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(54) Improvements relating to methods of and machines for washing textile articles.

(57) A method of washing textile articles in which, whilst the articles are immersed in a washing liquid, the liquid may be heated to a low temperature in the region of 30°C and is agitated for brief periods in the region of 15 to 60 seconds by reversals of a drum (2) rotatable about a substantially horizontal axis and containing the liquid and articles in each of a succession of longer basic periods in the region of 5 to 20 minutes, all continuing over a period of 2 hours or longer. Preferably increments of rotation are of different amounts in opposite directions respectively. A machine having a control means (10, 29, 44) determining the temperature (44) of the liquid and the durations of the basic periods and periods of agitation is also provided. The method of washing provides considerable saving in energy whilst achieving satisfactory cleanliness of the articles washed.

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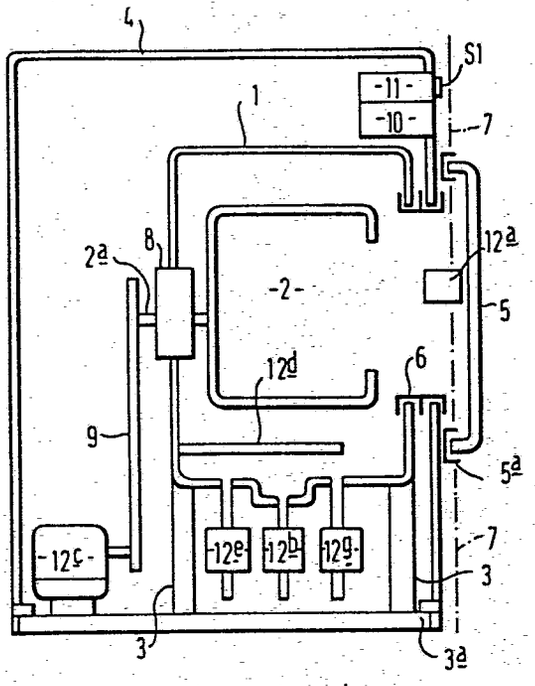
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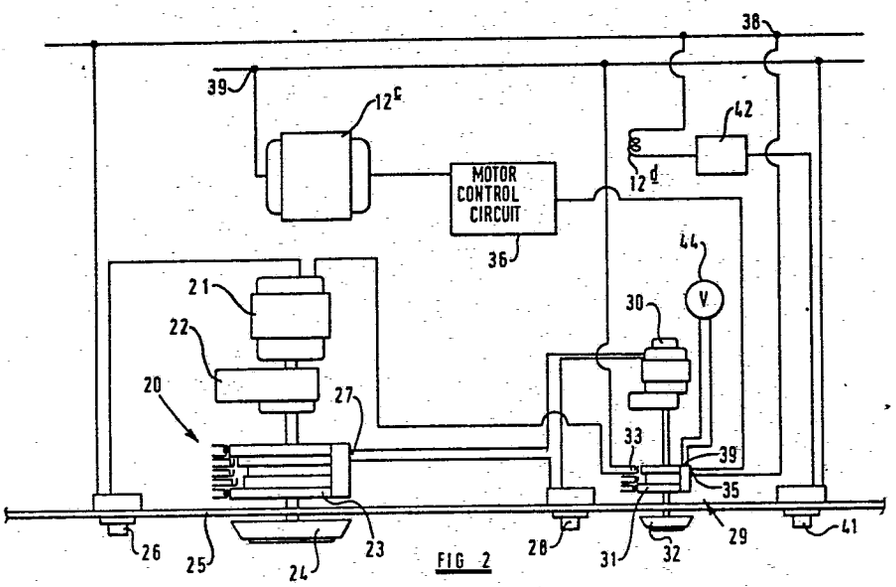
FIG 1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MOTOR CONTROL CIRCUIT
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FIG 2

Title: Improvements relating to methods of and machines for washing textile articles.

This invention relates to a method of and machine for washing clothes or other textile articles.

Conventional washing machines comprise a body including a chamber containing a perforated drum mounted for rotation about a horizontal axis and having an opening at one end through which the articles can be loaded into the drum, the latter being driven by an electric motor usually in a cycle which involves rotation in one rotational sense and then rotation in the other rotational sense at a speed in which the articles undergo tumbling action in a washing liquid introduced into the chamber to a level such that the articles in the drum are immersed in the liquid. Such washing action is continued for a relatively prolonged period and thereafter the washing liquid (which may contain a detergent) is pumped out of the machine and the articles are subjected to at least one rinsing in fresh water fed into the washing chamber after which it is pumped out, the articles being then subjected to centrifugal extraction by spinning the drum. Usually the rinsing and centrifugal extraction operations are repeated twice more.

