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(54) A METHOD AND APPARATUS FOR CONTROLLING FLUID DISCHARGE FROM AN APPLICATOR HEAD FOR A FLUID, AND AN APPLICATOR HEAD HAVING SUCH AN APPARATUS

(57) The invention relates to a method of controlling fluid discharge from an applicator head (1) for a fluid, said method comprising the steps of

- supplying a primary discharge signal (A) for controlling the applicator head,
- analysing only the primary discharge signal for a recurrent pattern,
- transforming the primary discharge signal into a secondary discharge signal (F) when a recurrent pattern has been detected, and
- supplying the secondary discharge signal to the applicator head.

The invention is characterised in that the secondary discharge signal has a plurality of successive, spaced-apart signal portions which are each determined as part of the length of the primary signal, preferably as a percentual part, and whose total length is less than the length of the primary signal.

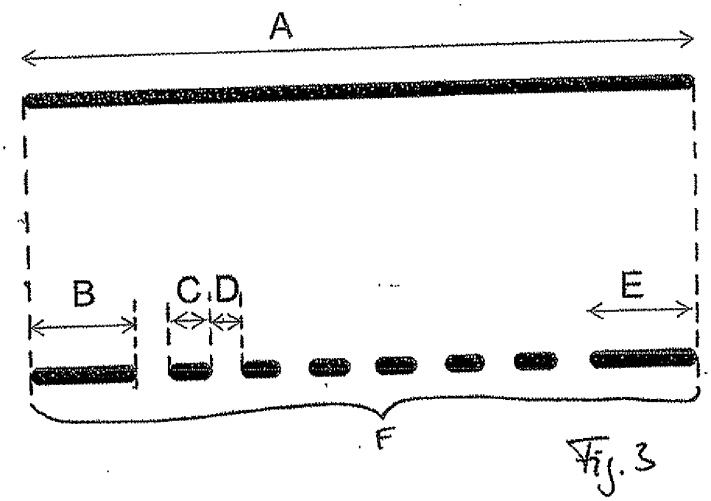

Fig. 3

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Description

[0001] The present invention relates to a method of controlling fluid discharge from an applicator head for a fluid.

[0002] Methods of the kind specified above are applied in the packaging industry in order to produce packaging materials. Specific examples of such packaging materials are plastic board or fibre cartonboard. The packaging materials are fed into a machine as substantially planar blanks (also referred to in the following as substrates). The fluid, mostly hot-melt adhesive, is then applied along one or more tracks on various areas of the blanks in a process for dispensing fluid by means of an applicator head. Other fluids, such as cold glue, fats and similar, may also be used. After application of fluid, the packaging materials are either filled with product or remain empty. The areas to which fluid was previously applied are then folded along defined edges and pressed onto corresponding areas. The applied fluid causes the areas to adhere to each other.

[0003] The applications described above are for mass production, so in addition to increasing efficient use of time, efforts to make improvements are also centred at all times on reducing the amount of material needed for production.

[0004] Rather than applying continuous beads of fluid onto the substrates, one well-known approach involves applying a pattern of intermittent, short-pulsed segments in order to provide an adequate adhesive effect while using a reduced amount of fluid or adhesive.

[0005] However, known methods and apparatus require a substantial amount of equipment. In order to operate the respective applicator heads of fluid dispensing devices, it has been necessary until now to provide a dedicated timer or controller, as well as encoders and switch units in the applicator device. Additional sensor means may also have to be provided in order to detect the geometry of the substrate on which fluid is to be applied, for example of the blanks of packaging material.

[0006] This results in the costs for equipment having such functions becoming relatively high and makes it complicated and expensive to refit old machines that do not feature the fluid- or adhesive-saving function described above.

[0007] The object of the invention is therefore to specify a method of the kind initially specified which saves material when dispensing fluid and which can therefore be implemented as cost-efficiently as possible.

[0008] The invention achieves its object with a method of the kind initially specified, comprising the steps of: supplying a primary discharge signal for controlling the applicator head, analysing only the primary discharge signal for a recurrent pattern, transforming the primary discharge signal into a secondary discharge signal when a recurrent pattern has been detected, and supplying the secondary discharge signal to the applicator head, the secondary discharge signal having a plurality of successive, spaced-apart signal portions which are each determined as part of the length of the primary signal, preferably as a percentual part, and whose total length is less than the length of the primary signal. The invention makes use of the discovery that it is possible, on the basis of a primary discharge signal or control signal for the applicator head, as predefined by the production equipment, to describe the secondary discharge signal or target signal, which is desired in order to save material, exclusively as a function of the primary discharge signal. From there, the method according to the invention is based on analysing any primary discharge signal already predefined by the production equipment for a recurrent pattern, then transforming it, once the recurrent pattern has been detected, into the secondary discharge signal in order to save fluid. This makes it possible to operate any unit with the method according to the invention, by implementing the method in a respective controller and applying it to the primary discharge signal that already exists and which is transmitted by an existing production unit.

[0009] The method according to the invention is advantageously developed by the secondary discharge signal having a leading signal portion, a trailing signal portion and one or more intermediate signal portions therebetween with time intervals on either side, the time duration between the beginning of the leading signal portion and the end of the trailing signal portion being equal to the time duration between the beginning and the end of the primary discharge signal. Spreading apart the secondary signal portions over the same period that is also occupied by the primary discharge signal results in fluid always being applied at the starting point of a bead of fluid in time and in space that is occupied by the leading signal portion, and in the portion at the end of a fluid bead that is occupied in time and in space by the trailing signal portion of the secondary discharge signal. It is highly important when a plurality of substrates are bonded together by means of a bead of fluid, particularly when the fluid is applied intermittently (also called "stitched"), that the length of the adhesive bead predefined by means of the primary discharge signal length really does lead in any event to the application of adhesive at the beginning and the end. If there is no adhesive at the beginning or the end of the bead of fluid, this can easily lead to parts that are being bonded to each other coming apart.

[0010] This is reliably prevented by spreading apart the portions of the secondary discharge signal. The savings in fluid are determined by the length of the time intervals between the signal portions, in combination with the length of the intermediate signal portions in time and space and with the leading and trailing signal portion of the secondary discharge signal. The longer the periods between the secondary signal portions, the more adhesive is saved. The periods in which a secondary discharge signal is applied are called "on" times, whereas the periods between the portions of the secondary discharge signal are called "off" times.

[0011] The primary discharge signal is preferably

formed as a one-part signal, a continuous signal or as a signal which recurs at substantially regular intervals, or the primary discharge signal is formed as a multipart signal recurring at substantially regular intervals and with signal portions of differing lengths. There are basically two main operating modes for the primary discharge signal. In a first operating mode, the primary discharge signal is a continuous signal, which corresponds to an uninterrupted, continuously applied bead of fluid. This operating mode also includes the presence of an intermittent primary discharge signal, which is substantially periodic, however, with regard to both the "on" time and the "off" time. A second operating mode is defined as the one in which the timing profile of the primary discharge signal is more complex. In this second operating mode, the primary discharge signal is a multipart signal and comprises a plurality of signal portions of different lengths that are spaced apart from each other by equal or also by different time intervals. The entire pattern in this operating mode is likewise substantially periodic, but that does not apply to the individual intervals of the "on" time and the "off" time, which may differ in relation to their immediate neighbours.

