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(54) Method for controlling washload drying in a clothes drying or similar apparatus

(57) Method for controlling washload drying in a clothes drying apparatus, in which an air flow (18) is heated up and used to remove moisture from the washload and convey the same moisture into a collecting container (11).

The variation in the level (L) of the water so removed from the washload is repeatedly detected at pre-set time intervals (t) and the heating of the air flow (18) is turned off in response to said variation being detected to show a decrease below a pre-determined value during at least one (tx) of said time intervals.

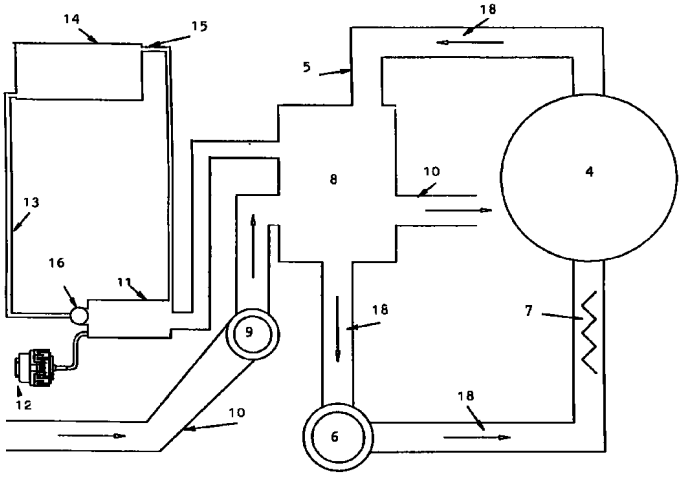

FIG. 1

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Description

[0001] The present invention refers to an improved method for controlling washload drying in a clothes drying apparatus or an automatic-type clothes washing and drying machine.

[0002] Clothes drying machines are generally known to widely use the technique based on the measurement of the residual moisture in the washload in order to appropriately control the working cycle of the machine, in particular to calculate in advance the right moment at which the drying process can be terminated in view of obtaining the desired drying result.

[0003] The large number of methods that are currently used to detect the drying degree of the washload, ie. the clothes to be dried, are basically of two main types, ie. temperature-based and conductivity-based methods.

[0004] Temperature-based methods calculate residual moisture in the clothes contained in the drum of the machine from the evolution of the temperature as measured by at least a specially provided proble that is usually arranged inside the same drum. An example of temperature-based or temperometric system is described in DE-A-3 030 864.

[0005] Temperature-based methods are relatively simple, but scarcely accurate, in particular when they have to detect moisture in so-called "damp" cycles, ie. the cycles in which drying must be terminated before the clothes become "bone-dry", for instance when they have to be subsequently ironed.

[0006] Conductivity-based or conductometric methods, on the contrary, are relatively accurate. They are based on the measurement of the conductivity of the clothes to be dried, which in turn varies in accordance with the degree of moisture in the same clothes. On the other hand, these methods are known to require the use of indesirably sophisticated control devices, as well as complicated and costly electro-mechanical component parts. As described in EP-B-0 106 283, for instance, the machine needs to be equipped with a metal rotating drum provided with two electrically conductive parts separated from each other by an insulating strip.

[0007] Furthermore, measurements may be influenced here by the degree of hardness of the water, which is known to be variable from case to case.

[0008] In addition thereto, owing to electric signals generated and processed by conductometric systems being very weak, measurements can be most easily altered by system's own tolerances and/or noise.

[0009] It therefore is a main purpose of the present invention to provide a method for controlling washload drying in a clothes drying or similar apparatus, which is capable of substantially doing away with the drawbacks of prior-art solutions.

[0010] It is in particular a purpose of the present invention to provide a method of the above cited kind which enables the degree of drying of the clothes to be measured in an accurate and reliable manner, and is at the same time capable of being implemented in a substantially simple and low-cost clothes drying or similar apparatus.

[0011] According to the present invention, these aims are reached in a method for controlling washload drying in a clothes drying or similar apparatus embodyng the characteristics as recited in the appended claims.

[0012] Features and advantages of the present invention will anyway be more readily and clearly understood from the description that is given below by way of non-limiting example with reference to the accompanying drawings, in which:

- Figures 1 and 2 are views of respective embodiments of a clothes drying apparatus adapted to implement the method according to the present invention; and

- Figure 3 is a diagrammatical view showing schematically the variations vs. time of some typical parameters of the drying process performed by the apparatus illustrated in Figures 1 and 2.

