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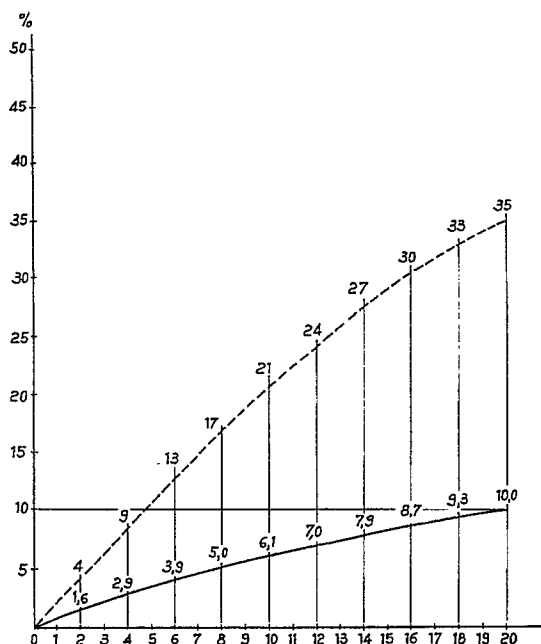
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54 **A process and a machine for washing and drying textile articles.**

57 An automatic or semi-automatic rotating drum machine for washing and/or drying textile articles is provided with a motor and a programme to perform washing and/or drying operations according to a process particularly suitable for textile products up to now washable only by hand to avoid size shrinkage due to felting and/or relaxation. Said process essentially consists in performing at least part of the washing stage at a drum angular speed equal to or higher than the lowest speed allowing to hold the products adhering to the drum walls.

Fig.1



A PROCESS AND A MACHINE FOR WASHING AND DRYING TEXTILE ARTICLES.

The present invention concerns a process and a machine for washing and/or drying textile products, and namely "very delicate" textile products, i.e. those liable to dimensional shrinkage due to felting and/or relaxation, that up to now could be washed only by hand.

Machines for washing and/or drying textile products have been widely known for long time; said washing-machines are mainly used to wash in a water medium clothes and linen, and they essentially comprise a rotating drum housed in a water tight bowl and connected to an electric motor which has said drum rotate about its own longitudinal axis. In almost all washing-machines the motor is controlled for actuation by a programmer where the washing cycles or programmes are previously set; said programmes comprise at least one of the following stages: pre-washing, washing, rinsing, spinning, drying.

As known, in the pre-washing and washing stages a detergent solution in water is used, the water being generally heated by a resistor, and the drum is rotated at a preselected speed, causing a motion which replaces the manual mechanical action; said motion provides for the partial lifting of the articles of clothing to be washed along the drum walls until they fall down on the bottom of the drum itself, in that the acceleration of gravity exceeds the centrifugal acceleration caused by the drum rotation. During the rinsing operation pure water is used or possibly added with products such as softening, blueing, sizing agents, etc. During the spinning stage, water is almost completely eliminated from the washed articles which, in the latest models of washing-machines, are then completely dried in the drying stage by means of hot air.

In an average household washing-machine, usually having a drum diameter of approximately 40-50 cm, the so called gentle cycles require a water consumption, for each stage, of approximately 18-25 litres, which are discharged at the end of each stage. The drum rotation speed for these average machines with drum having a 40-50 cm diameter, is approximately 50-60 revolutions per minute during the pre-washing, washing and rinsing stages, while it increases up to approximately 250 or even 1000 revolutions per minute during the spinning stage.

The main drawback of said washing-machines lies in the fact that the above reported type of washing, which is the most commonly used, is extremely damaging for all those textile products classified as "very delicate", and specially for knitted articles, in that they are particularly liable to size shrinkage due to felting (i.e. those articles made of wool, mohair, cashmere, alpaca, camel, etc.) and/or size shrinkage due to relaxation occurring in products made of any type of textile fibres.

Though specific washing programmes have been developed for delicate items or for woollen goods only, the abovementioned problems and drawbacks, even if reduced, are still present to such an extent as to make unsuitable the use of a washing-machine for "very delicate" products, which thus can be washed only by hand.

There is therefore the need of a process for automatic washing allowing all kind of items to be washed in a machine, included those now washable only by hand, without causing size shrinkage (for felting and/or relaxation) such as to jeopardize the possibility of wearing that article again.