[0012] The advantage of the present invention is that, regardless of the operating mode, a pattern which recurs after the respective number of logging operations is detected with the method according to the invention in respect of the primary discharge signal, on the basis of the duration of the primary discharge signal and by logging the timing sequence of the signals or signal parts of the primary discharge signal. Since the length of the primary discharge signal or of the signal part of the primary discharge signal is the measure for the length of the secondary discharge signal portions, fluid-saving application can be generated for any pattern in the primary discharge signal (apart from the theoretical case in which the primary discharge signal is less than the minimum technical limit, although the latter is not reached in practice because the primary discharge signal triggering a bead of fluid will always have a certain length, sufficient to achieve adhesion between two substrate portions)..

[0013] In one preferred embodiment of the invention, the secondary discharge signal has, for each part of the primary discharge signal, a leading signal portion, a trailing signal portion and one or a plurality of intermediate signal portions therebetween with time intervals on either side.

[0014] The time duration between the respective beginning of the leading signal portion and the respective end of the trailing signal portion is preferably equal, for each part of the primary discharge signal, to the time duration between the beginning and the end of the respective part of the primary discharge signal.

[0015] In another preferred embodiment, the step of analysing the primary discharge signal includes: detecting the duration or durations of a plurality of primary signals or signal parts, detecting the duration or durations between adjacent primary signals or signal parts, detecting the deviation or deviations in the durations of the primary signals or signal parts from each other, and starting transformation of the primary signal when, for each of the detected durations of the primary signals or signal parts, at least one additional duration of a primary signal or signal part has been detected with a deviation therefrom which is within a predefined range of values. Thus, during the analytical process, (n) "on" times and (n-1) "off" times are detected. The series starts at n=2. The deviations between the logged "on" times are then compared either by forming differences or by forming quotients. A pattern may potentially be present as soon as agreement is registered between at least two "on" times under comparison, which, depending on what is specified, can either be exact or within a tolerance range, for example in a range of +/- 5%. If the matching "on" times are adjacent "on" times, a pattern can be deemed a detected pattern if the "off" time between the "on" times is neglected in operation.

[0016] It is preferred that transformation of the primary signal does not start until the detected pattern has recurred a predefined number of times. In order to verify the pattern that has potentially been detected, a predefined number of repetitions are preferably performed, during which the supposedly detected pattern must firstly be verified. This is done by continuing the previously described comparison of "on" times and "off" times, if any. The step of transforming the primary signal is preferably not started until, for each of the detected durations between the primary signals ("off" times) or signal parts, except for at most one, at least one additional duration between adjacent primary signals or signal parts has been detected with a deviation therefrom which is within a predefined range of values. The "off" times, that is to say the intervals between the primary signals or signal parts, are preferably compared as well in the same manner as the "on" times described above, particularly in those cases in which, during comparison of the "on" times, two values have been found to match that are not adjacent to each other, however, but between which there is yet another (or a plurality of) "on" time(s) that is/are not equal to those values. A pattern of any length is then detected, after running the respective number of logging operations, from the combination of matching sequences of "on" times and "off" times. If there are any mismatches between individual pairs of values in this process, the method according to the invention is preferably applied in such a way that the presence of a pattern is nevertheless affirmed. The presence of the pattern is preferably not negated until two or more, preferably adjacent, deviations are registered.

[0017] According to one advantageous embodiment of the method according to the invention, one or more first quotients are calculated from the respective durations of two or more adjacent signals or signal parts, one or more second quotients are formed from two respectively adjacent durations between the primary signals or signal parts, and the step of transforming the primary signal is

started or continued if the deviation between the first and second quotients is within a predefined range of values. By means of this advantageous embodiment of the method, a pattern that has been detected and verified is also interpreted as such as long as the quotients formed by two adjacent signals do not exceed or fall short of a predefined ratio. This opens up the possibility of taking into account any increases or decreases in production speed that may occur inbetween. When the "on" times and the "off" times are reduced in the same ratio to each other, this indicates an increase in the speed of the production unit, whereas an increase in the "on" times and "off" times, while maintaining the same ratio to each other, is caused by a decrease in the speed of the production unit. If the quotients of "on" times and "off" times do not change at equal rates, it can be concluded, conversely, that irregularities in the feeding of substrate have occurred, for example of the packaging containers, or that there are other disruptions in production which require that transmission of the secondary discharge signal be discontinued.

[0018] The step of transforming the primary signal or signal parts preferably includes: detecting the total length of the primary signal or signal parts, deducting a predefined time value assigned to the leading secondary signal portion and a predefined time value assigned to the trailing secondary signal portion from the total length of the primary signal or signal parts, and calculating a quantity and duration of the one or more secondary intermediate signals according to a predefined minimum length of the intermediate signals, a predefined minimum length of the interruption between adjacent signals, and a predefined quotient obtained by dividing the total length of the secondary signal parts by the total length of the primary discharge signal. By complying with the aforementioned user stipulations, it is easily possible by means of the method according to the invention to calculate the subdivision of the primary discharge signal in order to obtain the portions of the secondary discharge signal, and to specify the fluid savings to be achieved as a parameter from the outset. By taking into consideration the required minimum lengths of the leading and trailing portions of the secondary discharge signal, the time interval and spatial gap between the leading secondary signal portion and the trailing secondary signal portion is filled uniformly with secondary intermediate signals within the remaining time window of the primary discharge signal. The length of those signals and the gaps between those signals are preferably measured on the basis of the user-specified savings to be achieved.

[0019] The method according to the invention is also developed by the leading secondary signal portion and the trailing secondary signal portion, and preferably the length of the one or more secondary intermediate signals being respectively predefined as a percentual part of the total length of the primary discharge signal.

[0020] Instead of the secondary discharge signal, the primary discharge signal is preferably transmitted to the applicator head if it is not possible in the calculation step to detect a quantity of the one or more secondary intermediate signals for which the boundary conditions of the predefined minimum length of the intermediate signals, the predefined minimum length of the interruption between adjacent signals, and the predefined quotient obtained by dividing the total length of the secondary signal portions by the total length of the primary discharge signal are complied with, and/or the primary discharge signal changes in such a way that a deviation between the primary discharge signal and the detected pattern is outside a predefined range of values, and/or the primary discharge signal is completely absent for a duration that is outside a predefined range of values.

[0021] The aforementioned discontinuation criteria for transmission of the secondary discharge signal ensure that whenever the recurrent pattern can no longer be detected, or when interim changes have occurred in the surroundings of the production unit, for example after shutdown or start-up, the control mode for the applicator head automatically returns to the analysis stage, according to this preferred embodiment, and is then in a so-called "learning mode". In this way, the control system on which the method is based automatically recognises when there are sufficiently serious changes in the primary discharge signal and responds by relearning the altered signal. No adhesive is saved during that process, but the substrate is reliably supplied with fluid during that period, due to the primary discharge signal being passed through to the applicator head.

[0022] The method preferably comprises one, several or all of the steps of: monitoring the primary discharge signal, comparing the primary discharge signal with the detected pattern; when a deviation between the primary discharge signal and the detected pattern is outside a predefined range of values: interrupting the transmission of the secondary discharge signal to the applicator head, and the transformation of the primary discharge signal, then once again analysing the primary discharge signal, and transmitting the primary discharge signal instead of the secondary discharge signal to the applicator head.

[0023] The invention also relates to a method for dispensing fluid, preferably a hot-melt adhesive, onto a substrate, preferably a packaging container, by means of an applicator head, preferably by means of a pneumatic applicator head.

