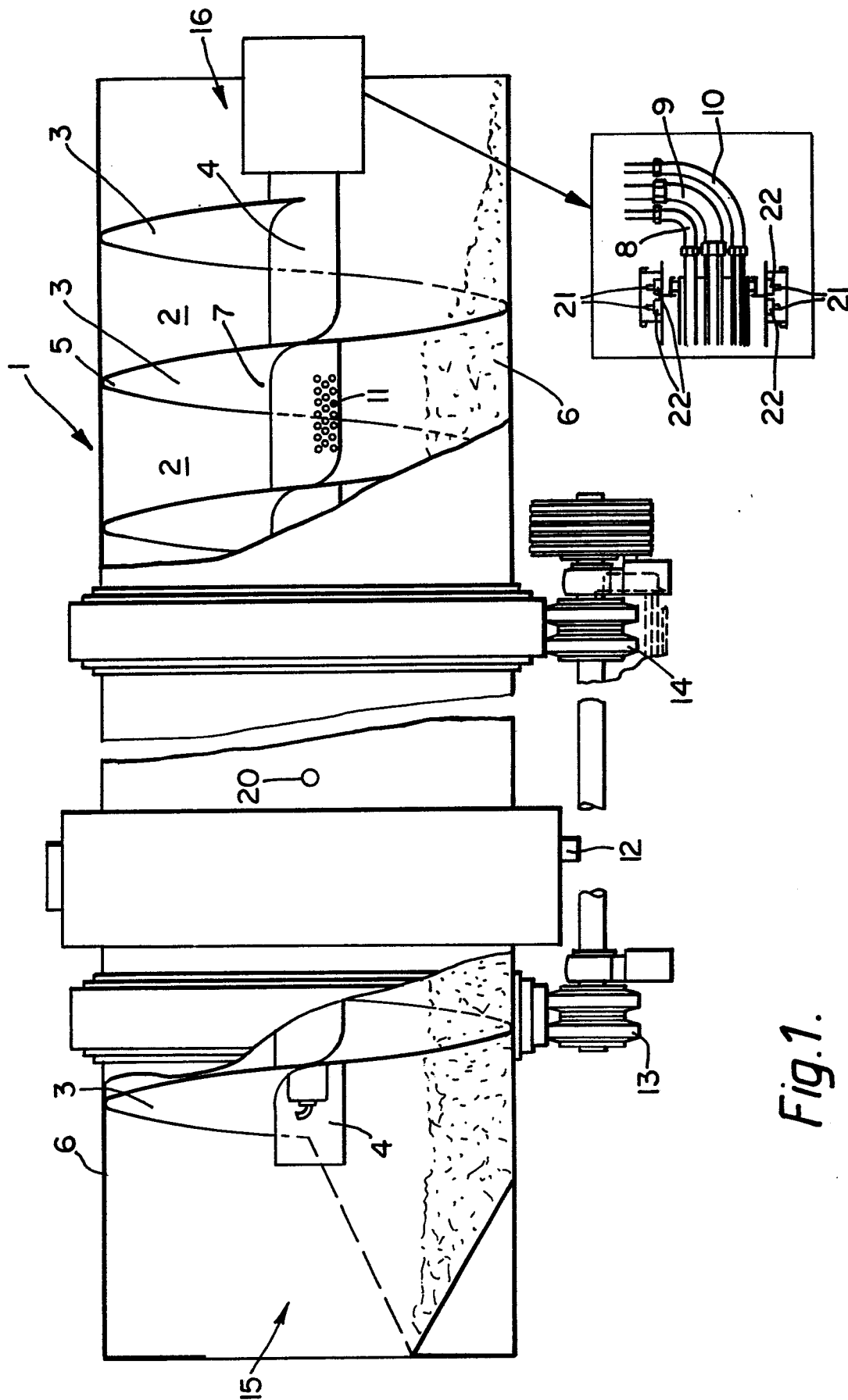


Fig.1.



European Patent
Office

EUROPEAN SEARCH REPORT

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EP 85 20 1012

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	FR-A-1 292 039 (ELLIS) * Figures; abstract; page 1, left-hand column and right-hand column, lines 1-4 *	1,3,4	D 06 F 39/00 D 06 F 31/00
A	--- US-A-3 645 669 (G. RAUSCH) * Figures 3-5; claims *	1,3,4	
A	--- US-A-3 335 501 (JANKE et al.) * Figures 2,3; column 3, lines 10-22 * -----	1,3,4,6	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			D 06 F B 08 B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 19-02-1986	Examiner COURRIER, G. L. A.
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	