Object of the present invention is to solve the aforesaid problems by means of a process and a machine for washing and/or drying textile articles, especially the "very delicate" ones, that reduces and limit within acceptable values size shrinkage due to felting and/or relaxation of the treated items.

To this purpose, the present invention provides a process for washing and/or drying textile products, of the type using an automatic or semi-automatic washing and/or drying machine provided with a rotating drum, characterized in that during at least part of one or more stages of the washing cycle, and/or during drying, said drum is rotated at an angular speed equal or higher than the lowest speed allowing to hold the products adhering to the drum walls during each drum revolution.

The invention furthermore concerns an automatic or semi-automatic machine for washing and/or drying textile articles of the type provided with a rotating drum, characterized in that it is provided with means to control, during at least part of one or more stages of the washing cycle and/or during drying, the rotation speed of the drum at a value equal to or exceeding the lowest speed allowing to hold said products adhering to the drum walls.

The process and the machine are especially suitable for those textile articles up to now washable only by hand in that liable to size shrinkage due to felting and/or relaxation. By these process and machine it will be possible to machine wash repeatedly (at least 20 times) all the products up to now washable only by hand, and to avoid size shrinkage, for felting and/or relaxation, exceeding 10% in area (a value deemed as the maximum acceptable one with respect to wearability).

While the invention is mainly conceived for the so-called "very delicate" articles, it is obvious that its use is not limited to treatment of these articles only, but also comprises the washing and drying of all textile

articles normally machine washable.

The invention will be now further described with reference to the accompanying table and drawings, where:

- figure 1 is a graph showing the percentage of shrinkage measured on textile articles washed according to the invention and according to the state of the art; and
- figure 2 is a graph showing the corresponding percentages of shrinkage measured on samples of standard fabric according to the IEC method.

As is well known, the studies carried out on the problem of the size shrinkage due to felting and/or relaxation of textile articles during their washing in water and/or their drying, stated that said problem is mainly due to the mechanical agitation or flapping action which the products undergo. The known washing methods aim to reduce said mechanical action by reducing the cycle time and the load of treated articles, and by increasing the volume of water in the basin with respect to the "normal" cycles, but they fail to obtain the required results.

It has now been surprisingly found that it is possible to perform the washing of said textile products in an absolutely safe and reproducible way free from any drawback by increasing the normal rotation speed of the drum (which is about 50-60 rounds per minute) up to a value, as already said, equal to or higher than the lowest speed allowing to hold the products adhering to the drum walls, notwithstanding the possible presence of water in the basin. In other words, the drum is rotated at such an angular speed ω that the corresponding centrifugal force F_c is sufficient to hold every single textile product or article adhering to the drum walls in spite of the presence of water in the drum, without however squashing it against said walls too vigorously. In practice, a sort of "soft spinning" is performed, where the centrifugal acceleration has a value that exceeds the acceleration of gravity, but is lower than the centrifugal acceleration during a stage of "strong spinning", i.e. the usual spinning stage in state-of-the-art methods.

Of course the required values of angular speed ω or of centrifugal acceleration will vary depending on the radius r of the drum of the washing-machine. Considering an average household washing-machine, i.e. with a drum diameter within a range from 40 to 50 cm, and a wash load not exceeding 1-1.5 kg of textile products, the preferred speed and acceleration will be those corresponding to a speed of rotation of the drum within the range from about 80 to about 240 revolutions per minute.

Said speed of rotation is similar to the speed used, in some of the latest models of washing-machines, during the stage of pre-spinning in order to obtain a uniform distribution of the load, but, unlike the latter ones, it is used during the whole washing cycle and/or during drying; said speed is thus maintained also in the presence of soapy water in the bowl, or vessel, as well.

Anyhow, such a speed is preferably used during at least part of the actual washing stage, in order to have every article at least partially soaked at each revolution by the soapy solution in the bowl. The use of the speed according to the invention provides a cleansing action that is equal and even better than that obtainable according to known washing methods.

In order to prevent the formation of folds on the textile article, the machine will preferably alternate periods of drum rotation at the speed according to the invention to periods of zero speed (steady drum) and/or reduced speed (20-40 revolutions per minute), in order to allow the articles to be differently positioned.

Moreover, at the end and/or during the different stages of the washing cycle, rotations of the drum at high speed (250-600 rpm) are preferably performed, to remove water and/or possible soap and detergent from the articles.

It was also noted that the total time of actual agitation or flapping of the articles, i.e. the total amount of the washing and drying cycle periods during which the textile articles are actually lifted and dropped at each drum revolution, is preferably within the range from 20 to 200 seconds.

