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EUROPEAN PATENT APPLICATION

(43) Date of publication:
11.06.2014 Bulletin 2014/24

(51) Int Cl.:
A47L 15/00 (2006.01)

(21) Application number: 12425196.8

(22) Date of filing: 10.12.2012

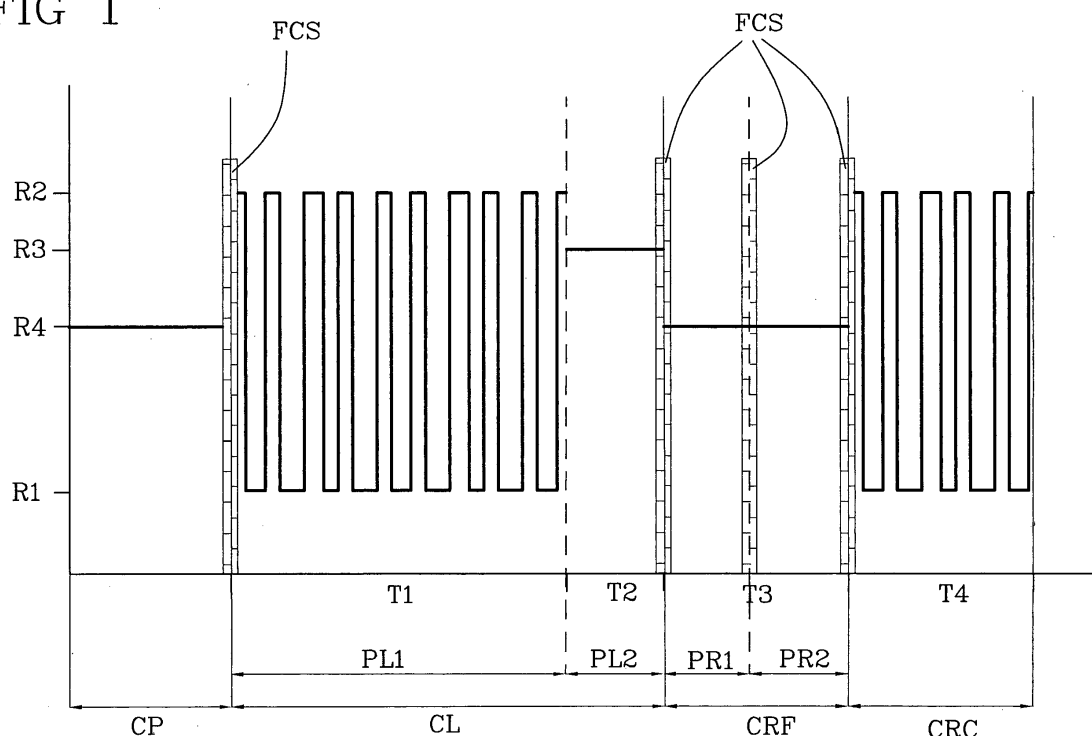
(84) Designated Contracting States: AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR Designated Extension States: BA ME	(72) Inventor: Fumagalli, Aldo 20900 Monza (MB) (IT) (74) Representative: Sgobba, Marco et al Perani & Partners Piazza San Babila, 5 20122 Milano (IT)
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(54) Method of operating a dishwasher

(57) A method of operating a dishwasher comprises providing a dishwasher having at least one main spray device, at least one auxilliary spray device and a motor-driven circulation pump which is selectively placed in fluid connection with said spray devices, executing a washing cycle (CL) in which the motor-driven pump feeds all the spray devices. The washing cycle (CL) comprises a first operating period (PL1) and a second operating period (PL2) of the motor-driven pump, in said first operating

period (PL1) the motor-driven pump being operated to rotate at a first rpm value (R1) and a second rpm value (R2), with a pulsed operation alternating the first rpm value (R1) and the second rpm value (R2), in said second operating period (PL2) the motor-driven pump being operated to constantly rotate at a third rpm value (R3) higher than the first rpm value (R1) and lower than the second rpm value (R2).

FIG 1



Description

[0001] The present invention relates to a method of operating a dishwasher.

[0002] Dishwashers comprise a washing chamber usually with two dish racks disposed therein, one above the other. One or a pair of spray devices, usually having two arms adapted to rotate about a common axis of rotation, with a plurality of nozzles thereon, spray a washing liquid on the dish racks, and hence on dishware. The spray devices are rotated by the washing liquid delivered by the nozzles, which imparts angular momenta to the two arms, thereby causing them to rotate about the axis of rotation.

