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(54) **PACKAGING SYSTEM AND METHOD FOR PRODUCING POUCHES COMPRISING A GEL AND A FILM**

(57) Packaging system for producing pouches comprising a water-soluble film and a gel, comprising:
- multiple moulds (5),
- a mould conveyer (8),
-- a filling device (13) comprising multiple gel dispensers (15), each gel dispenser comprising:
- a reservoir (18)
- an integer nozzle number of nozzles (20),
- a pin holder (23) arranged in the reservoir holding a pin number of pins (24), wherein:

-- the pin number is equal to the nozzle number,

-- the pin holder (23) is moveable by a pin actuator (25) from an active position into an inactive position, and vice versa,

-- in the inactive position of the pin holder, the pins (24) are arranged in the reservoir (18) and the nozzle openings (22) are in fluid communication with the reservoir (18),

-- in the active position of the pin holder (23), each pin (24) extends into the nozzle (20) through hole of its associated nozzle to expel gel from the nozzle through hole.

Fig. 1

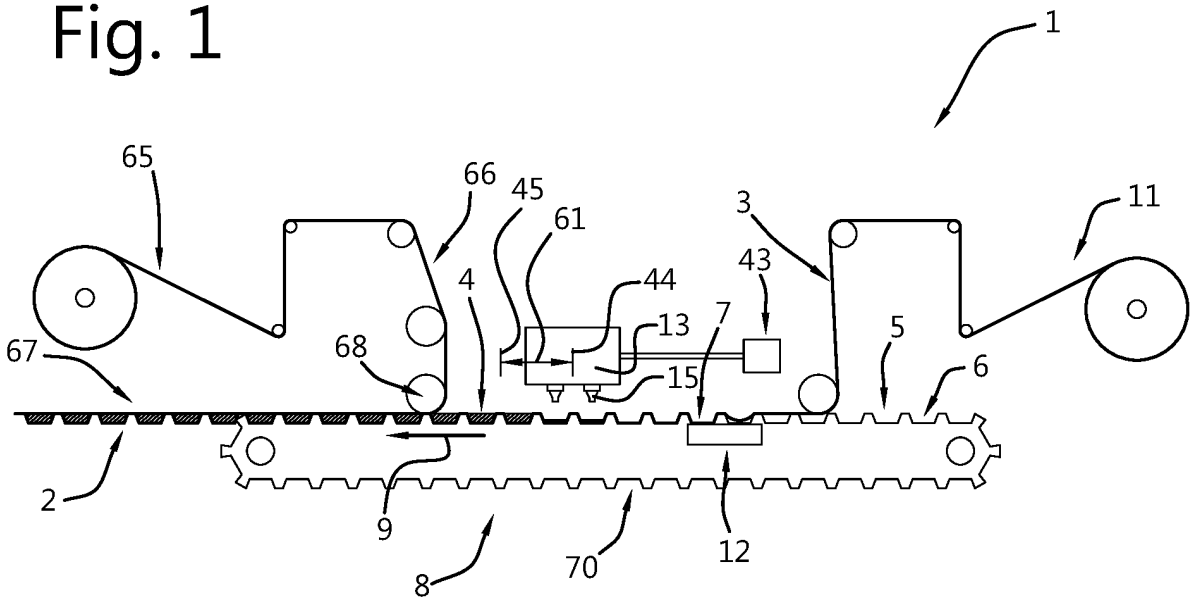

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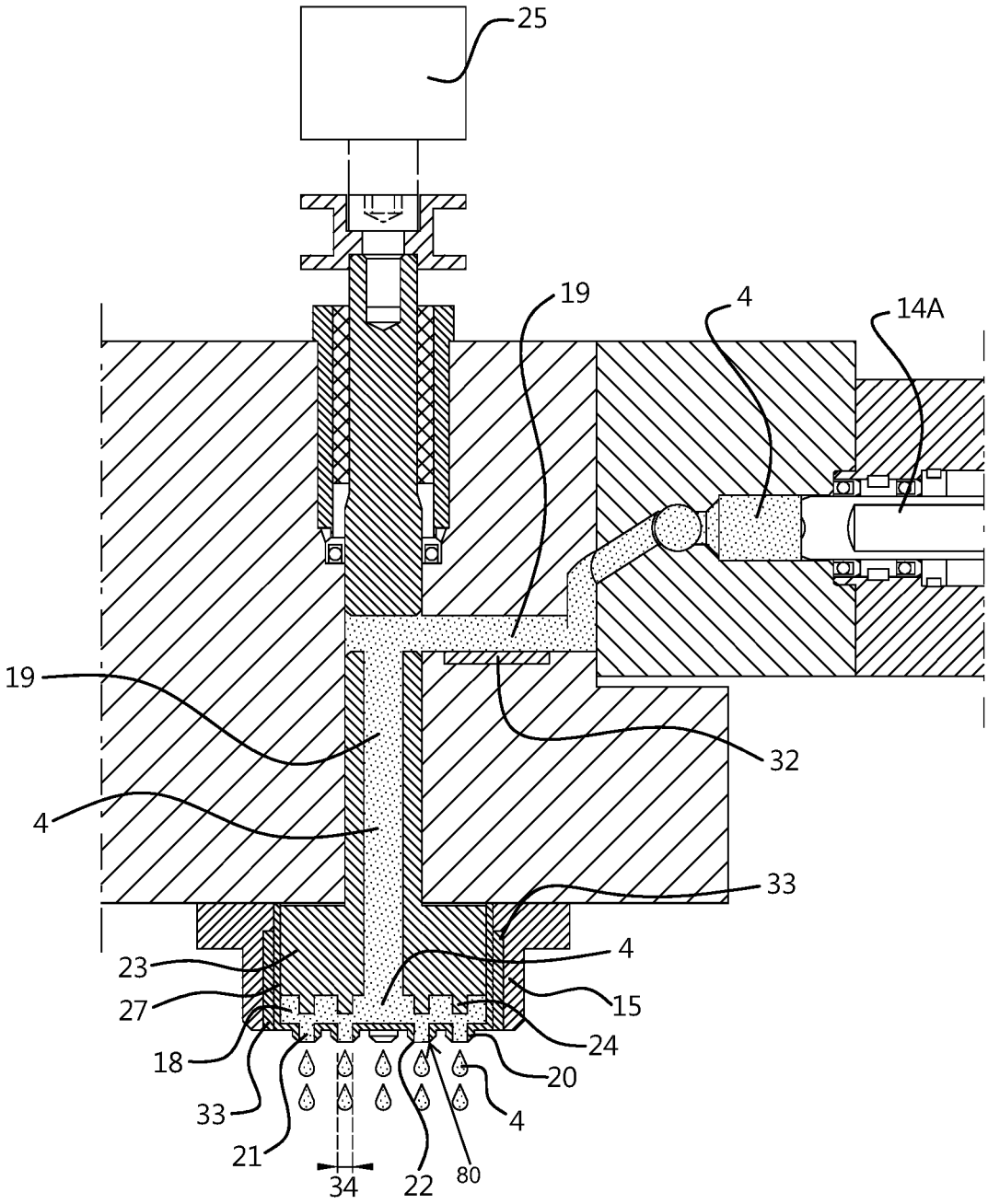
Fig. 4



Description

Field of the invention

[0001] The present invention relates to a packaging system and method for producing pouches comprising a water-soluble film and a gel comprising a substrate treatment agent.

Background of the invention

[0002] Known packaging systems dispense gel from one or more nozzles into a compartment formed in a water soluble film. After the correct amount of gel has been dispensed in the compartment, the flow of gel is stopped and the compartment and the nozzles are moved with respect to each other, such that the nozzles may dispense gel into a different compartment.

[0003] The gel being dispensed into the compartments is typically a viscous fluid with a tendency to degrade over time, resulting in an increase in viscosity or even solidification. This causes clogging of the nozzles when the system is temporarily out of use, for example during a scheduled or unscheduled machine stop. Separate operations are required, usually by manual labour, in order to unclog the nozzles and restart the packaging system. This leads to a loss of time and an increase in costs.

