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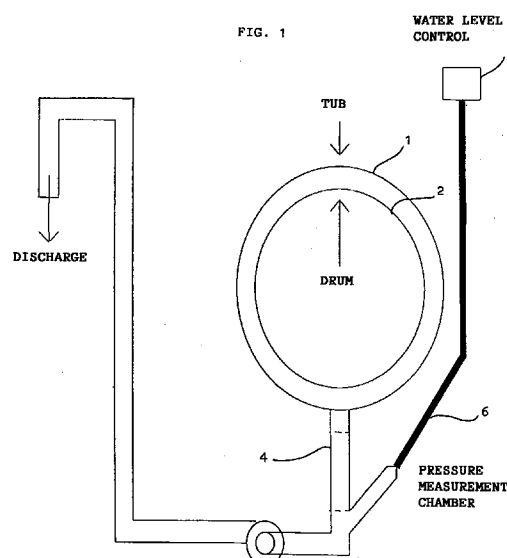
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(54) Clothes washing and drying machine with foam reducing arrangement

(57) Clothes washing machine comprising a washing tub (1), a rotating drum (2) capable of holding the washload, a discharge conduit (4) arranged underneath the tub, a pressure sensor (5) installed in an air chamber (6) connected with the lower portion of said discharge conduit, said machine being adapted to perform a washing cycle comprising at least a rinsing phase, and being further provided with processing and control means (7) adapted to receive from said pressure sensor a signal corresponding to the pressure detected in said air chamber and to periodically work out the mean value thereof. Said processing and control means are adapted to store said mean value and compare it with the mean value that is worked out subsequently. In a preferred manner, if the difference between the mean values being compared is found to be higher than a given pre-determined value, said processing and control means generate at least a modification in the pre-selected washing programme, consisting in reducing the rotational speed of the drum and/or increasing the rinsing phases.



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Description

The present invention refers to a clothes washing machine provided with improved means for automatically controlling excessive foaming reactions and taking corrective actions accordingly.

Clothes washing machines are generally known in the art, whose operation is controlled by programme sequence control means, said programme sequence usually including one or more clothes rinsing phases at the end of the actual washing phase.

It has been observed that, under particular operating conditions, eg. when excessive amounts of detergent substances are added to the washing liquor or when particularly high-foaming or high-sudsing detergent substances are used, as it frequently happens in current home laundering practice, a process of excessive foam formation takes place in the washing tub, whereas said foam, owing to the alternating rotational movement of the washload holding drum, tends to seep into all cavities that are accessible from the tub and, in particular, to spill outside the machine through the water inlet or detergent dispenser arrangement.

A further problem brought about by an excessive amount of foam forming in the tub during laundering lies in the fact that, in the subsequent rinsing and spin-extraction phases, such a foam cannot be entirely removed by the action of normal rinsing phases, which will obviously have been designed to cope with just low-to-medium sized amounts of foam, also in view of limiting rinsing water usage.

An undesired result of such a drawback is that, even after regularly performed washing, rinsing and spin-extraction phases, the clothes handled in such laundering processes tend to still show foam traces on them, which give an impression as such clothes had not been effectively rinsed, while the actual cause is the excessive amount of foam that it was practically impossible to entirely remove from the clothes through an ordinary rinsing process.

It therefore would be desirable, and it is in fact a purpose of the present invention, to provide a clothes washing machine which is capable of eliminating all of the afore cited drawbacks by using arrangements and processes that are adapted to reduce and/or compensate for the effect of an excessive presence of foam during the washing phase of the laundering process, in accordance with most simple and reliable methods and relying upon the use of readily available component parts and techniques.

The invention will be more readily understood from the description which is given below by way of non-limiting example with reference to the accompanying drawings, in which:

- Figure 1 is a schematical view of the various component parts involved by the present invention in a clothes washing machine;

- Figures 2, 3 and 4 are three diagrammatical representations of the evolution of the pressure in the water discharge conduit as recorded during a washing phase carried out without any detergent addition, with the addition of a medium-foaming detergent and with the addition of a high-foaming detergent, respectively.