[0024] In such a method, the invention achieves its objects by the steps of: supplying the fluid to the applicator head, transmitting a primary discharge signal from a controller in the direction of the applicator head, receiving the primary discharge signal, preferably in an interposed controller module, and controlling the application of the fluid by applying a method for controlling the discharge of fluid from an applicator head for a fluid, in particular hot-melt adhesive, preferably by means of the controller module, in accordance with any one of the preferred embodiments described herein, and dispensing the fluid by means of the applicator head in a controlled manner us-

ing a secondary discharge signal generated by the controller module. Regarding the advantages resulting from integrating the method according to one of the preferred embodiments, into the method for dispensing fluid according to the invention, reference is made to the observations described hereinabove.

[0025] The invention also relates to a controller module for an applicator head for dispensing a fluid, in particular hot-melt adhesive, the controller module comprising: a signal input terminal, a signal input terminal, a voltage monitoring device and a processor and/or a logic controller adapted to carry out the method according to one of the preferred embodiments described hereinabove. Reference is also made to the above observations on the method according to the invention with regard to the advantages and effects of the inventive controller module.

[0026] The processor and/or the logic controller is preferably configured to monitor a primary discharge signal fed in the form of a voltage signal to the signal input terminal.

[0027] The voltage supply for the processor and/or the logic controller is preferably provided by means of the primary discharge signal supplied to the signal input terminal and preferably by means of a buffer for storing electrical energy. The above configuration of the controller module allows it to be designed as a passive component that does not require a separate, external power supply. This has two advantages: The effort required for installation and deinstallation is reduced, and such a design of the logic controller and/or the processor allows very fast "wake-up times", in that a response time in the order of microseconds can be achieved by applying a primary discharge signal to the controller module using normal technical means.

[0028] The invention also relates to an applicator head for dispensing a fluid, in particular for dispensing hot-melt adhesive, comprising: one or more fluid supply channels which can be connected to a fluid source, one or more discharge orifices communicating with the fluid supply channel, and at least one electrically actuatable valve for controlling the discharge of the fluid from the applicator head and which is in signal communication with a controller module.

[0029] The invention achieves its object, with an applicator head of the kind described above, by the controller module being configured in accordance with one of the embodiments described herein above.

[0030] The valve is preferably a solenoid valve which is disposed in a pneumatic control line and which is adapted to selectively release and block the pneumatic control line. The pneumatic control line is preferably disposed so that it communicates with a valve mechanism that is configured to start and stop the flow of fluid through the outlet opening or outlet openings. Due to the low voltages used to actuate the solenoid valve, the present invention is particularly suitable for pneumatic applicator heads.

[0031] The invention shall now be described in greater detail with reference to preferred embodiments and to the attached Figures, in which

Figure 1	shows a side elevation view of an applicator head adapted for use with the present invention,
Figure 2	shows part of an applicator head according to the invention,
Figure 3	shows a schematic view of a plurality of application patterns,
Figure 4a	shows a timing chart for the primary discharge signal,
Figure 4b	shows another view of a timing chart for the primary discharge signal,
Figure 5	shows a schematic view of a controller module according to the invention.
Figures 6a - 6e	show various tables illustrating the method according to the invention, and
Figures 7a - 7d	show various application patterns on substrates, such as those which can be applied with the method according to the invention.

[0032] Figures 1 and 2 show an applicator head designed in accordance with the invention and having a controller module. Figure 1 firstly shows an applicator head 1 which includes a solenoid valve 3 that is mounted on a body member 5. Body member 5 accommodates, *inter alia,* the heater for the fluid to be guided through the body member, in particular hot-melt adhesive. Although hot-melt adhesive is preferred, other fluids such as cold glue, fat and similar can be used. Applicator head 1 is designed as a pneumatic applicator head. A module 7 provided with a nozzle 9 is attached to body member 5. A replaceable filter 11 is provided on an opposite side of body member 5 from module 7. A tube connector 13 for supplying the fluid, in particular the hot-melt adhesive, is likewise disposed on the body member. Tube connector 13 is therefore used as a fluid inlet connection and is connected in fluid communication to module 7 (in a manner not shown) via conduits inside the body member.

[0033] A holding device 15 which is used to secure applicator head 1 to a mounting rod or to similar elements is also disposed on the body member.

[0034] Solenoid valve 3 of applicator head 1 has one or more silencers 17, one of which is marked with a reference sign. Solenoid valve 3 is adapted to selectively release and close a pneumatic compressed-air line in which compressed air is fed into applicator head 1 by means of a compressed-air inlet 20. The valve is actuated

via a signal terminal 21.

[0035] Applicator head 1 also has an electrical connector 19 for a connection cable. The latter is used to supply power to the heater inside body member 5.

[0036] According to the invention, it is proposed that a controller module 23 be connected to the signal terminal 21 of the solenoid valve 3 of the applicator head. The interaction between controller module 23 and solenoid valve 3 at the applicator head according to the invention is indicated in Figure 2. Controller module 23 has a signal input terminal 25 and a signal output terminal 27. The two terminals 25, 27 each lead into a housing 29, inside which the controller of the controller module 23 is provided. These components are shown schematically in Figure 5.

[0037] Figure 5 shows a schematic view of the internal structure of controller module 23. Coming from the direction of signal input connection 25, a voltage measurement device 39 for monitoring the primary discharge signal applied to signal input terminal 25 is provided inside controller module 23. The voltage measurement device is additionally adapted, with capacitive means functioning as an energy accumulator or buffer, to ensure continued operation of controller module 23 when the energy supply via the primary discharge signal fails. Operation of controller module 23 is preferably ensured by the capacitive means for at least 90 minutes.

[0038] Voltage measurement device 39 is in signal communication with a logic controller 41. Logic controller 41 is responsible, along with a processor 43, for analysing and evaluating the incoming primary discharge signal. The logic controller 41 and/or processor 43 are specifically programmed in this regard to carry out the method according to the present invention. This is described further below with reference to Figures 3, 4, 6 and 7.

[0039] Processor 43 controls a switch 45, which is preferably embodied as a MOSFET switch. This can be opened and closed at high speed so as to subdivide the primary discharge signal applied to signal input terminal 25 into a subdivided secondary discharge signal which is then supplied to signal output terminal 27, if the method has successfully completed the pattern detection step and transforms the primary discharge signal.

[0040] Figure 3 shows a comparison of the signal timings of the primary discharge signal A and a subdivided secondary discharge signal F. The secondary discharge signal F has a plurality of signal portions. These are composed of a leading signal portion B, a trailing signal portion E and a plurality of intermediate signal portions C, which are spaced apart from each other by the time interval D ("off" time). The staggering of signals over time corresponds to the continuous bead of fluid (A) dispensed by means of applicator head 1, or the multipart bead of adhesive (F) applied while saving fluid. The leading secondary signal portion C and the trailing secondary signal portion E and also the length of the secondary intermediate signal portion C are predefined in this embodiment as a percentual part of the total length of the primary discharge signal A. The amount of fluid to be saved - for example a saving of 50% - is also predefined as a parameter. The subdivision of the primary discharge signal A into the portions of the secondary discharge signal F is then calculated on the basis of these parameters. By taking into consideration the lengths of the leading and trailing signal portions B, E and of the intermediate signal portion C, the time interval and spatial gap between the leading secondary signal portion B and the trailing secondary signal portion E is filled uniformly with secondary intermediate signals C with the remaining time window of the primary discharge signal A. The number of intermediate signal portions C and the time interval D between them are measured on the basis of the user-specified savings to be achieved.