Whilst efficient washing of the articles can be achieved by this conventional method, it does consume a considerable amount of energy both by reason of the fact that the washing action is continued for an appreciable period, and in this action the load of articles is raised from the lowest point of the drum to near its highest point repeatedly, and by reason of the fact that the drum undergoes reversals of rotation so that it has to be repeatedly accelerated from rest to the "tumbling" speed.

The ability of automatic washing machines to clean articles of clothing and other textile articles is considerable. However the energy expended by such machines can make a washing process quite expensive. It would be desirable therefore to provide in an automatic washing machine programme some washing event that enables the same cleanliness to result in the articles at the end of a washing programme with a reduced expenditure of energy.

It is known to soak articles to be washed for a long period, for example overnight, in cold water in washing liquid. However the dirt from the articles tends to form a scum on the surface of the washing liquid and then when the washing liquid is subsequently pumped out of the machine before the articles are removed therefrom, the scum settles on the surface of the articles and causes streaks or tide marks, which in a subsequent washing operation are as difficult, if not more so, to remove from the articles than the original dirt.

The above described soaking technique has therefore not really provided a satisfactory answer to providing a more economical method of washing textile articles and no longer finds the popularity with which it was first received.

Because of the rather unsatisfactory result of soaking articles as afore described, the tendency has been to provide shorter washing programmes which, since they are carried out for a briefer length of time, use considerably less energy and for some articles are quite satisfactory. However other articles made from different material, for example, or articles which by their nature of use are more soiled, may not reach a sufficient degree of cleanliness and require further washing.

The object of the present invention is to provide a method of washing by means of which energy saving can be achieved without detriment to washing performance, that has the ability to extract dirt from the articles undergoing washing and thereafter remove it from the vicinity of the articles.

According to the present invention a method of washing textile articles comprises substantially immersing the articles in a washing liquid, subjecting the washing liquid to agitation and subsequently removing the articles from the washing liquid relatively from the immersed relation, characterised in that:

a. the washing liquid is not higher than a predetermined relatively low temperature;

b. the washing liquid is subjected to agitation for a relatively brief period in each of a succession of considerably longer basic periods.

The term "washing liquid" includes water, water to which a detergent has been added, and water to which a biological agent has been added.

The number of considerably longer basic periods will be such that a sufficient time is allowed to remove dirt from the articles into the washing liquid.

The method preferably includes heating the washing liquid to a relatively low temperature. By "relatively low" is meant a temperature above that at which unheated water available from normal domestic water systems is supplied and which generally is between $4^{o}C$ and $15^{o}C$ depending upon climatic conditions, but not higher than is no more than pleasantly warm to the hand. Typically a "relatively low" temperature would be $30^{o}C$ but it is contemplated that more generally it would be in the range of $20^{o}C$ to $40^{o}C$.

It has surprisingly been found that even though the known technique of soaking articles for long periods in washing liquid did not produce satisfactory results, by causing, albeit intermittent, agitation of the washing liquid, the scum previously formed on the surface of the washing liquid was dispersed into suspension in the water which prevented the forming of streaks and tide marks on the articles being washed once the water was removed.

Furthermore, the intermittent agitation of the washing liquid, by causing movement of the articles being washed, considerably increased the effectiveness of the washing liquid to remove dirt therefrom. It is believed that this is primarily because of the relative motion between the washing liquid and the articles being washed.

By heating the washing liquid to a predetermined relatively low temperature, i.e. a temperature considerably lower than the temperature at which washing liquid is normally heated in automatic washing machines, an even more beneficial result was attained.

It was found that by heating to a relatively low temperature such as 30°C, i.e. less than normal body heat temperature, the length of time for which the soaking with intermittent action took place to achieve the same result could be considerably shortened.

The benefits obtained from heating to low temperature can be achieved at very little expenditure of energy since a typical low temperature of about 30°C may not require any additional heating by the machine which is supplied from a domestic hot water supply, or if the supply is from a cold supply, the amount of energy required to heat to 30°C would not be excessive and, in order to maintain the temperature of the washing liquid at the predetermined low temperature will require only a

small amount of energy since the temperature differential between the washing liquid at this relatively low temperature and the surrounding temperature, is far less than the temperature differential between washing liquid at normal operating temperatures in conventional washing machines and the surrounding temperature. Thus the heat "loss" is considerably reduced compared with that experienced in a conventional washing cycle.

Provided, however, the agitation of the liquid is repeated at the intervals of time aforesaid, the dirt remains distributed throughout the body of washing liquid rather than forming a scum on the surface and the streaking or "tide mark" effect is eliminated.

There is considerable flexibility of choice as to the ratio of the periods of time over which the agitation of the washing liquid is effected and the basic periods of time. Satisfactory results have been achieved using a ratio of 1 to 20 made up of an agitation period of 30 seconds in a basic period of 10 minutes.