The term "water" will be used generally in the following description to mean both washing liquor and rinsing water. However, such a simplification should not affect the understandability of the same description owing to the context in which such a term is used, as anyone skilled in the art will readily appreciate.

Referring now to Figure 1, which illustrates a preferred embodiment of the present invention, a solution according to the present invention will be described in the following, along with its principle of operation.

The described machine comprises a washing tub 1, a drum 2 rotatably arranged within said washing tub and adapted to hold the washload, a driving motor (not shown) connected to said rotating drum and adapted to rotatably driving the latter at variable, pre-selectable rotating speeds.

A water discharge conduit 4 is arranged underneath said washing tub along with water pressure sensing means 5 mounted in an air chamber 6, whose open portion is connected with the lower portion of said water discharge conduit, and adapted to detect the pressure of the water column acting on said lower portion of the discharge conduit, said machine being adapted to perform at least a washing cycle comprising at least a rinsing phase.

Also all other component parts of the machine that, although not specifically shown here with reference to the above cited illustrations, are nevertheless instrumental in contributing to create the conditions which are necessary in view of a correct operation of the machine, need also to be duly considered in this connection.

The present invention relies essentially on the discovery that the signal coming from said sensing means during a typical washing cycle, which is however performed without any detergent being added in order to more effectively illustrate on a comparative basis the process being described, is a signal that varies at a high frequency and oscillates about a mean value which however remains absolutely constant, as this can be seen in Figure 2 where such a mean value is represented by the straight line "A".

The oscillations of this signal represent the rapid pressure variations taking place on the bottom of the conduit as brought about by the agitation of the surface of the water which is in turn displaced continuously by the movement of the drum.

The fact that the mean value of the pressure keeps constant demonstrates that no foam growth process is going on which would cause the pressure to progressively increase. In this case, this is a quite obvious

observation, since the test is performed without any addition of detergent, as effectively shown in Figure 2.

Reference should be made now to Figure 3, which records the evolution of the pressure as detected under the same conditions as in the afore cited case, but with the addition of an amount of medium-foaming detergent product. It can be noticed that, even in this case, the mean value of the pressure, as indicated by the straight line "B", keeps substantially constant, albeit at a slightly different value. This must be interpreted to mean that such a variation in the average pressure is due to the presence of foam and that said average pressure does not however increase progressively, but stabilizes down at a still constant, albeit higher mean value.

Reference should be made now to Figure 4, which records the evolution of the pressure as detected under the same conditions as in the afore cited case, but with the addition of an amount of high-foaming detergent product. It can be noticed that, in this case, the mean value of the pressure, as represented by the straight line "C", varies by progressively increasing its value from a mean value of 70 (point generally referred to as G in Figure 4) to a final mean value of more than 78 (point generally referred to as H in Figure 4).

Such a behaviour represents the progressive pressure increase brought about by the continuous foam formation caused by the high-sudsing detergent product.

The present invention consists therefore in providing sensing means to detect the pressure on the bottom of either the tub or the discharge conduit, said means being adapted to deliver signals being representative of said pressure to processing means 7 arranged to handle such signals, said means being capable of determining the mean value of such a pressure during pre-defined periods of time.

Said means are also adapted to store said mean pressure values, as they are successively worked out by them, and compare them with each other to find out the difference. Finally, if they find out that the difference between subsequent values is greater than a pre-established value, said means are adapted to deliver corresponding commands to the controls and functional parts of the machine so as to correspondingly modify the process parameters of the washing cycle and/or the subsequent rinsing cycles in view of reducing or eliminating the excessive production of foam or the effects thereof.

Such processing, storage and control means, which are typically electronic means associated to a microprocessor, are easily implemented by anyone skilled in the art, so that no further explanation or description will be given of their nature, construction and operating modes. On the contrary, the fundamental functions of such means, which are an integral part of the present invention, will be described in greater detail.