[0041] Figures 4a, 4b schematically show in the form of voltage-time diagrams the basic profile of the primary discharge signal, as it might be logged by controller module 23. The timing of the primary discharge signal is shown in Figure 4a in the form of a waveform 30a and in Figure 4b in the form of a waveform 30b. Along voltage axis U, an upper tolerance value 31 and a lower tolerance value 33 are entered in each of the Figures, between which two values a tolerance range 35 extends. If a value of the primary discharge signal is within this tolerance range, as indicated by line 37 in the example in Figure 4a, the presence of a signal is registered as "on time". This also allows correct transformation of a signal that is not entirely constant, as indicated in Figure 4b.

[0042] One relevant aspect of the method according to the invention, namely the learning mode for detecting a recurrent pattern, shall now be described with reference to Figures 6a to 6e.

[0043] Figures 6a - 6e show tables in which time values are logged in an ongoing series, with each time value for an "on" time being succeeded by a time value for an "off" time.

[0044] Figure 6a shows, in Table 101, the values logged by the controller module in an early stage of pattern detection. A first duration T1 of the primary discharge signal or signal part (referred to hereinafter for the sake of simplicity as "on time") and a second on time T3 are applied, and times T1 and T3 are spaced apart from each other by time interval T2 ("off time"). It is assumed in the following that the tolerance for assessing the deviations between T1 and T3 is chosen such that T1 and T3 are not considered equal. The pattern detection method is now continued until a state shown in Figure 6b is reached. Table 103 shown in Figure 6b has been extended by time values T4 and T5. A comparison of "on" times T1, T3 and T5 shows that, when the predefined tolerance value is taken into account, T5 must be classified as equal to T1, but not to T3. This means there is a partial match for T1 and T5, but not for T3. Nor is there a match for T2 and T4. The pattern detection method is therefore continued, and after the next logging step the state shown in Figure 6c results. Compared to Table 103 in Figure 6b, Table 105 has been extended by values T6 and T7. When the

predefined permissible tolerance range is again taken into account, the assumption is made here that T6 must be classed as being equal in value to T2, but not to T4. It can be seen from Figure 6c, in particular, that after identifying a positive match between two "on" times, the next step involves comparing the "off" times detected up to then and the "off" times to be detected in that next step. Once a match has been detected in this regard also, at least with one other time value (T2), as in the state shown by Figure 6c, a new comparison of "on" times is performed. According to Figure 6c, this shows that time value T7 is equal or at least similar to time value T3.

[0045] A comparison of "off" times now follows, as depicted in Table 107 in Figure 6d. However, T8 differs so clearly from T4, according to the assumptions made for illustrative purposes, that exceeding of the permissible tolerance values is assumed. No match is therefore registered with regard to the T4 and T8 values. However, in the logging step according to Figure 6d, a comparison is also made for equivalence between the next time value for an on time, T9, with the previously registered values, and it is found that T9 must be classified as on a par with T5 and T1. In a further checking step according to Figure 6e, which is shown in Table 109, T10 is substantially on a par with T2, so a pattern consisting of three primary discharge signal portions of differing lengths has been detected using the method according to the invention. With the exception of T4 and T8, the "off" times between the "on" times are also formed in accordance with a pattern, so despite the error the pattern can be deemed as recognized. In the event, for example, that T10 were not to be classified as substantially equal to T2, pattern detection would not yet be ended at that point in time because two consecutive errors were detected.

[0046] A logged series such as the one shown in Figures 6a to 6e could be obtained from patterns of fluid beads applied to substrates 200 to 200"", 201 to 201"", 202 to 202"" and 203 to 203"", as illustrated in Figures 7a to 7d.

[0047] Each Figure 7a to 7d illustrates a series of five substrates 200 to 200"", 201 to 201"", 202 to 202"" and 203 to 203"", which run in a dispensing unit in a direction to the left in Figures 7a to 7d, the speed being assumed initially to be substantially constant. There may, of course, be more or less than five substrates in a given series.

[0048] Figure 7a illustrates the simplest embodiment, in which only one bead of fluid 250 - 250"" is applied to each substrate 200 - 200"". When the method is started, time values such as those described above with reference to Figures 6a - 6e are logged by the controller module. In the embodiment according to Figure 7a, this means that bead of fluid 250, which is provided on the first substrate 200 at the start of the method, forms the basis for a primary signal A of duration T1. The time interval between the end of bead of fluid 250 and the following bead of fluid 250' on the following substrate 200' is then the "off" time T2. The length of bead of fluid 250' then expresses the "on" time T3, and the gap between the end of bead of fluid 250' and the beginning of bead of fluid 250" on the next substrate 200" accordingly expresses the "off" time T4. It is found by comparing the times that "on" time T1 matches "on" time T3 and that "off" time T2 matches "off" time T4, as can also be seen easily from Figure 7a. A learning phase is thus completed at the end of "off" time T4, and a pattern has been detected. In the following, beads of fluid 250", 250'" and 250"" are applied intermittently to the next substrates 200", 200"', 200"", the total length of beads 250 - 250"" forming the respective basis for the primary signal which is then subdivided, as described with reference to Figure 3 above, into secondary signal portions in order to save fluid. This is shown by way of example with beads 250", 250'" and 250"". Bead 250" is thus divided into five fluid portions, namely a leading secondary bead portion 250B, three intermediate portions 250C and a trailing secondary bead portion 250E. The single fluid portions 250B, 250C, 250E are separated from each other by empty portions 250D. Portions 250B, 250C, 250D, 250E are based, as described with reference to Figure 3, on signal portions B, C, D, E.

[0049] The other embodiments in Figures 7b - 7d differ from the embodiment in Figure 7a in that the bead patterns are more complex.

[0050] For example, the bead pattern in Figure 7b, in which two differently long beads of fluid 251 - 251"" and 252 - 252"" are respectively applied to a substrate 201 - 201"" corresponds approximately to an "on-off" sequence as shown in Figures 6a - 6e. In a pattern as shown in Figure 7b, the result of comparing "on" times T1 and T3 is that these bear no similarity to each other. A comparison of "off" times T2 and T4 also shows that these likewise lack similarity. However, T5 is on a par with T1, T6 with T2, T7 with T3 and T8 with T4. A pattern is therefore recognised after "off" time T8, so application can then be intermittent from the third substrate 201" onwards. Beads of fluid 251" - 251'" are thus applied intermittently (see also Figure 3). Whether beads of fluid 252" - 252"" are applied intermittently or not is dependent on their absolute length. For example, if it is found that these beads of fluid are sufficiently short, application is preferably not intermittent.

[0051] A similar result is produced by the embodiments in Figures 7c and 7d, in which a third (Figure 7c) bead of fluid is additionally applied, or in which four beads of fluid 256, 257, 258, 259 (Figure 7d) are applied to a substrate. In the embodiment in Figure 7c, for example, a pattern is not detected until after "off" time T12, so application can be intermittent from the third substrate 202" onward. In the embodiment in Figure 7d, a pattern is not detected until after "off" time T16, but application is again intermittent from the third substrate 203" onward.

[0052] If it is now assumed, in addition, that the production speed is variable, for example accelerated, as is frequently the case when starting up production facilities, one or more first quotients are preferably calculated ad-

ditionally from the durations of two or more adjacent "on" times, and one or more second quotients are respectively formed from two adjacent "off" times. Alternatively or additionally thereto, adjacent "on"-"off" times and/or "off"-"on" times are used to calculate the quotients. The step of transforming the primary signal is then started or continued when the deviation between the first and second quotients is within a predefined range of values.