Besides the aforescribed advantage, the washing machine and the washing process according to the invention provide other advantages.

A first advantage consists in the possibility of reducing even by 40% the quantity of water used in each washing cycle. In fact, according to the invention, it is possible to reduce said volume of water in order to have a water level at approximately 3-10 cm above the lower edge of the drum, and in any case such as to at least partially wet the textile product by temporary immersion into the soapy solution or the rinsing water at each revolution of the drum.

In the washing-machine according to the invention this result in a consumption of about 5-13 litres of water during the washing stage itself, as compared to the 18-25 litres previously needed.

Of course the saving of water results in a corresponding saving of the electrical power used for heating the water up to a temperature that in a preferred embodiment is within the range from 30 to 40 degrees C.

Furthermore, said saving of water also involves a corresponding saving of detergent. In fact, it is

sufficient to maintain the same previous concentration of detergent to obtain a good cleansing degree of the products washed according to the invention; therefore, keeping constant the detergent concentration value, a reduction of water automatically involves a reduction of the detergent needed. Preferably the detergent used will be of the liquid type with limited foam formation, but a detergent in powder can be used as well.

5 The following table summarizes the above cited data for an easier comparison between the performances according to the invention and the traditional ones.

TABLE 1

	Invention	State of the art
Drum diameter	40-50 cm	40-50 cm
Washing load	1-1.5 kg	1-1.5 kg
Water load for the washing stage	5-13 l	18-25 l
15 Water consumption in each complete cycle	40-60 l	70-100 l
Detergent consumption	40-60 g	80-100 g
Rotation speed of the washing drum	80-240 rpm	30-60 rpm
Cycle Felting Reversion (CFS)	< 0.4%	3-4.5%

20 A typical programme of washing cycle using a process and a machine according to the invention is designed in a way as to have a first washing stage prior to heating at 30-40 degrees C the soapy solution containing the detergent, followed by the washing stage at said temperature, successively followed by 2 or 3 rinsings with cold water.

25 The washing takes place alternating periods of rotation of the drum at the speed according to the invention to periods of "strong spinning" (250-600 rpm) and to periods of steady drum (zero speed) and/or slow rotation (20-40 rpm) to allow the products change their position in the drum and avoid the formation of folds. The heating of the soapy solution at the desired temperature (30-40 degrees C) may take place with steady drum or during rotation at a speed according to the invention (80-240 rpm).

30 The rinsing is carried out twice or three times according to the aforereported concept of alternating rotations at different speeds and pauses; at the end of each rinsing the water is discharged (with steady drum or rotation at 80-240 rpm) and a final high-speed spinning is performed.

35 While the drum rotates at a speed according to the invention the wetting of the products both with soapy solution or with the rinsing water occurs by temporary and at least partial immersion of the products into the bath provided in the bottom area of the drum. Said wetting may be made easier and improved by means of shower or spraying systems (in the machines which are provided with said devices).

As already mentioned, the total time of actual agitation, or flapping, of the articles should not exceed 200 seconds.

40 Figure 1 is a graph showing the different behaviour of a knitted article made of "pure wool" washable only by hand (not treated for "unshrinkability") after a series of washings according to the traditional "delicate-wool" cycle and according to the invention cycle. On the abscissae the number of washings performed is reported, while on the ordinates there is indicated the percentage of area shrinkage of the washed article. The dashed line shows the behaviour of the examined article washed in a household washing-machine with a gentle cycle according to the state of the art, while the continuous line indicates the behaviour of the same article washed with a cycle according to the invention.

45 As it can be noted, the slope of the two curves is dramatically different: the curve of size shrinkage upon a traditional gentle cycle washing (namely with the drum rotating at about 50/60 rpm) reaches the critical value of 10% approximately only after 4-5 washings, while the curve of size shrinkage upon a washing according to the invention attains this value only after 20 washings. Since this value of 20 washings corresponds to the average number of washings which a woollen article undergoes during its life, the process according to the invention allows a woollen product "washable by hand" to be machine washed for the whole length of its average life without being aesthetically damaged or its use being prevented upon extreme size shrinkage.