Considering however the fact that a situation of excessive foam formation may not be detected by the comparison of the pressure values of two subsequent periods of time, since the pressure increase may in

such a case be limited by the closeness of the successive measurement intervals or by some other factor, it is a more effective solution when the mean pressure value is detected and stored first at the beginning of the washing phase and then for all of the appropriately selected successive measurement intervals. The comparison will then be performed successively between each one of such mean pressure values, as the corresponding value becomes available, and the initially measured value.

Any possible problem or drawback as may be brought about by a progressively increasing amount of foam is in such a manner overcome. The same applies to the problem connected to the detection of such a progressive development of the foaming process, which can in this way be carried out through a much more reliable and simple control of the actually reached mean value as compared to the initial value.

The presence of such means in the machine enables a number of further improvements to be implemented. A first such improvement consists in systematically monitoring the mean pressure value at pre-defined intervals of time, storing such value and comparing it with the value that it worked out subsequently. If the difference emerging from such a comparison is greater than a pre-determined value, so as to therefore indicate a situation of "too much foam" being developed in the tub on the basis of both theoretical considerations and practical tests, said means will then automatically determine a reduction in the rotating speed of the drum, so as to reduce the resulting foam formation accordingly.

Another such improvement, which may be implemented at the same time as or contextually with the above cited one, consists in causing the number of rinses to be correspondingly increased, since regularly provided rinses might not be adequately effective to handle such a "too much foam" situation.

For the same reason, still another improvement consists in causing the amount of rinsing water filled in to be increased in connection with one or more of the regularly provided rinses, so as to more effectively remove the excessive amount of foam from the wash-load.

Finally, a further improvement consists in using said "too much foam" information generated by said control means to activate some appropriate form of alarm or attention-arousing contrivance for the user, so that he or she is enabled to duly take the irregular condition into account and possibly take the corrective steps as necessary, by for instance interrupting the washing cycle prematurely, causing part of the washing liquor to be discharged before the proper time, causing one or more rinses to be repeated, etc., according to the circumstances and the possibilities offered by the machine in this connection.

Such an information may be in the form of any signal-conveying contrivance adapted to be adequately perceived by the user, such as an acoustic or optical alarm, a combination thereof, or another type or signal