[0053] In this way, a pattern is also interpreted as such as long as the respective quotients do not exceed or fall short of a predefined ratio. That means that increases or decreases in production speed can also be taken into account. When the "on" times and the "off" times are reduced in the same ratio to each other, this indicates an increase in the speed of the production unit, whereas an increase in the "on" times and "off" times, while maintaining the same ratio to each other, is caused by a decrease in the speed of the production unit. If the quotients of "on" times and "off" times do not maintain the same ratio to each other when changes occur, it can be concluded, conversely, that irregularities in the feeding of substrate have occurred, for example of the packaging containers, or that there are other disruptions in production which require that transmission of the secondary discharge signal be discontinued, so that application of fluid is subsequently no longer intermittent but continuous, - preferably for a specific period only. With reference to Figure 7a, this means that in the case of acceleration, the quotient of T1 and T3, for example, produces a value of 1.05 when the increase in speed is 5% per substrate. The quotient formed by "off" times T2 and T4 would then have to be the same value. A change in speed can thus be taken into account. Alternatively or additionally, quotients could likewise be formed from times T1 and T2 and from times T3 and T4, or vice versa. Each combination of individual time values is suitable for calculating the quotients. The exact design may be carried out according to the respective production conditions.

[0054] The invention relates to a method of controlling fluid discharge from an applicator head for a fluid, said method comprising the steps of supplying a primary discharge signal for controlling the applicator head, analysing only the primary discharge signal for a recurrent pattern, transforming the primary discharge signal into a secondary discharge signal when a recurrent pattern has been detected, and supplying the secondary discharge signal to the applicator head. The invention is characterised in that the secondary discharge signal has a plurality of successive, spaced-apart signal portions which are each determined as part of the length of the primary signal, preferably as a percentual part, and whose total length is less than the length of the primary signal.

The invention is further described by the following embodiments, wherein:

[0055]

Embodiment 1. A method of controlling fluid discharge from an applicator head for a fluid, said method comprising the steps of:

- supplying a primary discharge signal for controlling the applicator head,
- analysing only the primary discharge signal for a recurrent pattern,
- transforming the primary discharge signal into a secondary discharge signal when a recurrent pattern has been detected, and
- supplying the secondary discharge signal to the applicator head,

wherein
the secondary discharge signal has a plurality of successive, spaced-apart signal portions which are each determined as part of the length of the primary signal, preferably as a percentual part, and whose total length is less than the length of the primary signal.

Embodiment 2. The method according to embodiment 1,
wherein the secondary discharge signal has a leading signal portion, a trailing signal portion and one or more intermediate signal portions therebetween with time intervals on either side, and
wherein the time duration between the beginning of the leading signal portion and the end of the trailing signal portion is equal to the time duration between the beginning and the end of the primary discharge signal.

Embodiment 3. The method according to embodiment 1 or 2,
wherein the primary discharge signal is formed as a one-part signal, a continuous signal or as a signal which recurs at substantially regular intervals, or
wherein the primary discharge signal is formed as a multipart signal recurring at substantially regular intervals and having signal parts of differing lengths.

Embodiment 4. The method according to embodiment 3,
wherein, for each part of the primary discharge signal, the secondary discharge signal has a leading signal portion, a trailing signal portion and one or a plurality of intermediate signal portions therebetween with time intervals on either side.

Embodiment 5. The method according to embodiment 4,
wherein, for each part of the primary discharge signal, the time duration between the respective beginning of the leading signal portion and the respective end of the trailing signal portion is equal to the time duration between the beginning and the end of the

respective part of the primary discharge signal.

Embodiment 6. The method according to any one of the preceding embodiments,
wherein the step of analysing the primary discharge signal includes:

- detecting the duration or durations of a plurality of primary signals or signal parts,
- detecting the duration or durations between adjacent primary signals or signal parts,
- detecting the deviation or deviations in the durations of the primary signals or signal parts from each other, and
- starting transformation of the primary signal if, for each of the detected durations of the primary signal or signal parts, at least one additional duration of a primary signal or signal part has been detected with a deviation therefrom which is within a predefined range of values.

Embodiment 7. The method according to embodiment 6,
wherein transformation of the primary signal does not start until the detected pattern has recurred a predefined number of times.

Embodiment 8. The method according to any one of the preceding embodiments,
wherein one or more first quotients are calculated from the respective durations of two or more adjacent signals or signal parts,
one or more second quotients are formed from two respectively adjacent durations between the primary signals or signal parts, and
the step of transforming the primary signal is started or continued when the deviation between the first and second quotients is within a predefined range of values.

Embodiment 9. The method according to any one of the preceding embodiments,
wherein the step of transforming the primary signal or signal parts includes:

- detecting the total length of the primary signal or signal parts,
- deducting a predefined time value assigned to the leading secondary signal portion and a predefined time value assigned to the trailing secondary signal portion from the total length of the primary signal or signal parts, and
- calculating a quantity and duration of the one or more secondary intermediate signals according to a predefined minimum length of the intermediate signals, a predefined minimum length of the interruption between adjacent signals, and a predefined quotient obtained by dividing the total length of the secondary signal parts by the total length of the primary discharge signal.

Embodiment 10. The method according to any one of the preceding embodiments,
wherein the leading secondary signal portion and the trailing secondary signal portion, and preferably the length of the one or more secondary intermediate signals is respectively predefined as a percentual part of the total length of the primary discharge signal.

Embodiment 11. The method according to any one of the preceding embodiments, wherein the primary discharge signal is transmitted instead of the secondary discharge signal to the applicator head when

- it is not possible in the calculation step to detect a quantity of the one or more secondary intermediate signals for which the boundary conditions of the predefined minimum length of the intermediate signals, the predefined minimum length of the interruption between adjacent signals, and the predefined quotient obtained by dividing the total length of the secondary signal parts by the total length of the primary discharge signal are complied with, and/or
- the primary discharge signal changes in such a way that a deviation between the primary discharge signal and the detected pattern is outside a predefined range of values, and/or
- the primary discharge signal is completely absent for a duration that is outside a predefined range of values.

Embodiment 12. The method according to any one of the preceding embodiments, said method comprising the steps of:

- monitoring the primary discharge signal,
- comparing the primary discharge signal with the detected pattern,
- if a deviation between the primary discharge signal and the detected pattern is outside a predefined range of values:
- interrupting the supplying of the secondary discharge signal to the applicator head, and the transformation of the primary discharge signal, then once again
- analysing the primary discharge signal, and
- transmitting the primary discharge signal instead of the secondary discharge signal to the applicator head.

Embodiment 13. A method for dispensing fluid onto a substrate, preferably a packaging container, by means of an applicator head, preferably by means of a pneumatic applicator head,

said method comprising the steps of:

- supplying the fluid to the applicator head,
- transmitting a primary discharge signal from a controller in the direction of the applicator head,
- receiving the primary discharge signal, preferably in an interposed controller module, and
- controlling the application of fluid by applying a method according to any one of embodiments 1 to 12, preferably by means of the controller module, and
- dispensing the fluid by means of the applicator head in a controlled manner using a secondary discharge signal generated by the controller module.