It is contemplated, however, that these periods of time may be varied without deleterious effect based on the following considerations. Lengthening of the periods of agitation results in higher consumption of energy and it is, therefore, undesirable to lengthen these periods unduly if satisfactory loosening and removal of the dirt has already been achieved by the use of shorter periods of agitation. Evidently too big a reduction in the period of agitation will react adversely on washing performance, that is ability to loosen and remove the dirt. It is believed that the ratio above referred to may be increased to $^{1}/_{5}$ or reduced to $^{1}/_{80}$ without encountering the specific disadvantages referred to to any significant extent.

As regards the magnitude of each agitation period, it is considered on the basis of similar considerations that it might be reduced to 15 seconds or increased to 60 seconds and correspondingly the basic period might be reduced to 5 minutes or increased to 20 minutes.

Further, when agitation is effected by rotation at a tumbling speed of a drum rotatable about a horizontal axis and in which both the articles and liquid are present, it is preferred to effect such agitation by increments of rotation of different amounts in opposite directions respectively, e.g. 4 seconds in a forward direction and 2 seconds in a reverse direction.

It is not intended that this range of ratios or the ranges of the agitation period and the basic period should be strictly limiting since evidently the degree of contamination of the articles by dirt and the nature of the articles themselves would admit of variations outside these limits being effected without detriment to washing performance or consumption of energy, or indeed with benefit thereto.

In principle, however, the washing method differs fundamentally from that which is customarily in use, in that it is composed of brief periods of agitation in substantially longer basic intervals repeated over a substantially longer period of time. Thus it is contemplated that the overall period of time may be in the region of 2 hours and preferably will be longer.

The steps of the method in accordance with the invention as above defined may be supplemented by the conventional step of supplying water to the articles for rinsing and thereafter subjecting the articles to centrifugal extraction either once or a plurality of times as is conventionally performed.

Further, if desired, the steps of the method above defined may be preceded by subjecting the liquid to agitation for a longer time (possibly the whole of the basic period) during the first basic period and thereafter reverting to agitation for said brief period within each subsequent basic period.

From a further aspect the invention resides in the provision of a machine for washing textile articles comprising a body defining a washing chamber for reception of the articles to be washed, means for supplying washing liquid to said chamber, means for agitating said liquid in said chamber, means for discharging the washing liquid from said chamber, characterised in that control means are provided for rendering the agitation means operative for a brief period in each of a succession of considerably longer basic periods.

Preferably the machine will also include means for heating the washing liquid, and means for controlling the temperature to which it is heated to a relatively low value as herein defined.

The ratio of the brief periods of agitation to the basic periods, and the values of each of these periods may be as already referred to in defining the method of the invention.

The invention will now be described with reference to the accompanying drawings wherein:-

FIGURE 1 is a diagrammatic view in side elevation and in vertical cross-section of one embodiment of washing machine in accordance with the invention for performing the method thereof;

FIGURE 2 illustrates part of a washing machine control circuit for effecting the method of washing in accordance with the present invention;

FIGURE 3 is a schematic circuit diagram of the control circuit of such washing machine;

Referring firstly to Figure 1, the washing machine illustrated comprises a body which includes a stationary washing chamber 1 which may be of generally cylindrical form containing a washing drum 2 rotatable about a horizontal axis, the washing chamber being supported in any suitable manner, for example by struts 3 from a base 3a.

A casing 4 encloses the washing chamber and drive means for the drum which comprises a motor 12c which drives the drum spindle 2a through the intermediary of a belt and pulley drive 9. The spindle 2a and the drum is supported by a suitable bearing 8 carried by the washing chamber.

The washing chamber has a plurality of inlets, for example hot water inlet controlled by a solenoid valve 12e, a cold water inlet controlled by a solenoid valve 12g and a drain outlet preferably communicating with a well or sump in the washing chamber and controlled by an electrically driven pump 12b.

The washing chamber 1 is sealed with respect to the casing by a flexible gasket or sealing ring 6 and the entrance to the washing chamber 1 and drum 2 is controlled by a door 5 which is hingedly connected to the casing 4 about a vertical axis 7 and is movable upon release of a solenoid controlled door lock 12a between the closed position shown and an open position. Associated with the door is a sealing ring or gasket 5 operative between the door and the casing.

A further functional unit seen in Figure 1 is a heater 12d for heating the liquid in the washing chamber. Other electrically energised functional units are

omitted from Figure 1 merely for the sake of simplicity and may include a solenoid operated conditioner valve controlling the flow of conditioning liquid through a duct into the washing chamber.

Referring now to Figure 2, a simple control mechanism for bringing the invention into effect is illustrated.