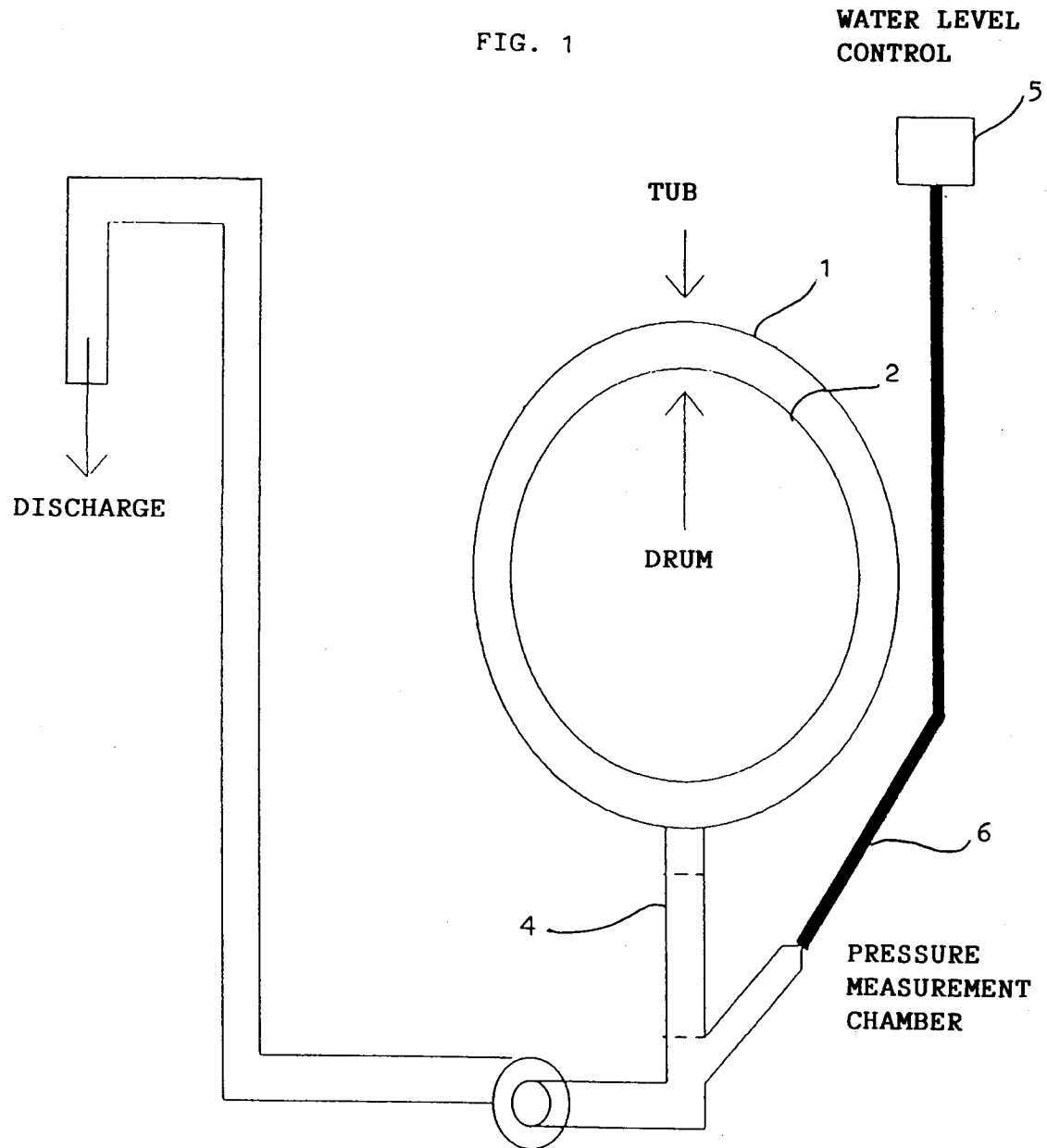
yet which may or may not be associated with an interruption of the operation of the machine.

Claims

1. Clothes washing machine comprising a washing tub (1), a drum (2) rotatably arranged within said tub and adapted to hold the washload, a discharge conduit (4) provided underneath said tub, a pressure sensor means (5) installed in an air chamber (6) whose open portion is connected with the lower portion of said discharge conduit, said sensor means being adapted to detect the pressure of the water column acting on said lower portion of the discharge conduit, wherein said machine is arranged to perform at least a washing cycle comprising at least a rinsing phase, **characterized in that** it is further provided with processing and control means (7) arranged to receive from said pressure sensor a signal corresponding to the pressure detected in said air chamber, and to periodically work out the mean value thereof. 5 10 15 20
2. Clothes washing machine according to claim 1, **characterized in that** said processing and control means (7) are further adapted to store said mean value and compare it with the mean value that is worked out subsequently. 25
3. Clothes washing machine according to claim 1, **characterized in that** said processing and control means (7) are adapted to store the first mean value worked out in said manner, and to compare it with each mean value being worked out subsequently. 30 35
4. Clothes washing machine according to any of the preceding claims, **characterized in that** the activation of both said processing and control means (7) and said sensor means is determined automatically upon starting a washing phase. 40
5. Clothes washing machine according to any of the preceding claims 2 to 4, **characterized in that** if the difference between the mean values being compared is found to be higher than a given pre-determined value corresponding to a condition of "too much foam" being developed in the tub, said processing and control means generate at least a modification in the pre-selected washing programme, in view of restraining the foam formation process. 45 50
6. Clothes washing machine according to claim 5, **characterized in that** said at least a modification consists in reducing the rotational speed of the drum. 55
7. Clothes washing machine according to claim 5 or 6, **characterized in that** said at least a modification

consists in adding at least a supplementary rinsing phase.