Embodiment 14. A controller module for an applicator head for dispensing a fluid, comprising:

- a signal input terminal,
- a signal output terminal,
- a voltage monitoring device, and
- a processor and/or a logic controller for executing a method according to any one of embodiments 1 to 13.

Embodiment 15. An applicator head for dispensing a fluid, comprising:

one or more fluid supply channels which can be connected to a fluid source,
one or more discharge orifices communicating with the fluid supply channel, and
at least one electrically actuatable valve for controlling the discharge of the fluid from the applicator head and which is in signal communication with a controller module, characterised in that the controller module is configured in accordance with embodiment 14.

Claims

1. A controller module for an applicator head for dispensing a fluid, comprising:

   - a signal input terminal,
   - a signal output terminal,
   - a voltage monitoring device, and
   - a processor and/or a logic controller for executing a method comprising the steps of:

     - supplying a primary discharge signal for controlling the applicator head,
     - analysing only the primary discharge signal for a recurrent pattern,
     - transforming the primary discharge signal into a secondary discharge signal when a recurrent pattern has been detected, and
     - supplying the secondary discharge signal to the applicator head,

   wherein
   the secondary discharge signal has a plurality of successive, spaced-apart signal portions which are each determined as part of the length of the primary signal, preferably as a percentual part, and whose total length is less than the length of the primary signal;
   wherein the processor and/or monitor is configured to monitor a primary discharge signal fed in the form of a voltage signal to the signal input terminal.

2. The controller module of claim 1,
wherein the voltage supply for the processor and/or the logic controller is provided by means of the primary discharge signal supplied to the signal input terminal.

3. The controller module of claim 1 or 2,
wherein the voltage supply for the processor and/or the logic controller is preferably provided by means of a buffer for storing electrical energy.

4. An applicator head for dispensing a fluid, comprising:

   one or more fluid supply channels which can be connected to a fluid source,
   one or more discharge orifices communicating with the fluid supply channel, and
   at least one electrically actuatable valve for controlling the discharge of the fluid from the applicator head and which is in signal communication with a controller module,
   characterised in that the controller module is configured in accordance with any one of claims 1 to 3.

5. A method of controlling fluid discharge from an applicator head for a fluid, said method comprising the steps of:

   - supplying a primary discharge signal for controlling the applicator head,
   - analysing only the primary discharge signal for a recurrent pattern,
   - transforming the primary discharge signal into a secondary discharge signal when a recurrent pattern has been detected, and
   - supplying the secondary discharge signal to the applicator head,

   wherein
   the secondary discharge signal has a plurality of successive, spaced-apart signal portions which are

each determined as part of the length of the primary signal, preferably as a perceptual part, and whose total length is less than the length of the primary sign, wherein
wherein the step of analysing the primary discharge signal includes:

- detecting the duration or durations of a plurality of primary signals or signal parts,
- detecting the duration or durations between adjacent primary signals or signal parts,
- detecting the deviation or deviations in the durations of the primary signals or signal parts from each other, and
- starting transformation of the primary signal if, for each of the detected durations of the primary signal or signal parts, at least one additional duration of a primary signal or signal part has been detected with a deviation therefrom which is within a predefined range of values and
wherein the step of transforming the primary signal is not started until, for each of the detected durations between the primary signals or signal parts, except for at most one, at least one additional duration between adjacent primary signals or signal parts has been detected with a deviation therefrom which is within a predefined range of values.

6. The method of claim 5,
wherein a pattern of any length is then detected, after running the respective number of logging operations, from the combination of matching sequences of "on" times and "off" times.

7. The method of any one of claims 5 or 6,
wherein the presence of a pattern is affirmed as long as there are only any mismatches between individual pairs of values

8. The method of any one of claims 5 to 7,
wherein the presence of the pattern is not negated until two or more, preferably adjacent, deviations are registered.

9. A method for dispensing fluid onto a substrate, preferably a packaging container, by means of an applicator head, preferably by means of a pneumatic applicator head, said method comprising the steps of:

- supplying the fluid to the applicator head,
- transmitting a primary discharge signal from a controller in the direction of the applicator head,
- receiving the primary discharge signal, preferably in an interposed controller module, and
- controlling the application of fluid by applying a method comprising the steps of:
- supplying a primary discharge signal for controlling the applicator head,
- analysing only the primary discharge signal for a recurrent pattern,
- transforming the primary discharge signal into a secondary discharge signal when a recurrent pattern has been detected, and
- supplying the secondary discharge signal to the applicator head,
wherein
the secondary discharge signal has a plurality of successive, spaced-apart signal portions which are each determined as part of the length of the primary signal, preferably as a percentual part, and whose total length is less than the length of the primary signal;
by means of the controller module of any one of claims 1 to 3, and
- dispensing the fluid by means of the applicator head in a controlled manner using a secondary discharge signal generated by the controller module.