A conventional programme control mechanism shown by arrow 20 has an electric motor 21 which drives through gearbox 22 a rotary cam-operated switch 23. The position from which the rotary switch 23 commences is adjustable by a manually controlled member 24 which is normally situated externally of the casing 25 of the washing machine normally on the front panel thereof. The operation of such switches is well known and in use, depending on the wash programme required, the control member 24 is rotated from an off position to a commence position, a start switch 26 is operated, the motor 21 will rotate causing rotation of rotary switch 23.

The rotary switch 23 comprises many different pairs of contacts which are operated sequentially to cause the normal functions of a washing machine to operate, such as valves to allow the ingress or prevent ingress of water into the washing machine, a pump to pump out the water from the washing machine and heating means to heat the water to the required temperature etc.

The rotary switch 23 is provided with a pair of contacts 27 connected through switch 28 to a second programmer generally indicated at 29 and which comprises motor/gearbox 30, rotary timer switch 31 and manually operable member 32.

If it is required in a washing programme to employ the method of washing of the present invention, the switch 28 is closed and at a predetermined time in a washing programme, preferably near the beginning (see programmes on page 16), the rotary switch 23 closes contacts 27 which has the effect, providing the switch 28 has been closed, of commencing operation of motor 30 which drives rotary timer switch 31.

The rotary timer switch 31 has a plurality of contacts, one pair of which 33 are normally closed but, on energisation of motor 30 they will open to prevent further rotation of the conventional programmer 20.

A second pair of contacts 34 will open, which contacts 34 are connected to the water inlet valve to allow the container to fill with water and contacts 35 will also close. The contacts 35 connect the motor 12c driving the drum 2 through an electrical control circuit 36 to a source of supply connected to terminals 38 and 39.

The electronic circuit 36 is adapted to provide energy for a short duration at predetermined intervals of time such that the motor 12c will be energised for a period of 30 seconds for example once in each basic period of 10 minutes for example. Such electronic circuits are well known and may comprise semi-conductor switches operated by constant time delay means provided by the rate of charging of a capacitor through resistive means.

The electronic circuit 36 may also be adapted during its period of energisation to cause the motor 12c to rotate the drum 2, first in one direction and then in an opposite direction of rotation. Such action can be achieved by using a D.C. electric motor to drive the drum

2 and causing a reversal of polarity of energisation by the control circuit 36 to cause reversed rotation.

The clothing or other textile articles present in the drum 2 will thus be washed in accordance with the method of the present invention for a period of time which may be determined by the manually operable member 32.

The rotary timer switch 31 may, for example, be adapted to complete one revolution in 12 hours but its starting point may be predetermined by rotating the manually operable member 32 to any desired position so that the method of washing of the present invention may be carried out for any time, say from a quarter of an hour to 12 hours.

On completion of rotation of the timer, the contacts 33 will again close which will once again connect power to the motor 21, thus recommencing operation of the programmer 20 to allow the remainder of the washing programme to continue.

During the method of washing of the present invention controlled by programmer 29, the water will not be heated in the washing machine itself. In the case where a hot water supply and a cold water supply both supplies may have been open to fill the tub with water, that is at a relatively low temperature, for example 30°C, or alternatively only the valve allowing cold water to enter may have been opened, in which case the temperature of the water will be lower.

In the case of an automatic machine having a cold fill only, when time is limited and it is desired to achieve the same results in a short time by using the method of washing of the present invention as would be

achieved by carrying out the method of washing of the present invention for a considerably longer time in cold water, the water may be heated to said predetermined low temperature by heater 12d.

A switch 41 is provided on the facia of the washing machine which, when in its switched on position will ensure that the heater 12d is energised through thermostat 42 designed to switch on and off at the predetermined desired low temperature so that the water will be heated by heater 12d up to the desired low temperature and when it achieves that temperature thermostat 42 will open to terminate the heating supply. If the temperature falls below the predetermined low temperature thermostat 42 will once again switch on to re-energise the heater 12d to return the water to said predetermined low temperature.

Figure 2 shows only one pair of contacts 34 connected to water valve 44 for allowing the ingress of water into the tub. However it will be appreciated that in a washing machine which is adapted to be supplied with both hot and cold water from a supply, there may be two such pairs of contacts 34 and two water valves 44, one for the hot water and one for the cold water.

The point of time at which the method of washing of the present invention is carried out during a conventional washing cycle will preferably be near the beginning of that cycle. However the remainder of the washing cycle will, in view of the substantial degree of cleaning carried out by the method of washing of the present invention, be considerably shorter than would normally have been the case. Thus, if the method of washing of the present invention is selected by switching on switch 28, it will also have the effect of curtailing some of the stages, in particular the washing stage of the subsequent part of the programme.