[0013] As illustrated in Figure 1, the method according to the present invention can be for instance implemented in a traditional type of clothes drying machine for home use comprising mainly a rotating drum 4 connected to a closed-loop air conduit 5 in which there are arranged aldo a blower 6, at least an electric heating element 7, or the like, as well as condensing means 8. In particular, the air heated up by the electric heating element 7 is caused by the blower 6 to circulate along the conduit 5 (as shown by the arrows 18), so as to flow across the drum 4 in order to remove moisture from the clothes contained therein and cause said moisture to condense in correspondence of said condensing means 8. The latter can be of any type fitting the application: in the described example, it can be noticed to be of the type cooled by the air that is circulated by a blower 9 along a conduit 10 which, through the condenser 8, is in a heat-exchange relation with the conduit 5.

[0014] In a per sè known manner, the moisture removed from the clothes condenses in the condenser 8 and collects into a container 11 arranged therebelow and provided with level sensing means such as a pressure switch 12 or the like. Such level sensing means drive the programme sequence control unit of the machine (which is preferably of an electronic type and is not shown here for reasons of greater simplicity) with a signal that is indicative of the level reached by the water in the container 11.

[0015] In the herein described example, such a container 11 is connected via a pipe 13 to a large-capacity reservoir 14 that is removably provided thereabove and communicates with the container 11 also via an overflow arrangement 15. In a per sè known manner,

the water collecting into the container 11 is periodically conveyed into the reservoir 14 via said pipe 13 and a therewith associated pump 16, in order to be stored there until the same reservoir is totally filled. Such a filled condition eventually causes water to flow over, via the overflow arrangement 15, towards the container 11, so that it can be most easily be detected by said level switch 12. As a result, the programme sequence control unit of the machine is able to most suitably output an indication that the reservoir 14 is full, so that the same can be appropriately emptied.

[0016] In a simpler version, the the clothes drying machine can be of the type illustrated in Figure 2, which is substantially similar to the one described with reference to Figure 1. The sole difference derives here from the fact that the removable reservoir 14 is arranged substantially at the same level as the container 11, to which it is only connected through a base conduit 17, so as to form a communicating-vessel system. The water condensing in the condenser 8 therefore collects into the container 11 and the reservoir 14, and the level switch 12 is capable of detecting not only the level of the water in the container 11, but also the filling condition of the reservoir 14.

[0017] In any case, during the usual operation of the machine with heated air circulating in the conduit 5, the temperature of the air flowing across the drum 4 varies in the manner shown by the curve T in Figure 3, ie. with an initial phase in which the temperature increases, an intermediate steady-state phase in which the temperature remains substantially stationary as the clothes contained in the drum are being dried, and a final phase in which the temperature increases again in a marked manner, since the clothes are now substantially dry.

[0018] Correspondingly, the percentage of water that is in the clothes to be dried, and that is caused to evaporate by the flow of hot air circulated along the conduit 5, varies according to the pattern shown by the curve W in Figure 3, ie. in a gradually decreasing manner until the clothes are fully dried.

[0019] The curve Q in Figure 3 shows the instant amount of water removed from the clothes. During an initial phase, such an instant amount Q of water removed from the clothes can be seen to rapidly increase up to a maximum steady-state value. It then decreases in the final phase of the process, when the clothes tend to become fully dry.

[0020] Accordingly, the total amount of water removed from the clothes increases in the manner shown by the curve L in Figure 3, with a slope, or steepness, that decreases in a marked manner in the final phase when the residual moisture in the clothes tends to run out.

[0021] According to the present invention, therefore, even if the initial moisture contents of the clothes to be dried are not known, it is possible for the drying state of the clothes to be controlled by detecting the variation Q of the amount L of water removed from the clothes during repeated pre-established intervals of time and controlling the working programme of the machine accordingly. Such intervals of time are schematically indicated at t in Figure 3 and can for example have a fixed duration of approx. 1 minute. Alternatively, said intervals t can have a variable duration.

[0022] In particular, the programme sequence control unit of the machine can be easily set to switch off the heating of the air flow 18 by the electric heating element 7 in response to the above cited variation in the amount of water removed from the clothes been detected to decrease, during at least one of said pre-established periods of time t, below a pre-determined value.

[0023] In other words, the heating of the air flow 18 is interrupted (possibly with a certain delay, according to the final drying degree desired) when the steepness of the curve L decreases below a pre-determined value that is correlated to the desired drying degree of the clothes. In still other words, the heating of the air flow 18 is interrupted (possibly with a certain delay) when the curve Q slopes downwards below of a pre-determined threshold that is in correlation with the desired degree of dryness of the clothes. In the example illustrated in Figure 3, both such corresponding conditions occur during the time interval indicated at tx.