55 In figure 2 it is possible to note the dramatic difference of washing severity between a "wool-gentle" cycle according to the state of the art (drum rotation at 60 rpm) and a cycle according to the invention. This graph was drawn using the I.C.E. method as criterium of evaluation for measuring the felting degree (size shrinkage) of the wool washing programmes in the household electrical washing-machines. Said method developed by the I.C.E. (International Electrotechnical Commission) is presently still at the draft state

(document 59D (secretariat) 48) but will be made official soon. This method evaluates the C.F.S. (cycle felting severity), that is the average felting severity of a wool washing cycle by measuring the size shrinkage of a standard wool sample washed (under specific conditions) in the washing cycle under test.

The short dashed line shows the behaviour of a wool-gentle-cycle (with drum rotation at 50/60 rpm) according to the state of the art, while the continuous line shows the behaviour of the washing cycle according to the invention. From this graph it can be gathered that the C.F.S. (average felting severity of a wool washing cycle) of a wool-gentle washing cycle according to the state of the art is 3.5%, while the C.F.S. of the cycle according to the invention is below 0.4%. Thanks to the washing process according to the invention, notwithstanding such a low CFS it is possible to obtain a cleansing efficiency of the articles similar to that obtainable with the known cycles, but with minimal felting. It is thus possible to perform up to 20 washings of each product without its being appreciably altered in size. These data show that the felting severity of the cycle according to the invention is 8-9 times lower than that of the wool-gentle cycle according to the state of the art. What reported hereinabove gives evidence that the process and the machine according to the invention represent the ideal solution not only for the washing and drying of "very delicate" textile articles usually washable only by hand, but also more generally for any textile article, as already mentioned. The invention can thus be applied also to the so-called washing-and-drying machines and to dryers, maintaining the characteristic properties of non-felting and non size shrinkage.

20 Claims

1. A process for washing and/or drying textile articles, of the type using an automatic or semi-automatic washing and/or drying machine with rotating drum, characterized in that during at least part of one or more stages of the washing cycle and/or during drying, the said drum is rotated at an angular speed equal to or higher than the lowest speed allowing to hold the articles adhering to the drum walls.
2. A process according to claim 1, wherein said drum is rotated at the said speed of rotation during at least part of the washing stage of said washing cycle, in the presence of water in the bowl and in the drum.
3. Process according to claim 2, characterized in that drums with diameter within the range from about 40 cm to about 50 cm are rotated at a speed within the range from about 80 to about 240 rpm.
4. A process according to claim 2 or 3, characterized in that during the washing, rinsing and/or drying stages the rotation of the drum at the aforesaid speed is alternated with periods of quick rotation (250-600 rpm), periods of absence of rotation ("steady drum") and/or with periods of reduced rotation (20-40 rpm); the total time of actual article agitation being within the range from 20 to 200 seconds.
5. A process according to any one of the claims from 1 to 4, characterized in that during the washing stage said textile articles are at least partially wetted by the soapy solution or the rinsing water present in the drum by temporary immersion into said solution or rinsing water at each revolution of the drum.
6. A process according to any one of the preceding claims, characterized in that it uses, during the washing stage, a volume of water proportional to the volume of the bowl and the drum, said water volume for drums with diameter within the range from 40 to 50 cm, being within the range from 5 to 13 litres.
7. A process according to any one of claims from 1 to 6, characterized in that it has a CFS (index of cycle felting severity) lower than 0.4%, measured according to the I.E.C. regulations.
8. An automatic or semi-automatic machine for washing and/or drying textile articles, of the type provided with a rotating drum, characterized in that it is provided with means to control, during at least part of one or more stages of the washing and/or drying cycle, the rotation speed of the drum to a value equal to or higher than the lowest speed allowing to hold said articles of clothing adhering to the drum wall.
9. A machine according to claim 8, characterized in that it is provided with means to rotate said drum, at least during part of the washing stage, at a speed equal to or higher than that capable of holding said textile articles adhering to the drum wall in the presence of water in the bowl and the drum.
10. A machine according to claim 8 or 9, wherein said drum has a diameter ranging between 40 and 50 cm, characterized in that said speed of rotation has a value within the range from 80 to 240 rpm.
11. A machine according to any claim from 8 to 10, characterized in that it is provided with means to alternate, during said stages of the washing and/or drying cycle, periods of rotation of the drum at said selected speed (80-240 rpm) to periods of high speed (250-600 rpm) and periods of no rotation ("steady drum") and/or reduced rotation (20-40 rpm), the total time of actual article agitation being within the range from 20 to 200 seconds.
12. A machine according to any claim from 8 to 11, characterized in that it comprises a washing and/or drying programme providing washing and/or drying stages according to any claim from 1 to 6.