8. Clothes washing machine according to claim 5, **characterized in that** said at least a modification consists in filling in a greater amount of water in connection with at least a rinsing phase.
9. Clothes washing machine according to any of the preceding claims 4 to 8, **characterized in that** it is arranged to convey to the user a signal indicating the occurrence of said condition of "too much foam" developing in the tub.



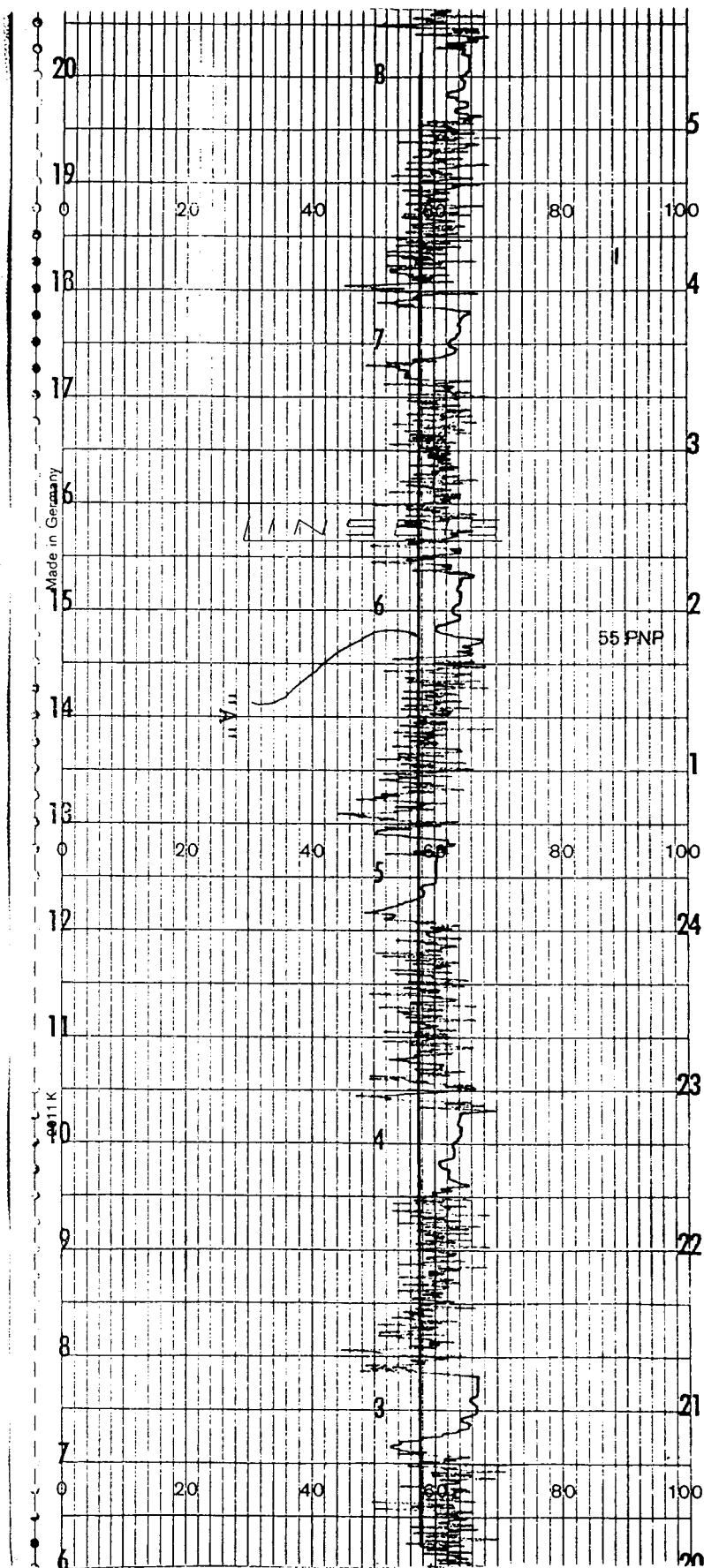


FIG. 2

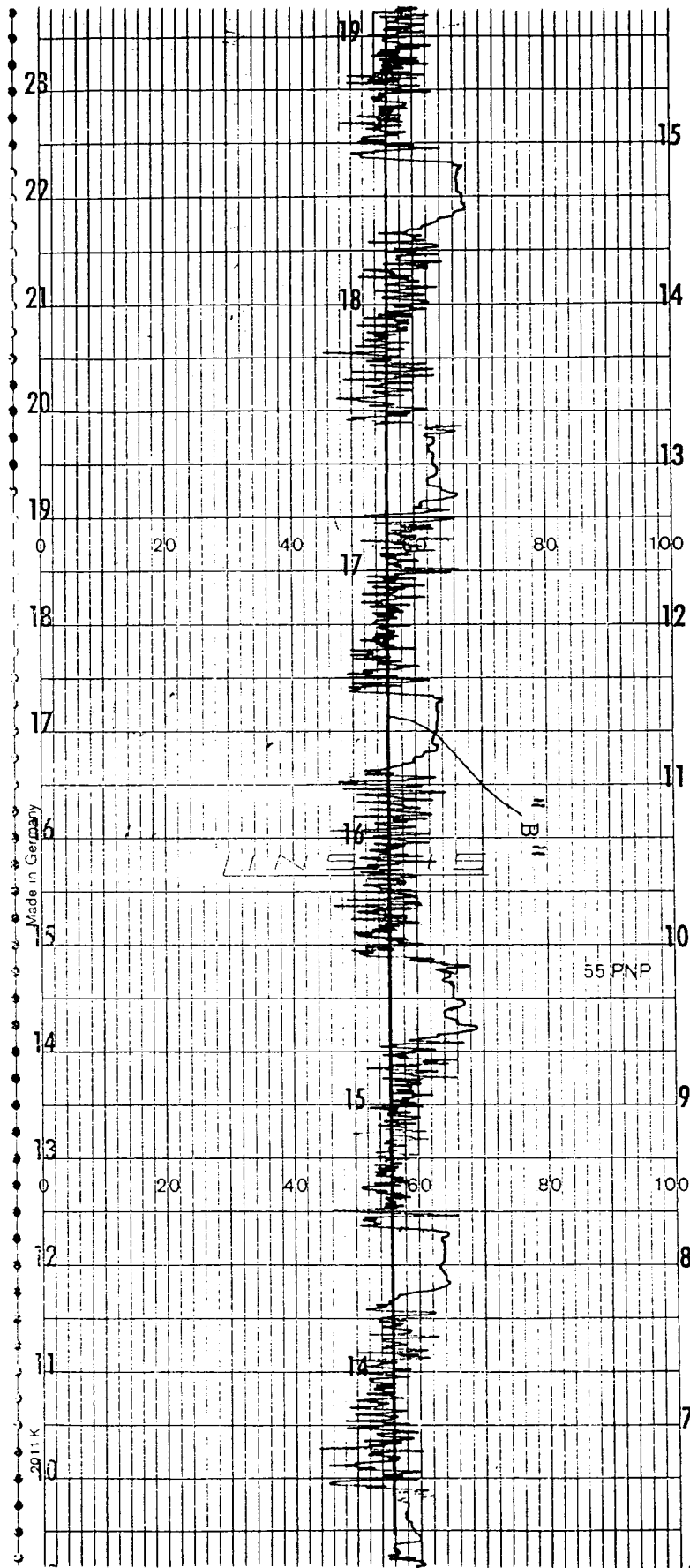


FIG. 3

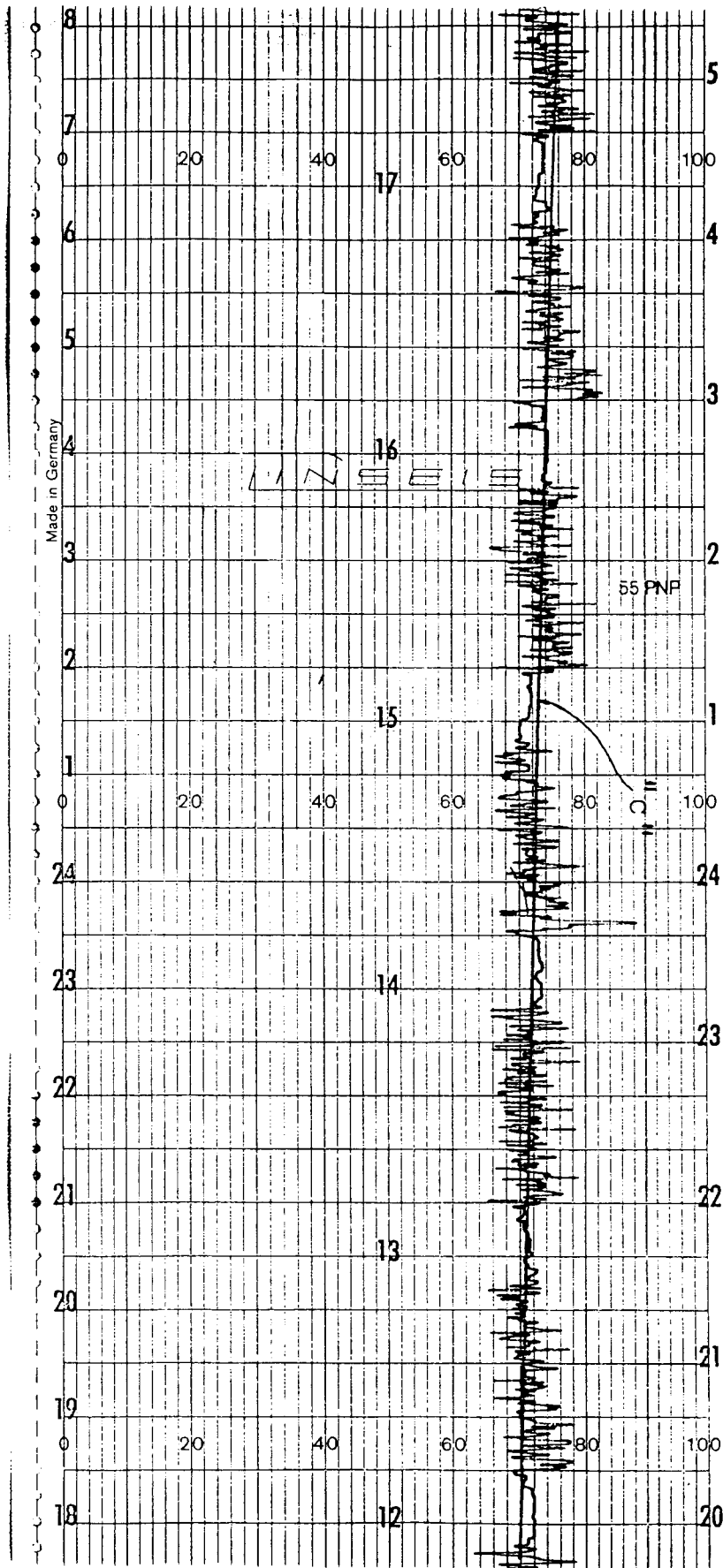


FIG. 4



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EUROPEAN SEARCH REPORT

Application Number
EP 96 10 0503

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.6)
X	EP-A-0 278 239 (BOSCH-SIEMENS HAUSGERÄTE GMBH) * claims 1-5,7; figure * ---	1-6	D06F39/06
A	DE-A-41 04 151 (MIELE & CIE GMBH) * claims 1,3,5; figure * ---	1-6	
A	EP-A-0 268 155 (LICENTIA PATENT-VERWALTUNGS-GMBH) * claims 1-4,8,9,16,17; figure * ---	1,2,5-8	
A	DE-A-23 25 586 (MIELE & CIE GMBH) * claims; figure * -----	1,5,7-9	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.6) D06F
Place of search		Date of completion of the search	Examiner
THE HAGUE		13 May 1996	Courrier, G
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			

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