[0024] In a preferred manner, the variation in the amount of water being removed from the clothes is detected by measuring the level of the water collecting in the container 11 by means of the level or pressure switch 12 (or a similar level sensing device) which may be of either the analogue or the digital type. In any case, a pressure switch appears to particularly fit the application, since it is capable of driving the programme sequence control unit of the machine with a signal that is indicative of the level reached by the water in the container 11 and, therefore, representative of the amount of water L removed from the clothes.

[0025] It is therefore fully apparent that the control method according to the present invention can be advantageously implemented in a clothes drying machine, or any similar apparatus, of a traditional type without implying any structural complication, while making use of component parts that already exist in the same machine.

[0026] Furthermore, owing to the fact that no absolute value of a quantity is actually detected, but rather the variations thereof within a period of time, the method according to the present invention turns out to be particularly accurate and substantially insensitive to noise, disturbances and tolerances of the system, as opposite to what actually occurs with prior-art conductometric-type systems.

[0027] As compared with prior-art systems based on temperature measurement, this is further magnified by the fact that the quantity being measured, ie. the amount of water removed from the clothes contained in the drum 4, is in a direct correlation with the degree of dryness reached by the same clothes.

Claims

1. Method for controlling washload drying in a clothes washing or similar apparatus, in which a flow of air is heated up and used to remove water from said washload and convey it into at least a collecting container, **characterized in that:**

- the variation (Q) in the amount of water (L) removed from the washload is repeatedly detected during a number of pre-determined time intervals (t); and
- heating-up of said flow of air (18) is interrupted in response to said variation (Q) decreasing below a pre-determined value during at least one (tx) of said time intervals.

2. Method according to claim 1, **characterized in that** said variation (Q) is detected by measuring the level of the water collecting in said container (11).