The above described arrangement is only one method of providing control means for permitting of operation of the method of washing of the present invention and an alternative method of control can incorporate a microprocessor in which the switching of the various functional items of the machine is carried out electronically. Such a method of operation will now be described with reference to Figure 3.

Referring now to Figure 3, the electrically energised functional units are identified at 12a to 12g. The supply of current to these units from a 240 volt alternating current mains is connected to the input terminals t1, t2 of a main manually operable isolator switch S1, the output terminals t3, t4 of which are connected to the primary winding of power supply transformer T1 and also to power supply rails 15 and 16, in the latter case through the intermediary of a switch S2 operated by door release solenoid 12a.

The supply of current to the functional units 12a to 12g from the conductors 15 and 16 is controlled by respective gate controlled semi-conductor devices 13a to 13g respectively in accordance with the output signals developed at the outlets of control circuits incorporating a micro processor and designated 10a to 10g respectively. In the case of functional units 13b to 13g these outputs are fed through the intermediary of an output driver 17. Associated with the functional devices are a number of supplementary devices which control or contribute to the function performed by the functional devices, these being high, medium and low level switches S3, S4, S5 serving respectively to control current to the hot water solenoid valve 12e, cold water solenoid valve 12f and heater 12d and which provide inputs to the micro processor at terminals 10k, 10l, 10m. to control the liquid levels in the drum. A further supplementary

device is a tacho generator $12c_1$ operatively coupled mechanically as indicated by the broken line $12c_2$ to drive motor 12c and providing an input to the micro processor at terminal 10n.

A further supplementary device is a thermistor Th_1 which senses the temperature of the washing liquid in the washing chamber and provides an input to the micro processor at terminal 10p.

The direction of energisation of the field winding F of the drive motor 12c is controlled by a further supplementary device, namely a relay RV having reversing contacts S6 and powered from secondary winding T1c, transformer T1 (44 volts). The relay RV is operated under the control of the output at micro processor terminal 10i. The magnitude of the current in the motor is controlled by the output at terminal 10c of the micro processor and current supply to the motor is isolated by a master relay MR having switch contacts S7.

For bringing the washing machine into operation in accordance with the required programme, a series of switches, preferably of the press button type, S8a to S8i provide inputs at terminals 11a to 11i respectively for initiating the following programmes or operations, namely cancel, open door, rinse hold, test, high level, bio, prewash, start, and programme, the significance of which is explained hereinafter.

Indicator means 14 are provided comprising a plurality of electrically energisable indicator elements, for example light emitting diodes 14a - 14g which constitute a 7 segment numerical indicator and elements 14h - 14m which consist of single light emitting diodes, both sets of light emitting diodes being controlled by outputs at terminals 13a - 13g of the micro processor through the

intermediary of a display power driver. The two sets of display elements, namely 14a - 14g and 14h - 14m are each supplied respectively by alternate half cycles of the A.C. electricity supply from transformer secondary T1b via diodes 19a and 19b.

The programming provided by the micro processor is such that certain of the display elements provide different classes of information at stages of operation of the machine. Thus before and during programme selection the single L.E.D.'s 14a - 14m indicate options for selection whilst the LED's providing the seven segment numerical indicator will indicate the identification number of the wash programme. After start the single L.E.D.'s 14a - 14m indicate progress of the selected wash programme as described later. If a fault develops, the seven segment numerical indicator display is then used to indicate this fact by flashing alternatively 'F' and a code number signifying the nature of the fault.

Referring now to the washing programmes which can be provided under the control of the micro processor, the latter may furnish outputs producing many different programmes, one of which will now be described in detail.

The method of washing of the present invention may be incorporated in a complete washing programme and is hereinafter referred to by the designation "Soak".

1. Fill cold for 10 seconds no action.
   Fill hot and cold to high level with action.
   Heat to 30°C with action.
   Wash for 10 minutes.
   SOAK - one tumble action every 10 minutes.
   This sequence will continue until 'START' is pressed.
   Pump spin at 95 r.p.m. for 1 minute 30 seconds.

2. Fill cold to low level no action.
Fill cold to high level with action.
Rinse for 1½ minutes.
Pump spin at 95 r.p.m. for 1 minute 30 seconds.
Pump spin at 460 r.p.m. for 10 seconds.
Pump out with cold valve open for 15 seconds.

3. Fill cold to low level no action.
Fill cold to high level with action.
Rinse for 1½ minutes.
Pump spin at 95 r.p.m. for 1 minute 30 seconds.
Pump spin at 460 r.p.m. for 10 seconds.
Pump out with cold valve open for 15 seconds.

4. Fill cold to low level no action.
Fill cold plus fabric conditioner to high level with action.
Rinse for 1½ minutes.
Pause until start is operated if rinse hold is selected.
Pump spin at 95 r.p.m. for 1 minute 30 seconds.
Pump spin at 460 r.p.m. for 2 minutes.