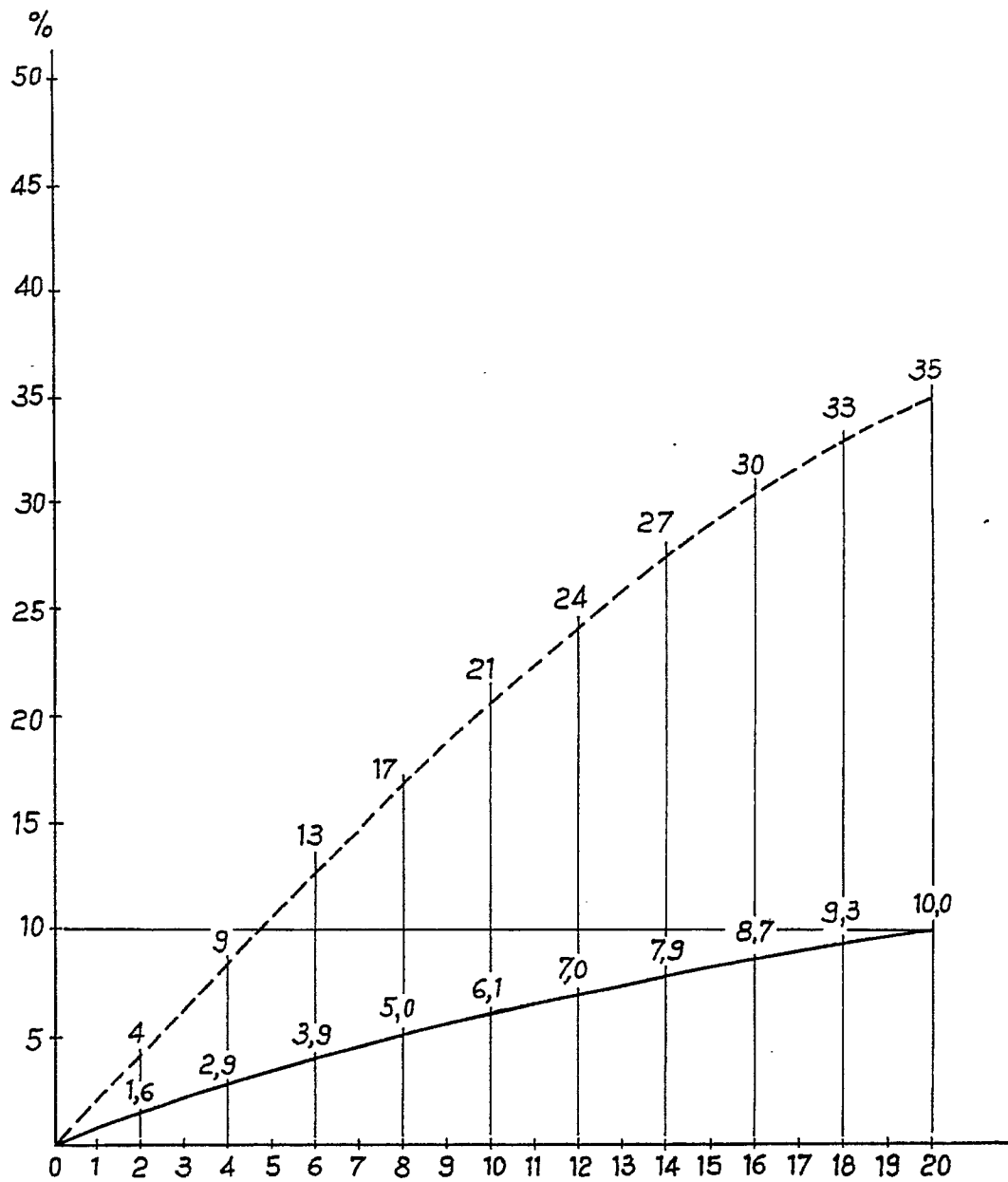
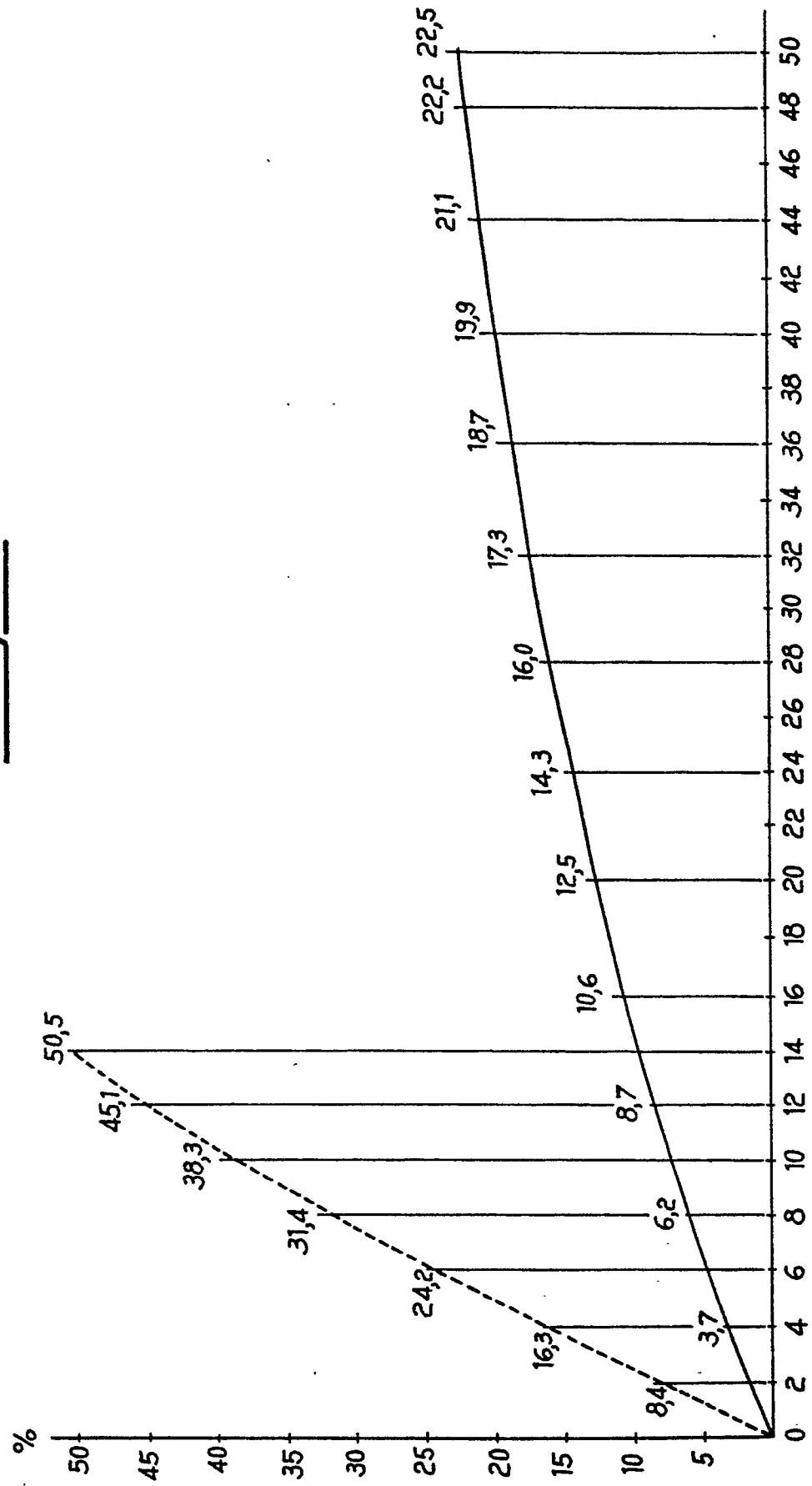
Fig.1

Fig. 2





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number

EP 90 11 1540

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.5)
X, P	FR-A-2632329 (CIAPEM) * the whole document *	1-3, 5, 8-10, 12	D06F35/00
A	---	6, 7	
X	US-A-3388410 (D.E. MARSHALL) * abstract *	1-4, 8-10, 12	
A	---	5-7, 11	
X	US-A-2432766 (THE APEX ELECTRICAL MANUFACTURING COMPANY) * column 2, line 1 - column 3, line 10; figure 3 *	1-3, 8-10, 12	
A	---	5-7	
X	FR-A-1364698 (J-E. CADOUX) * the whole document *	1-3, 8-10, 12	
A	---	5-7	
A	FR-A-1418870 (THE MAYTAG COMPANY) * claims 1-9 *	4, 11	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			D06F
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 02 OCTOBER 1990	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		I : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application I : document cited for other reasons A : member of the same patent family, corresponding document	