Object of the invention

[0004] It is an object of the invention to provide a packaging system and method allowing faster restarts after a scheduled or unscheduled machine stop.

Summary of the invention

[0005] In order to achieve the above object, the invention provides a packaging system for producing pouches comprising a water-soluble film and a gel comprising a substrate treatment agent, the packaging system comprising:

- multiple moulds, each mould having a mould cavity for forming a compartment in the film, and
- a mould conveyer configured to move the moulds in a conveying direction along a mould trajectory, such as an endless mould trajectory, and wherein the moulds are moved along:

    -- a film supplying device configured to position the film on the moulds,
    -- a compartment forming device configured to position parts of the film in the mould cavities to form the compartments in the film,
    -- a filling device comprising a gel supply and multiple gel dispensers, wherein each gel dispenser is configured to dispense the gel into an associated compartment of the film positioned in an associated mould,

    each gel dispenser comprising:

    - a reservoir in fluid communication with the gel supply via a gel channel,
    - an integer nozzle number of nozzles, each nozzle comprising a nozzle through hole extending from the reservoir to a nozzle opening, the nozzle number being one or more,
    - a pin holder arranged in the reservoir holding a pin number of pins, wherein:

        -- the pin number is equal to the nozzle number,
        -- each pin is associated with one of the nozzles,
        -- each nozzle is associated with one of the pins,
        -- the pin holder is moveable by a pin actuator from an active position into an inactive position, and vice versa,
        -- in the inactive position of the pin holder, the pins are arranged in the reservoir and the nozzle openings are in fluid communication with the reservoir,
        -- in the active position of the pin holder, each pin extends into the nozzle through hole of its associated nozzle to expel gel from the nozzle through hole.