[0003] Certain dishwashers use one (or more) auxiliary spray devices, in addition to the above mentioned main spray devices. Such auxiliary spray device is usually located in the washing chamber below the rack for pots and pans, such that pots and pans or any larger dishware may be more intensively sprayed with the washing liquid.

[0004] The auxiliary spray devices, also equipped with spray nozzles, rotate (usually about an axis of rotation other than that of the main spray devices) and their rotation is ensured, as for the main spray devices, by the washing liquid delivered by the nozzles, which imparts angular momenta and cause rotation of the auxiliary spray device. These auxiliary spray devices have been appreciated by consumers, as they provide a more intensive cleaning action on dishware, such as pots and pans, which sometimes are soiled with hard-to-remove food residues.

[0005] Nevertheless, while on the one hand the cleaning action of the dishwasher is improved, on the other hand the power of the motor-driven circulation pump has to be increased to also supply power to the auxiliary spray device. This is because, since rotation of the (either main or auxiliary) spray devices is directly actuated by the washing liquid delivered by the nozzles, a lower limit is set for the rotation speed and hence for the spray device function, which is given by the delivery rate of the circulation pump. The use of a motor-driven pump of higher power involves higher dishwasher manufacturing costs and higher power consumption as compared with conventional dishwashers.

[0006] This the present invention has the object of providing a method of operating a dishwasher that allows the use of auxiliary spray devices without requiring an increase of the power rate of the motor-driven circulation pump.

[0007] This problem is solved as defined in one or more of the annexed claims.

[0008] The method of operating a dishwasher according to the present invention will be now described in greater detail with reference to the accompanying drawings, given by way of illustration and without limitation, in which:

- Figure 1 shows a diagram of the method of operating

a dishwasher according to the present invention;

- Figure 2 is a diagrammatic view of a detail of Figure 1.

[0009] The operation method of the present invention is applicable to a dishwasher of the type comprising a motor-driven circulation pump, at least one, preferably two, main spray devices and at least one auxiliary spray device. The motor-driven pump is selectively placed in fluid communication with the spray devices, i.e. may be placed in fluid communication with all the spray devices or only with the main ones (depending on the desired operating cycle).

[0010] The method includes the execution of a washing cycle CL in which the motor-driven circulation pump feeds the main spray device and the auxiliary spray device. The washing cycle CL comprises a first operating period PL1 and a second operating period PL2 of the motor-driven pump, where in the first operating period PL1 the motor-driven pump is operated to rotate at a first rpm value R1 and a second rpm value R2, with a pulsed operation alternating the first rpm value R1 and the second rpm value R2 (see Figure 1, in which the x-axis is representative of time and the y-axis is representatives of the rpm of the motor-driven pump) In the second operating period PL2, the motor-driven pump is operated to constantly rotate at a third rpm value R3, higher than the first rpm value R1 and lower than the second rpm value R2. It shall be noted that the rpm of the motor-driven pump is directly proportional to its delivery rate.

[0011] The term pulsed operation alternating the first rpm P1 and the second rpm value R2 as used herein is intended to designate an operation of the motor-driven pump in which the latter rotates at the first rpm value R1, then at the second rpm value R2, then again at the first rpm value R1 and so on, as schematically shown in Figure 2. If transients from the first rpm value R1 to the second rpm value R2 and vice versa, which are very short, are neglected, then the alternate pulsed operation is of the square wave type (as schematically shown in the figures).

[0012] The rpm of the motor-driven pump is adjusted by acting upon the electric motor of the pump, i.e. by changing voltage or current supplied thereto. The second rpm value R2 at which the motor-driven pump is operated is such that the electric motor of the pump runs at its highest power or even above its maximum rated power. This will provide a useful flow for operation of all spray devices. The alternate pulsed operation in the first operating period PL1 allows the spray devices to be fed with an adequate flow rate and avoids damages to the electric motor of the pump. Thus motor-driven pumps as used in conventional dishwashers (i.e. with no auxiliary spray device) will be also usable in dishwashers having auxiliary spray devices.