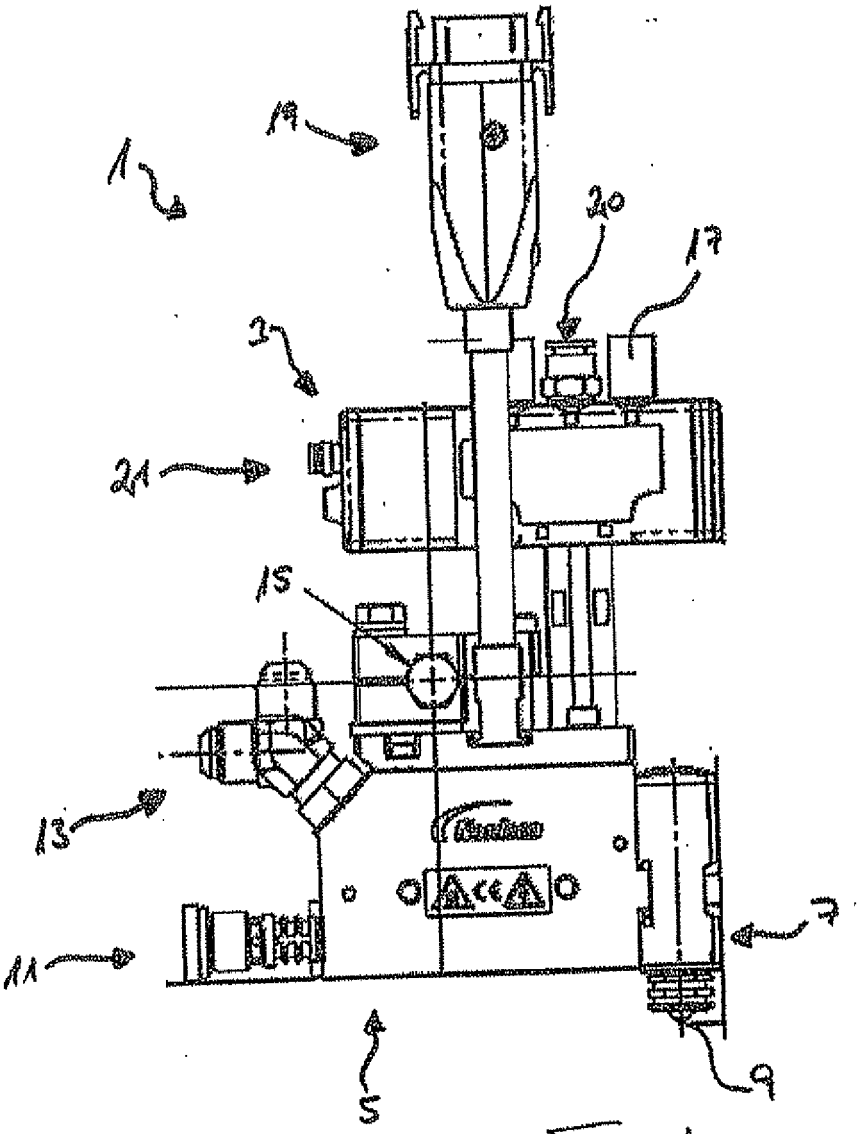


Fig. 1

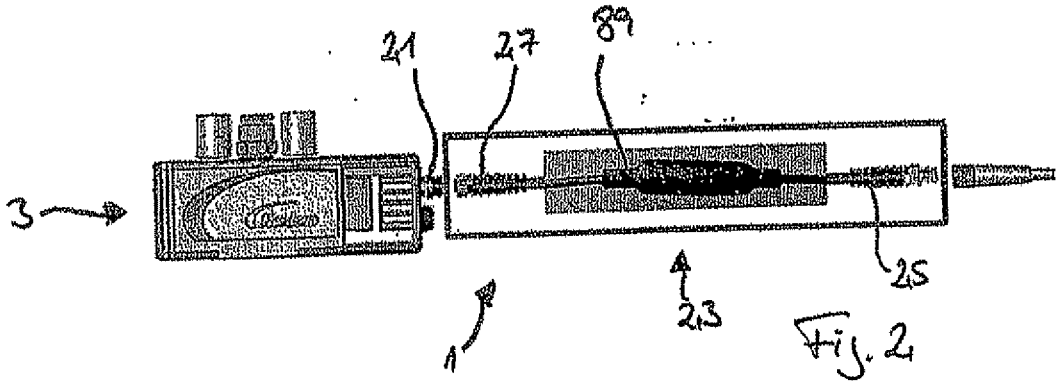


Fig. 2

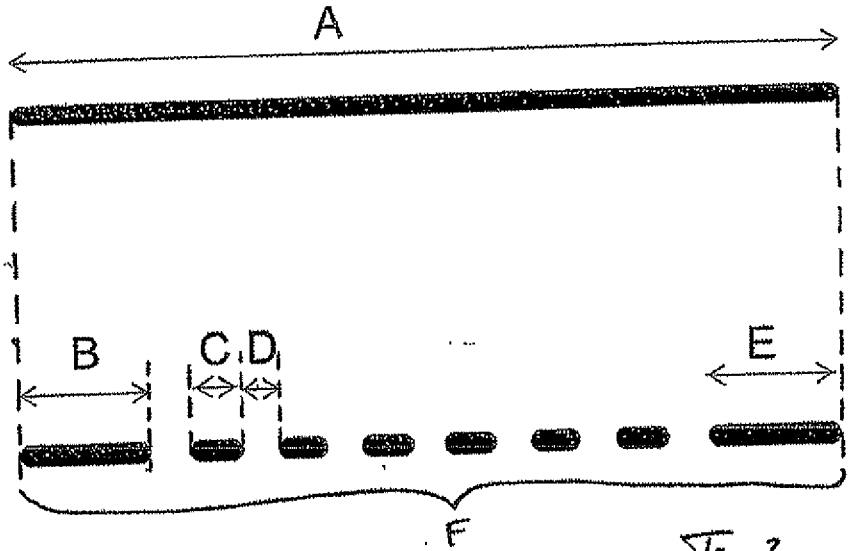


Fig. 3

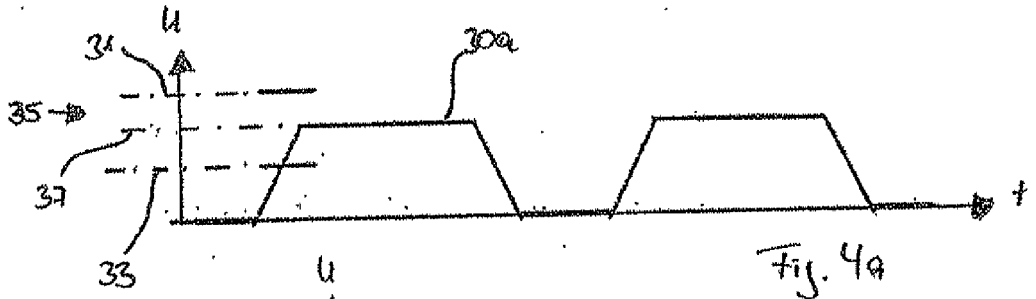


Fig. 4a

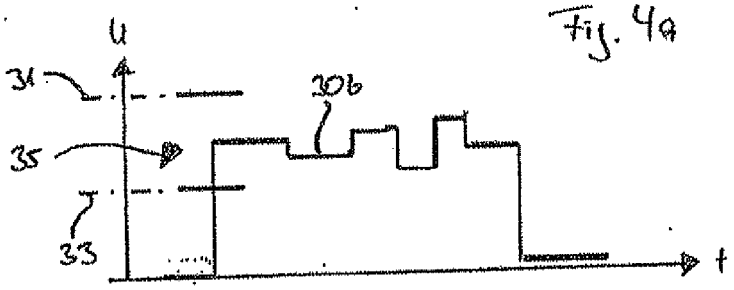


Fig. 4b

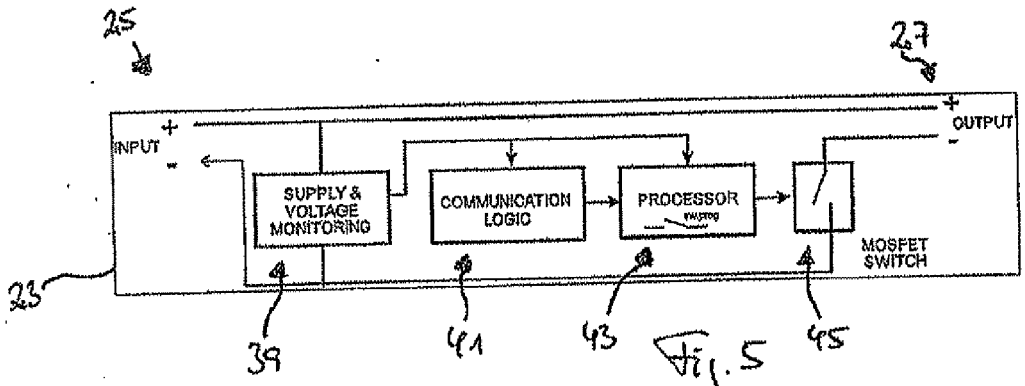
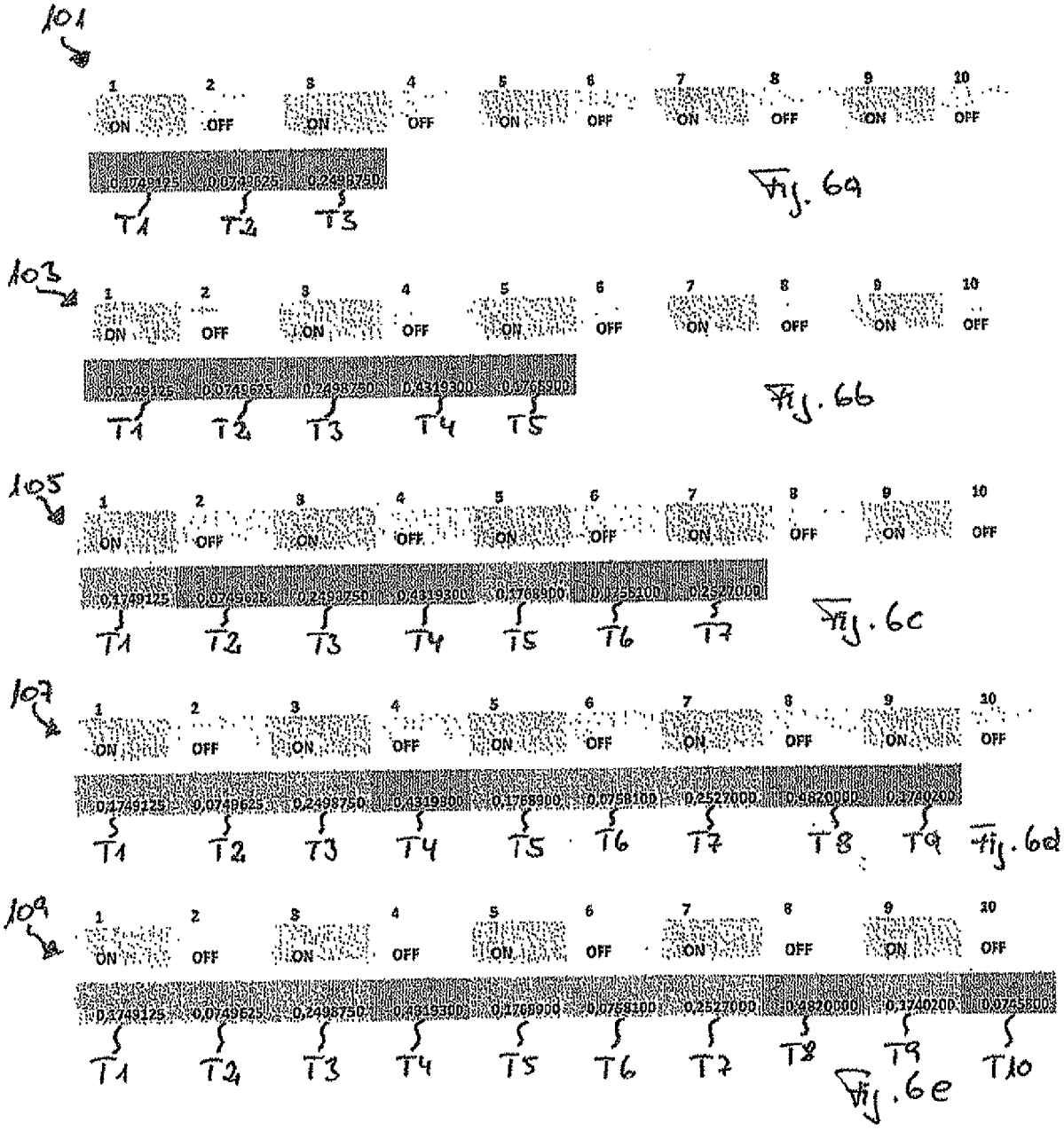


Fig. 5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9 ON
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T1
T2
T3
Fig. 6a
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T1
T2
T3
T4
T5
Fig. 6b
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T1
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T3
T4
T5
T6
T7