3. Method according to claim 1, **characterized in that** said time intervals (t) have a fixed duration.

4. Method according to claim 1, **characterized in that** said time intervals (t) have a variable duration.

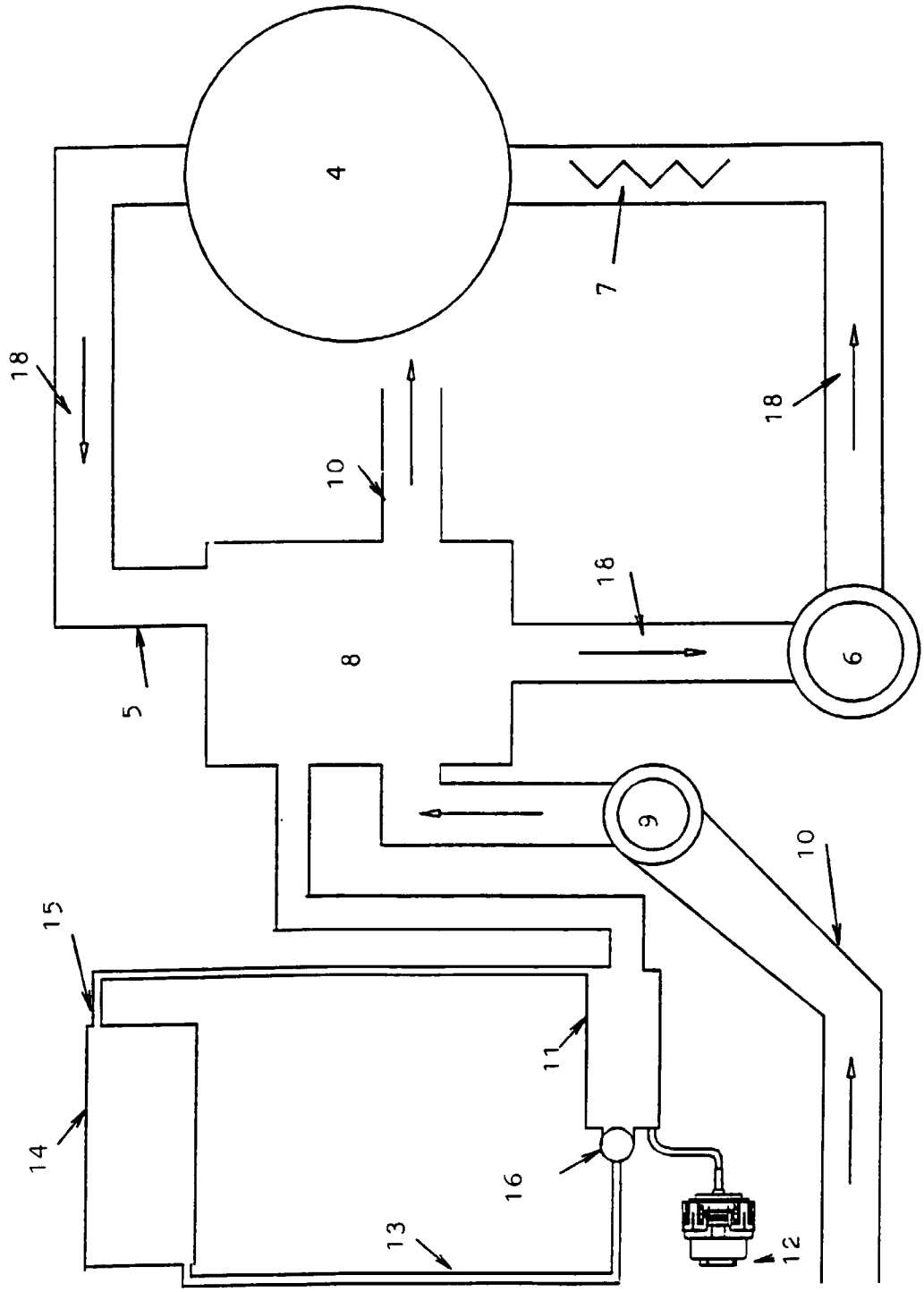

FIG. 1

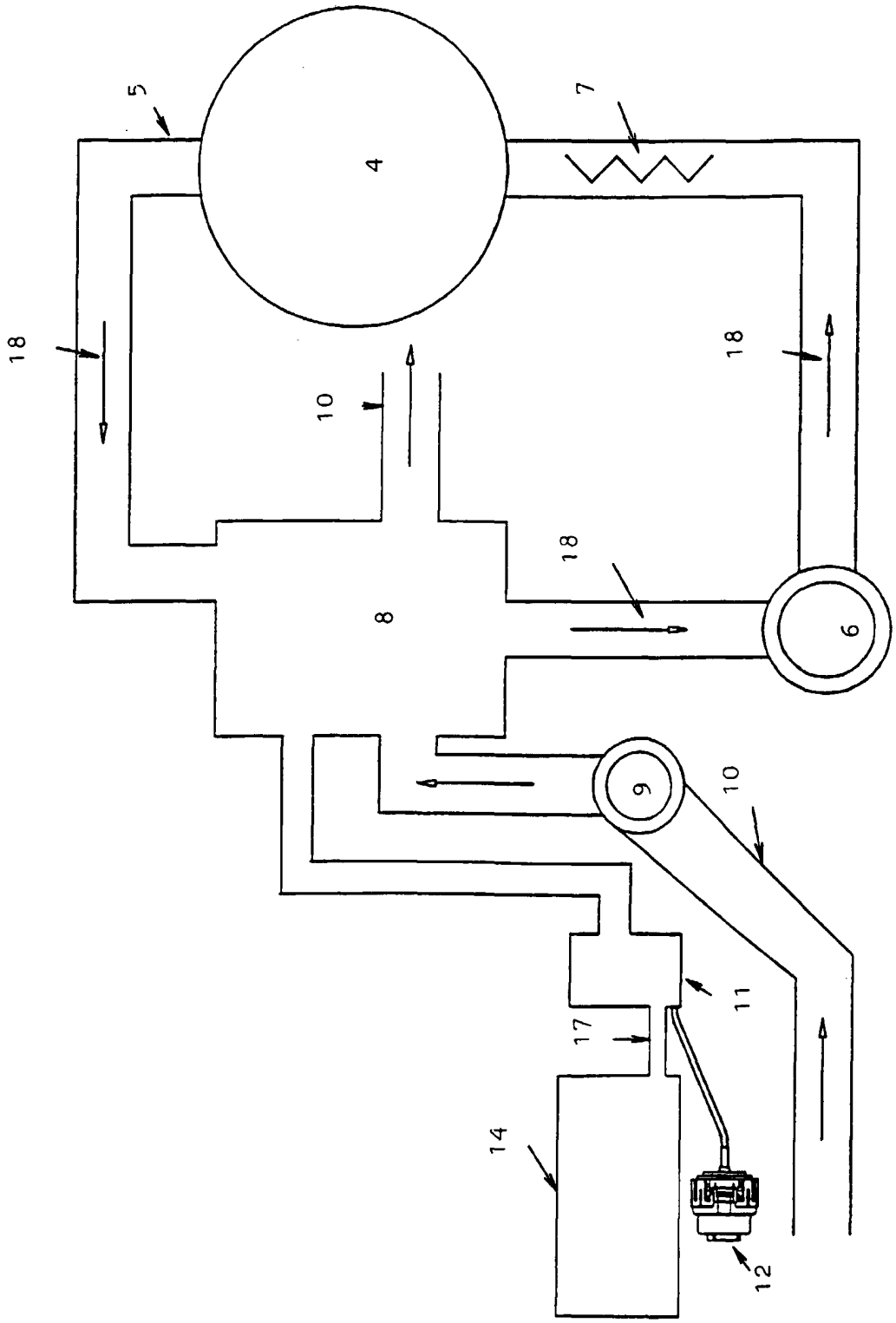

FIG. 2

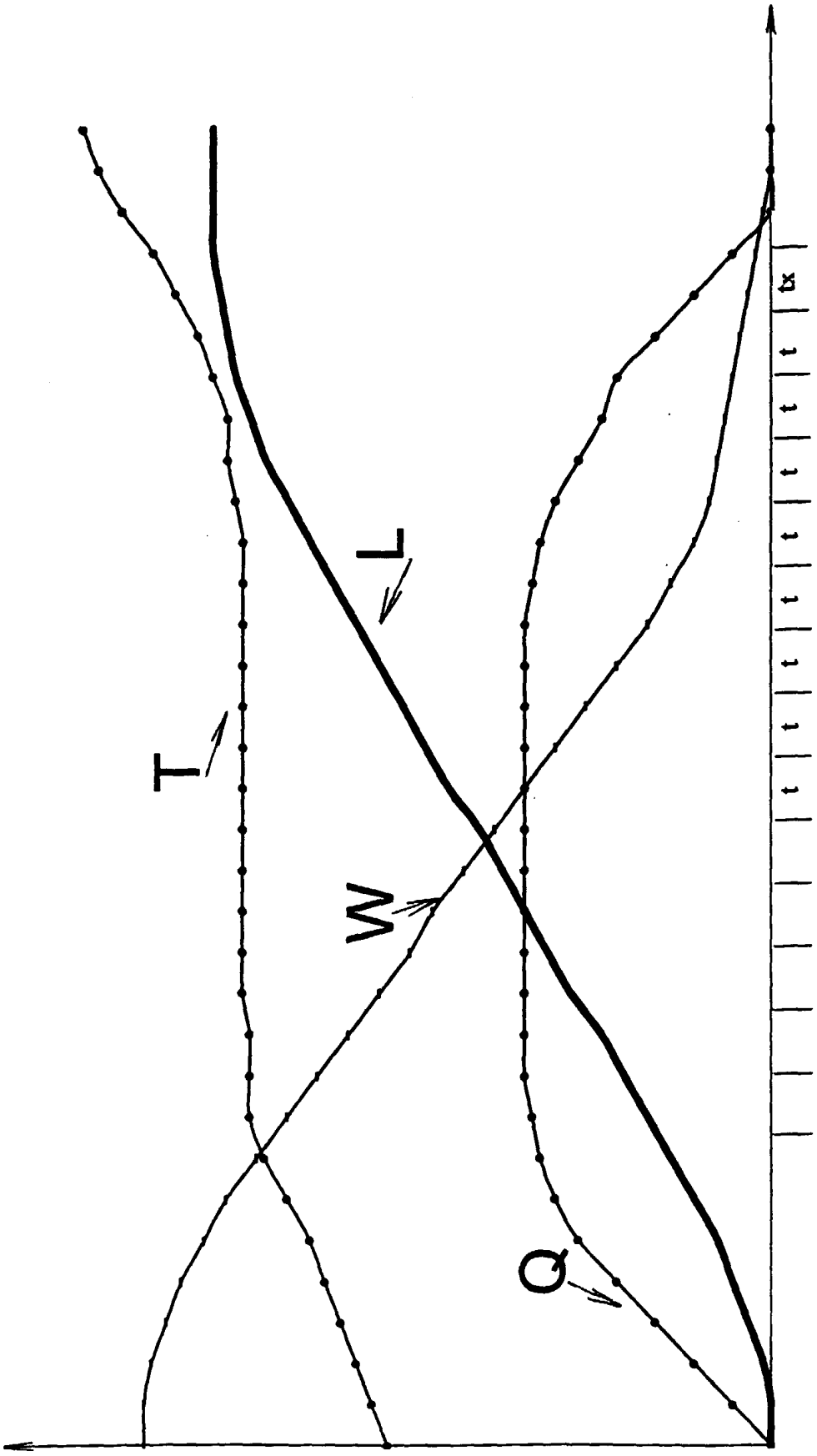

Fig. 3