[0013] Preferably the third rpm value R3 at which the motor-driven pump is operated is also such that the electric motor of the pump runs at its highest power or even above its maximum rated power. In this case, the duration

T2 of the second operating period PL2 is limited to a value that is lower than the maximum operating time of the electric motor of the pump prior to its being damaged.

[0014] In the preferred embodiment of the invention, the first operating period PL1 of the washing cycle CL has a duration T1 longer than the duration T2 of the second operating period PL2. Preferably, the duration T2 of the second operating period PL2 of the washing cycle CL is less than 1000 seconds, preferably ranges from 400 to 700 seconds, and more preferably is about 600 seconds.

[0015] Preferably, the pulsed operation alternating the first rpm value R1 and the second rpm value R2 of the motor-driven pump comprises periodically repeating sequences S (see Figure 2). Each sequence S comprises an initial pulse IP and a final pulse FP, in which the rpm of the motor-driven pump is equal to the second rpm value R2. The initial pulse IP and the final pulse FP have the same duration t1 and are separated by an interval of predetermined length. Each sequence S further comprises a middle pulse MP, in which the rpm of the motor-driven pump is equal to the second rpm value R2. The middle pulse is operative in the interval between the initial pulse IP and the final pulse FP. The duration t2 of the middle pulse MP is shorter than the duration t1 of the initial IP and final FP pulses. Each sequence S comprises a base B between two successive pulses, in which the rpm value of the motor-driven pump is equal to the first rpm value R1. Therefore, each sequence S comprises three pulses in which the motor-driven pump is operated at the second rpm value R2 and three bases in which the motor-driven pump is operated at the first rpm value R1. In the preferred embodiment of the invention, the duration t3 of each base B is at least five times longer than the duration t1, t2 of a pulse. Preferably, each sequence S comprises an initial pulse IP having a duration t1 of about 0.5 seconds, followed by a base B having a duration t3 of about 4 seconds, followed by a middle pulse MP having a duration of about 0.3 seconds, followed by a base B having a duration t3 of about 3 seconds, followed by a final pulse FP having a duration of about 0.5 seconds, followed by a base B having a duration t3 of about 4 seconds.

[0016] The washing cycle CL is preceded by a pre-wash cycle CP, in which the motor-driven pump only feeds the main delivery device and is operated to constantly rotate at a fourth rpm value R4, higher than the first rpm value R1 and lower than the third rpm value R3. The fourth rpm value R4 falls within the normal operation parameters of the motor-driven pump. The pre-wash cycle CP has a duration that ranges from 500 to 1500 seconds, preferably from 700 to 1200 seconds, more preferably of about 950 seconds.

[0017] The washing cycle CL is followed by a cold rinse cycle CP, in which the motor-driven pump only feeds the main delivery device and is operated to constantly rotate at the fourth rpm value R4. The cold rinse cycle CRF has a duration T3 that ranges from 800 to 1800 seconds,

preferably from 900 to 1500 seconds, more preferably of about 1100 seconds. The cold rinse cycle CRF is preferably divided into two identical sub-cycles PR1, PR2 with a liquid fill and drain step FCS therebetween.

[0018] The cold rinse cycle CRF is followed by a hot rinse cycle CRC, in which the motor-driven pump feeds all the spray devices (including the auxiliary spray device) and is operated to rotate at the first rpm value R1 and the second rpm value R2, with a pulsed operation alternating the first rpm value R1 and the second rpm value R2. The hot rinse cycle CRC has a duration T4 that ranges from 800 to 1800 seconds, preferably from 900 to 1500 seconds, more preferably of about 1200 seconds.

[0019] A liquid fill and drain step FSC is provided between the above mentioned cycles CP, CL, CRF, CRC.

[0020] It shall be noted that the average volumetric delivery rate of the motor-driven pump during its pulsed operation alternating the first rpm value R1 and the second rpm value R2 is substantially equal to the average volumetric delivery rate of the motor-driven pump during its operation at the fourth rpm value R4. Thus, the flow rates/hour of the motor-driven pump in both the above operations are substantially identical.