It will be noted that although the initial wash sequence set forth in sub-paragraph 1 does include a wash action for 10 minutes, it is thereafter followed by a sequence which involves a tumble action (producing agitation of the liquid) every 10 minutes and typically this agitation may be effected over a relatively brief period of 30 seconds in each of a series of longer basic periods of 10 minutes. This sequence continues until the start control is pressed to bring into operation pump out of the liquid followed by the rinse sequences set forth in sub-paragraphs 2 to 4.

The sequence of paragraph 1 starting with the first tumble action producing agitation of the washing liquid

would be continued for at least 1 hour and preferably longer, for example 3 to 4 hours.

It would be possible to set a period automatically for continuance of the tumble sequence of the duration 1, 2 or more hours so that it is not necessary for the operator manually to press the start control and the machine would then continue with the sequences set forth in sub-paragraphs 2, 3 and 4 automatically.

The principal difference between the 'soak' technique of the present intention and conventional washes is that equivalent cleansing is achieved by long soak at relatively low temperature with minimum agitation compared with a short wash at high temperature with vigorous agitation. The economy is achieved by not heating water to a high temperature, whilst the efficiency of the wash is maintained by the minimum wash action to prevent 'tide-marks' and redisposition of dirt.

This can be achieved by electronic control of the functional units of the machine without difficulties which would be encountered by use of a mechanical timer due to the long operational period which may be required e.g. starting the machine at say 2300 hours and terminating the soak programme at say 0800 hours the next day. The requisite programme to carry out the soak programme hereinbefore referred to, followed, if required, by a main washing programme is provided by a micropressor as more fully disclosed in our co-pending application entitled "Improvements relating to control circuits in or for washing and the like machines or other apparatus".

CLAIMS:

1. A method of washing textile articles comprising substantially immersing the articles in a washing liquid and subjecting the washing liquid to agitation and subsequently removing the articles from the washing liquid relatively from the immersed relation, characterised in that:

a. the washing liquid is not higher than a predetermined relatively low temperature;

b. the washing liquid is subjected to agitation for a relatively brief period in each of a succession of considerably longer basic periods.

2. A method as claimed in claim 1, characterised in that the washing liquid is heated to said predetermined relatively low temperature.

3. A method as claimed in either of claims 1 and 2, characterised in that the ratio of the time period over which agitation is effected to the basic period is between 1 : 5 and 1 : 80.

4. A method according to any one of the preceding claims, characterised in that the duration of each of the agitations is between 15 seconds and 60 seconds.

5. A method according to any one of the preceding claims, characterised in that the duration of each of the basic periods is between 5 minutes and 20 minutes.

6. A method according to any one of the preceding claims, characterised in that agitation is effected by rotation at a tumbling speed of the drum (2) rotatable about a horizontal axis and in which both the articles and liquid and present and in that the drum (2) is given movements of rotation of different amounts in opposite directions respectively.

7. A machine for washing textile articles adapted to carry out the method of washing textile articles as claimed in any one of claims 1 to 6.

8. A machine for washing textile articles comprising a body (1) defining a washing chamber for reception of the articles to be washed, means for supplying washing liquid to said chamber (1), means (2) for agitating said liquid in said chamber, means (12b) for discharging the washing liquid from said chamber (1), characterised in that control means (10, 29) are provided for rendering the agitation means (2) operative for a brief period in each of a succession of considerably longer basic periods.

9. A machine according to claim 8 comprising means (40) for heating the washing liquid, characterised in that means (42) are provided for controlling the temperature to which it is heated to a relatively low value as herein defined.

10. A machine according either of claims 8 and 9, characterised in that control means (10, 29) are operable to control the ratio of the brief periods of agitation to the basic periods and the values of each of these periods as claimed in respect of any one of claims 3, 4 or 5.