Fig. 6c
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Fig. 6d
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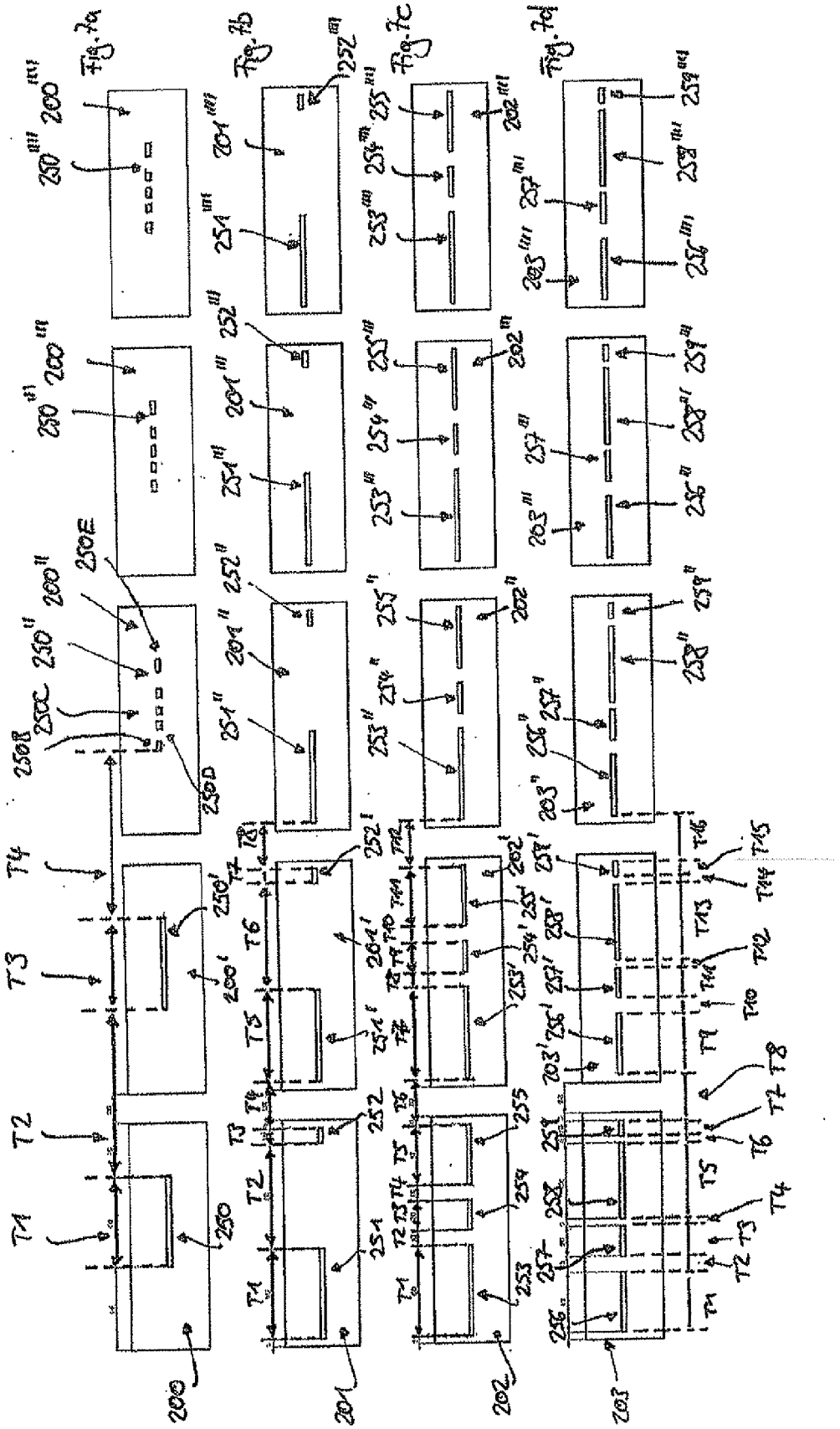
Fig. 6e



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EUROPEAN SEARCH REPORT

Application Number
EP 15 18 9483

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2002/142102 A1 (ROMINE MICHAEL J [US]) 3 October 2002 (2002-10-03) * paragraphs [0031] - [0032] * * figures *	1-9	INV. B05C5/02 B05C11/10
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B05C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	9 December 2015	Roldán Abalos, Jaime

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