[0021] In the preferred embodiment of the invention, the first rpm value R1 ranges from 2500 to 3800 rpm, preferably from 3000 to 3400 rpm, and is more preferably about 3240 rpm. The second rpm value R2 ranges from 4500 to 5500 rpm, preferably from 4800 to 5200 rpm, and is more preferably about 5040 rpm. The third rpm value R3 ranges from 4300 to 5200 rpm, preferably from 4600 to 5000 rpm, and is more preferably about 4860 rpm. The fourth rpm value R4 ranges from 4000 to 5000 rpm, preferably from 4300 to 4700 rpm, and is more preferably about 4500 rpm.

[0022] During the washing cycle CL, the washing liquid (e.g. water from the mains) undergoes heating. Such heating starts at the start of the washing cycle CL and has a liquid heating curve that increases in substantially linear fashion from ambient temperature (e.g. 20 °C) to a threshold temperature ranging from 60°C to 85°C, preferably about 73°C. The threshold temperature is reached after about three quarters of the duration T1 of the first operating period PL1 of the motor-driven pump. Once the threshold temperature has been reached, the washing cycle is no longer heated during the washing cycle CL. A similar heating step is carried out during the hot rinse cycle CRC. Here, the threshold temperature is reached at the end of the cycle.

[0023] The above disclosure clearly shows that the method of operating the dishwasher allows use of auxiliary spray devices without having to increase the rated power of the motor-driven circulation pump that is typically used in dishwashers equipped with main spray devices only.

Claims

1. Method of operating a dishwasher comprising:

providing a dishwasher having at least one main spray device, at least one auxiliary spray device and a motor-driven circulation pump which is selectively placed in fluid connection with said spray devices;

executing a washing cycle (CL), in which the motor-driven circulation pump feeds the main spray device and the auxiliary spray device; **characterized in that** said washing cycle (CL) comprises a first operating period (PL1) and a second operating period (PL2) of the motor-driven circulation pump, in said first operating period (PL1) the motor-driven circulation pump being operated to rotate at a first rpm value (R1) and a second rpm value (R2), with a pulsed operation alternating the first rpm value (R1) and the second rpm value (R2), in said second operating period (PL2) the motor-driven circulation pump being operated to constantly rotate at a third rpm value (R3) higher than the first rpm value (R1) and lower than the second rpm value (R2).

2. A method as claimed in claim 1, wherein the washing cycle (CL) is preceded by a pre-wash cycle (CP), in which the motor-driven circulation pump only feeds the main delivery device and is operated to rotate at a fourth rpm value (R4), higher than the first rpm value (R1) and lower than the third rpm value (R3).

3. A method as claimed in claim 1 or 2, wherein the washing cycle (CL) is followed by a cold rinse cycle (CRF), in which the motor-driven circulation pump only feeds the main delivery device and is operated to rotate at a fourth rpm value (R4), higher than the first rpm value (R1) and lower than the third rpm value (R3).

4. A method as claimed in any of the preceding claims, wherein the washing cycle (CL) is followed by a hot rinse cycle (CRC), in which the motor-driven circulation pump feeds the main spray device and the auxiliary spray device and is operated to rotate at said first rpm value (R1) and said second rpm value (R2), with a pulsed operation alternating the first rpm value (R1) and the second rpm value (R2).

5. A method as claimed in claim 2, wherein the average volumetric delivery rate of the motor-driven circulation pump during the pre-wash cycle (CP) is equal to the average volumetric delivery rate of the motor-driven pump during the first operating period (PL1) of the washing cycle (CL).

6. A method as claimed in any one of the preceding

claims, wherein said pulsed operation alternating said first and second rpm's comprises periodically repeating sequences (S), each sequence (S) comprising an initial pulse (IP) and a final pulse (FP), wherein the rpm of the motor-driven circulation pump is equal to the second rpm value (R2), each having the same duration (t1) and being separated by an interval of predetermined length (t3).

7. A method as claimed in claim 6, wherein each sequence (S) further comprises a middle pulse (MP), in which the rpm of the motor-driven circulation pump is equal to the second rpm value (R2) operating in said interval of predetermined length (t3), whose duration (t2) is less than that (t1) of the initial pulse (IP) and the final pulse (FP).

8. A method as claimed in claim 6 or 7, wherein each sequence (S) comprises a base (B) between two successive pulses, in which the rpm of the motor-driven circulation pump is equal to the first rpm value (R1).

9. A method as claimed in any of the preceding claims, wherein the duration (T2) of the second operating period (PL2) of the washing cycle (CL) is less than 1000 seconds, and preferably ranges from 400 to 700 seconds.