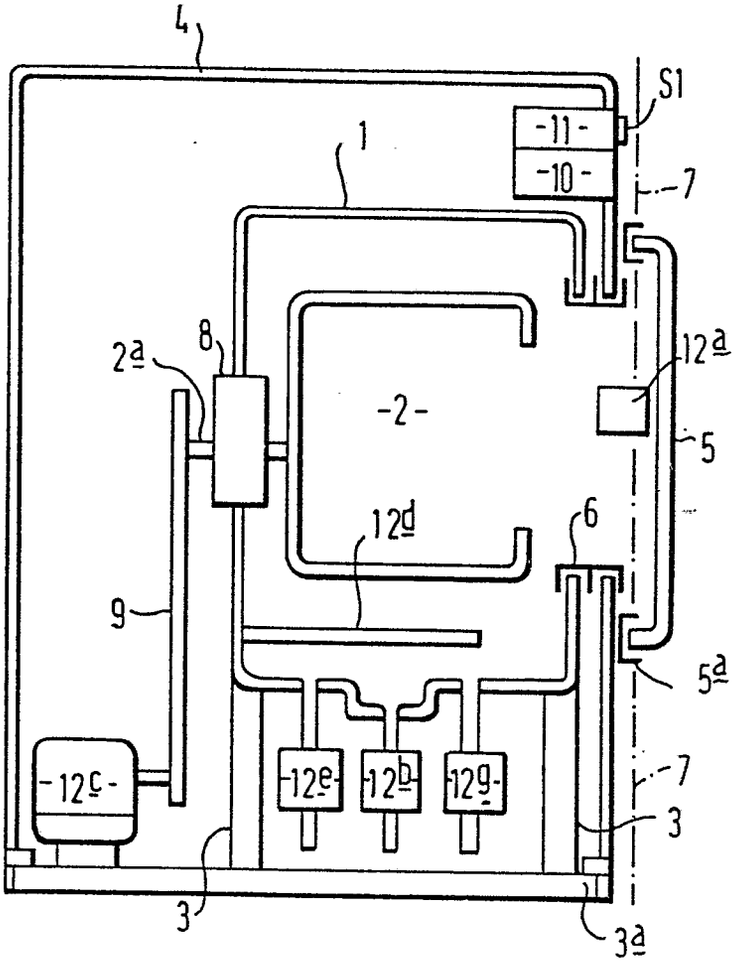

FIG 1

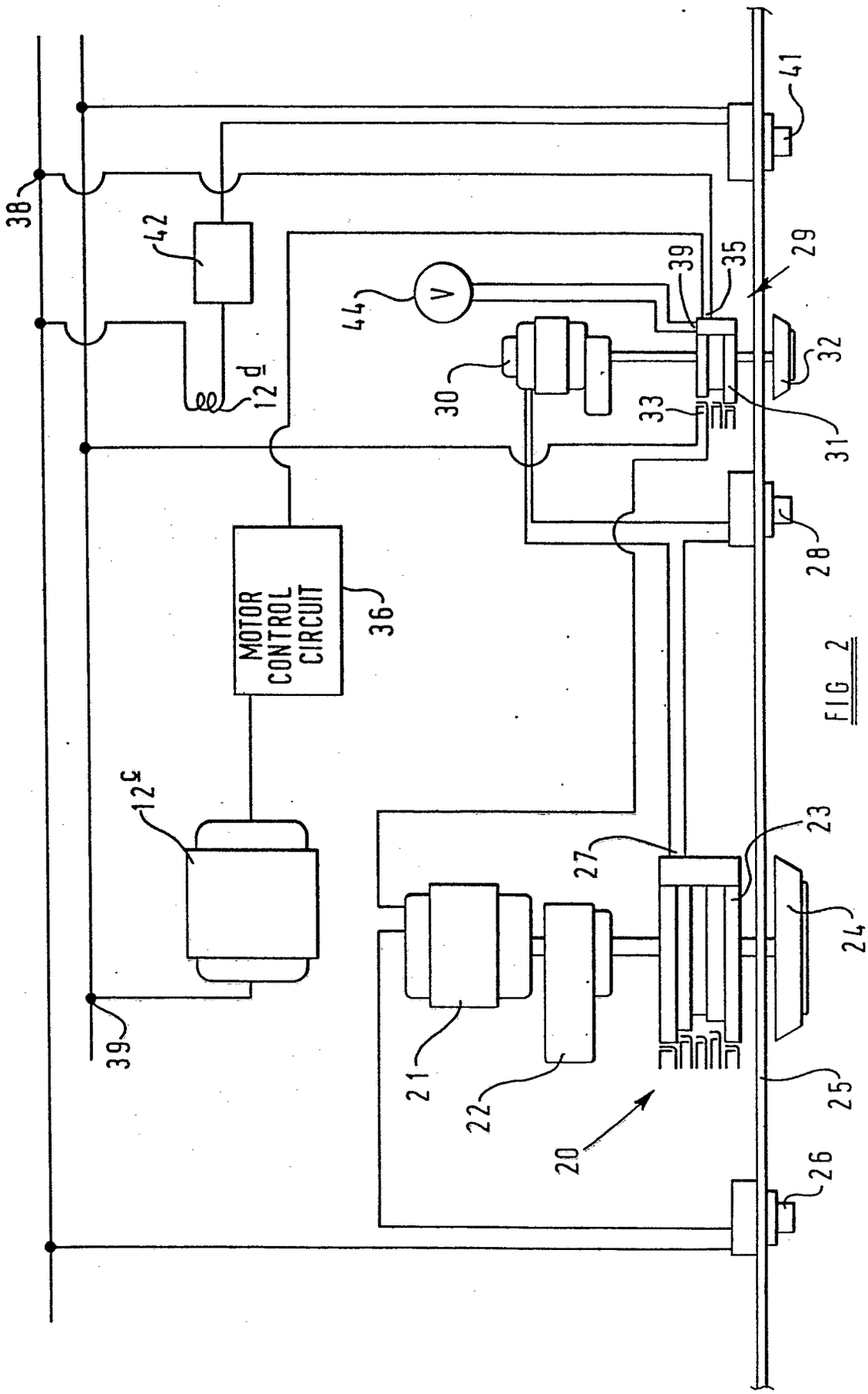
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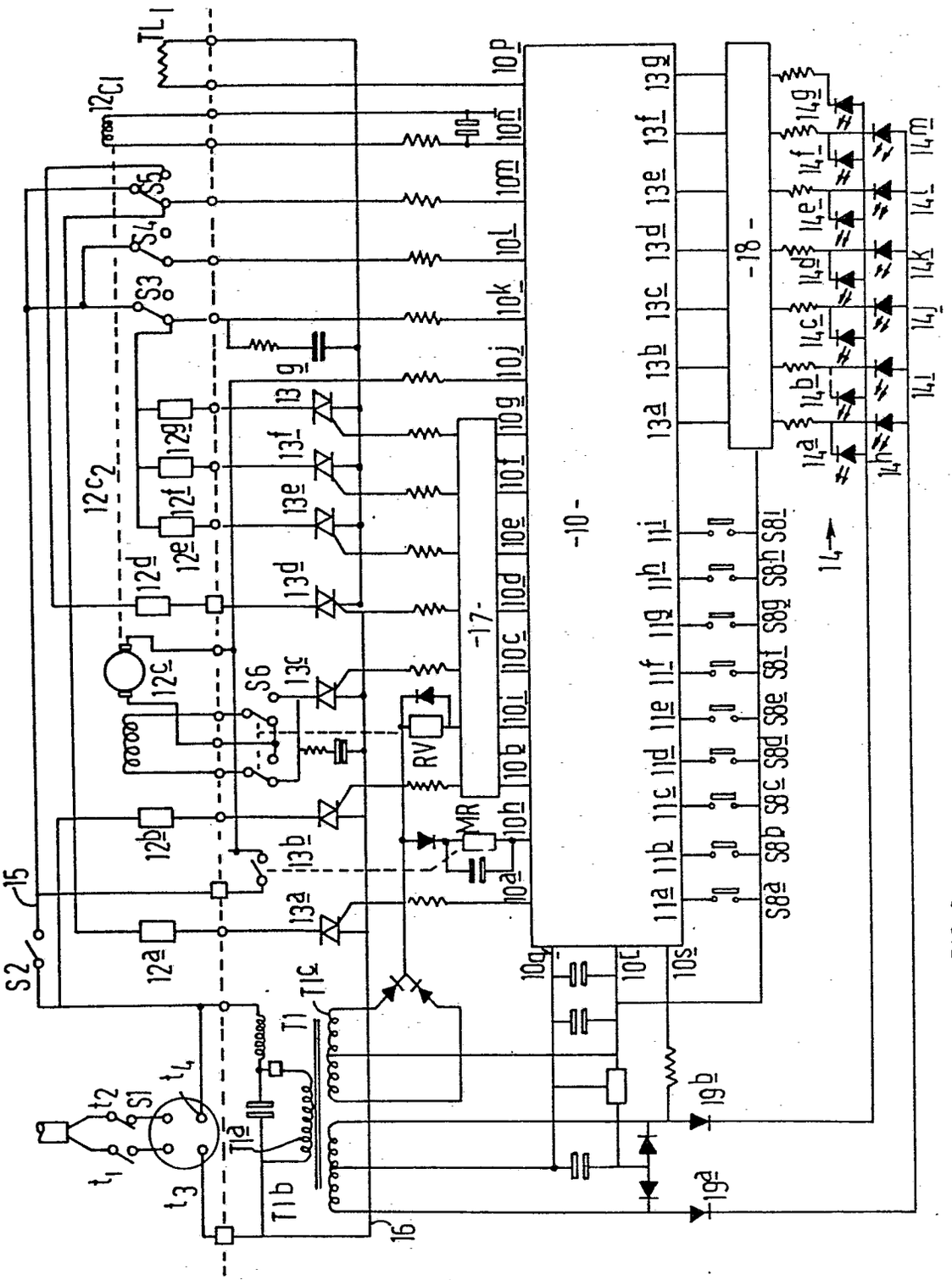
FIG 2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12c2
S5
S4
S3
S6
S2
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16
T1
T1a
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T1c
t1
t2
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t4
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-17-
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14-

FIG 3