10. A method as claimed in claim 8, wherein the duration (t3) of the base (B) is at least five times longer than the duration (t1, t2) of one of said pulses.

11. A method as claimed in any of the preceding claims, wherein the first rpm value (R1) ranges from 2500 to 3800 rpm, preferably from 3000 to 3400 rpm, and is more preferably about 3240 rpm, the second rpm value (R2) ranges from 4500 to 5500 rpm, preferably from 4800 to 5200 rpm, and is more preferably about 5040 rpm, the third rpm value (R3) ranges from 4300 to 5200 rpm, preferably from 4600 to 5000 rpm, and is more preferably about 4860 rpm.

FIG 1

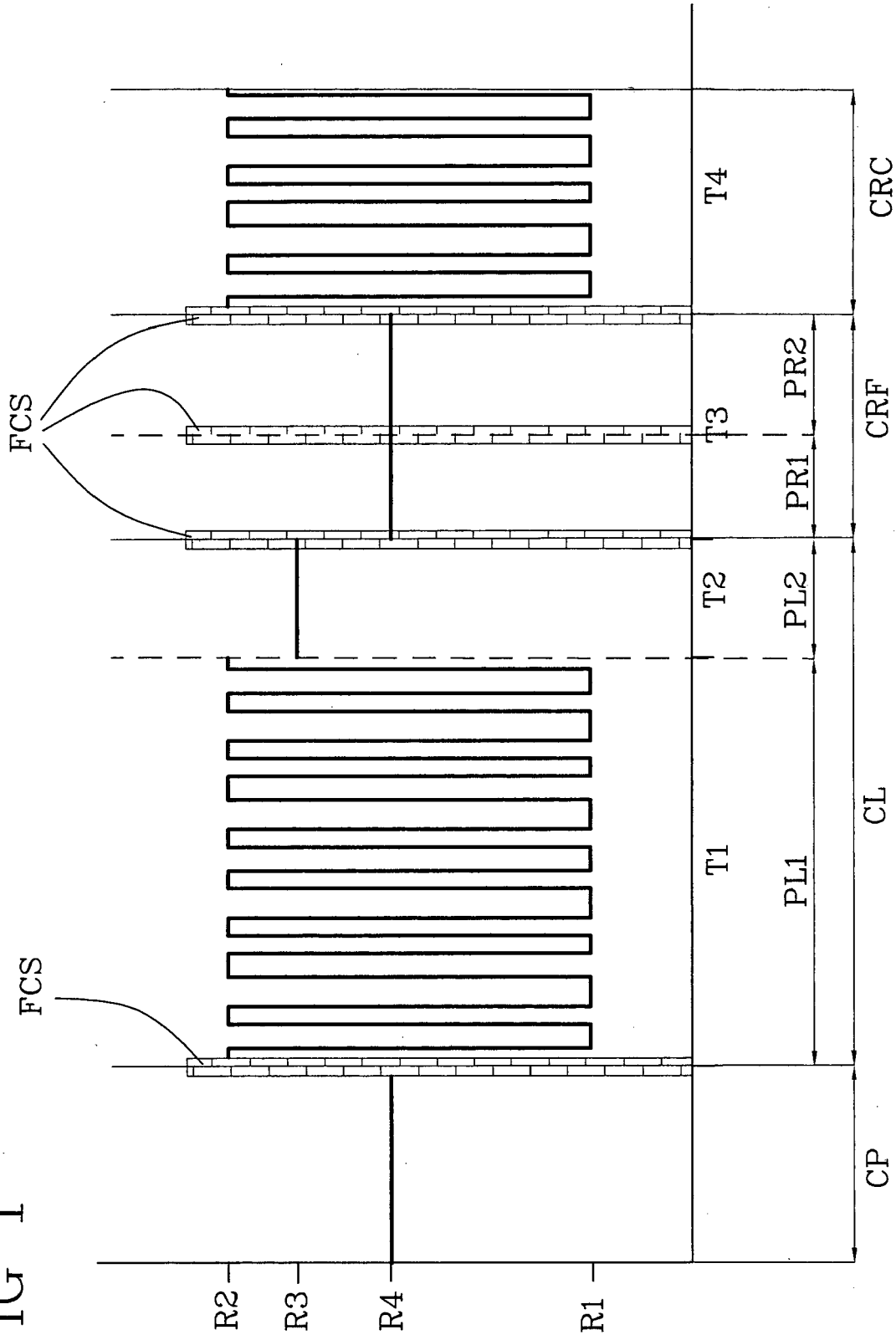
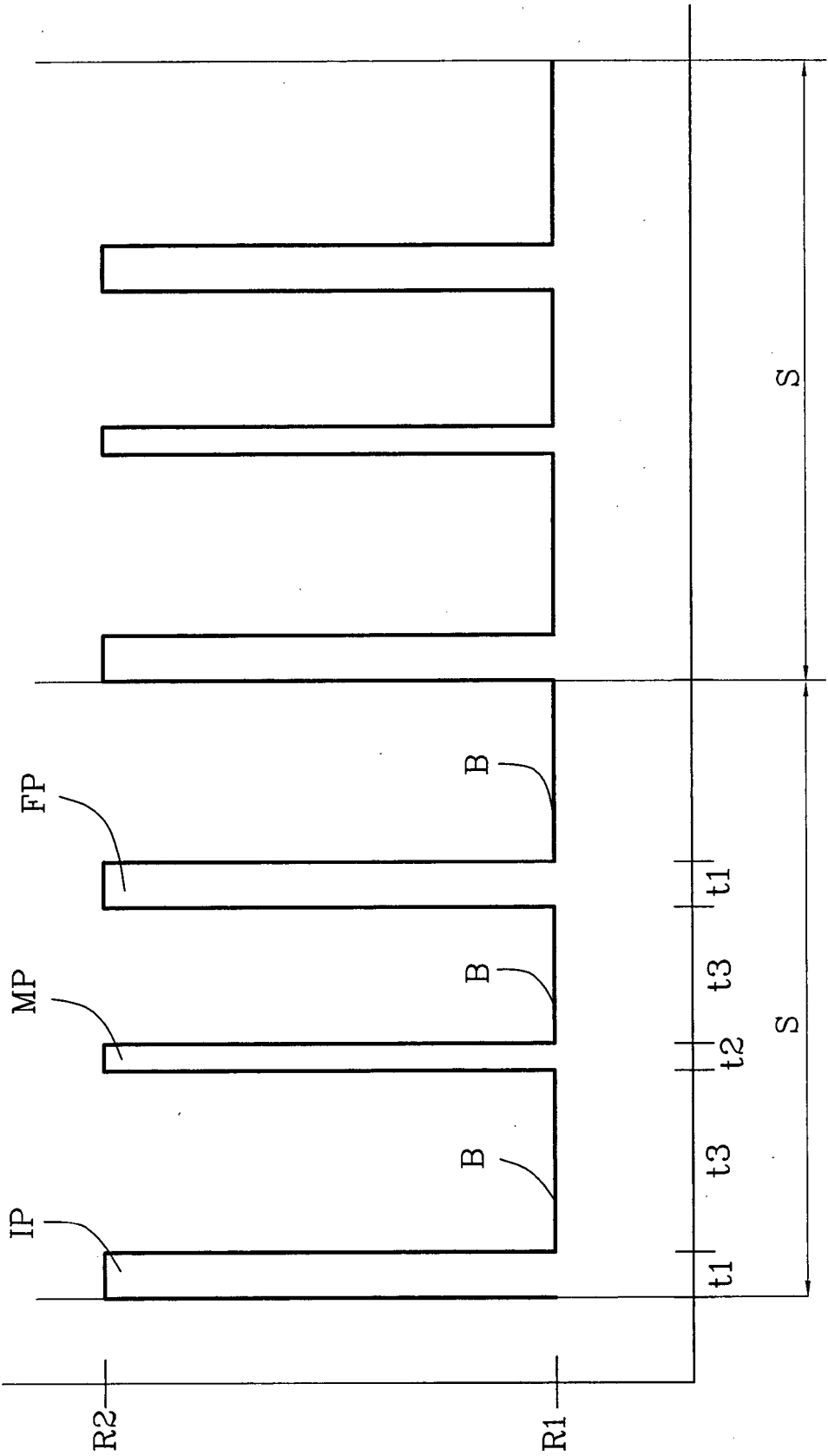


FIG 2





EUROPEAN SEARCH REPORT

Application Number
EP 12 42 5196

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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