[0006] During operation of the packaging system, the pins are in the inactive position. When the system is stopped, the pin holder is moved into the active position. Gel present in the nozzle through hole is then pushed out of the nozzle by the pins. This prevents the gel from solidifying in the nozzle through holes while the machine is not operating. When the packaging system is restarted at a later point in time, the pin holder is moved back to the inactive position. The space inside the nozzle through holes that was occupied by the pins while the pin holder was in the active position is thereby opened, such that gel can flow from the reservoir through the nozzle through hole out of the nozzles. This packaging system thereby prevents clogging of the nozzles during a machine stop, obviating the need for separate unclogging operations. This allows faster restarts after scheduled and unscheduled machine stops.

[0007] In an embodiment of the packaging system according to the invention, the nozzle number is larger than one.

[0008] In an embodiment of the packaging system according to the invention, the pins of each dispenser are held by a single shared pin holder.

[0009] In an embodiment of the packaging system according to the invention, in the active position of the pin holder, the pins extend along the complete through hole of their respective associated nozzles, the pins optionally ending flush with the nozzle openings of their respective associated nozzles.

[0010] In an embodiment of the packaging system ac-

cording to the invention, in the active position of the pin holder, the pins extend in a direction from the reservoir to their respective associated nozzle openings along the complete through hole of their respective associated nozzles, the pins optionally ending flush with the nozzle openings of their respective associated nozzles.

[0011] In an embodiment of the packaging system according to the invention, wherein each nozzle opening is configured to dispense the gel out of the respective gel dispenser.

[0012] In an embodiment of the packaging system according to the invention, wherein each nozzle opening is located at a nozzle through hole end of the respective nozzle through hole.

[0013] In an embodiment of the packaging system according to the invention, the through holes of the nozzles and their respective associated pins have a same shape such as a cylindrical, conical, or pyramid shape.

[0014] In an embodiment of the packaging system according to the invention:

- the nozzles are arranged in a dispensing shape,
- the nozzles are configured to dispense the gel into the associated compartment in a deposit shape,
- preferably the deposit shape and the dispensing shape are elongated.

[0015] In an embodiment of the packaging system according to the invention, the packaging system comprises an upstream heating device for heating the gel between the nozzle and the gel supply to an upstream gel temperature.

[0016] In an embodiment of the packaging system according to the invention, the packaging system comprises a nozzle heating device for heating the gel at the nozzle to a nozzle gel temperature.

[0017] In an embodiment of the packaging system according to the invention, the nozzle gel temperature is higher than the upstream gel temperature.

[0018] The upstream gel temperature and the nozzle gel temperature are typically in a range of 128 to 140 degrees Celsius, dependent on the type of gel used.

[0019] In an embodiment of the packaging system according to the invention, a nozzle diameter of the nozzle openings is between, and including, 1,4 and 2,2 mm, preferably between, and including 1,6 mm and 2,0 mm, more preferably 1,8 mm.

[0020] In an embodiment of the packaging system according to the invention, the gel channel is at least partially straight and at least partially concentric with the pin holder. The gel channel may extend at least partially through the pin holder.

[0021] In an embodiment of the packaging system according to the invention, the gel channel is offset with respect to each of the nozzle openings.

[0022] In an embodiment of the packaging system according to the invention, the pins and the nozzle through holes extend parallel to each other.

[0023] In an embodiment of the packaging system according to the invention:

- the gel supply comprises multiple gel pumps,
- the gel supply comprises multiple gel channels, and
- each gel channel connects exactly one of the multiple gel pumps to exactly one of the multiple gel dispensers.

[0024] In an embodiment of the packaging system according to the invention, the gel has a viscosity of between 1000 Cp and 3000 Cp. One Cp equals one millipascal-second or mPa*s.

[0025] In an embodiment of the packaging system according to the invention, the filling device comprises one or more fume extraction openings in fluid communication with one or more fume extraction channels for extracting fumes originating from the gel dispensed by the gel dispenser, wherein optionally the one or more fume extraction channels are heated to a temperature above a condensation temperature of the fumes.

[0026] In an embodiment of the packaging system according to the invention, the one or more fume extraction channels are in fluid communication with a flow generating device, such as a motorised fan or low pressure source, and the flow generating device is arranged downstream from the one or more fume extraction openings with respect to a flow through the one or more fume extraction channels.

[0027] In an embodiment of the packaging system according to the invention, the multiple gel dispensers comprising a dispenser number of gel dispensers, wherein:

- the dispenser number is an integer number of 2 or more,
- the one or more fume extraction openings are arranged between the multiple gel dispensers and above the moulds,
- a dispenser spacing between adjacent gel dispensers is the same for all adjacent dispenser pairs,
- either:

    -- the dispenser spacing between adjacent gel dispensers is an odd integer multiplied by a mould spacing of adjacent moulds and the dispenser number is even, OR
    -- the dispenser spacing between adjacent gel dispensers is an even integer multiplied by a mould spacing of adjacent moulds and the dispenser number is odd,

- preferably:

    -- the dispenser number is 2,
    -- the multiple gel dispensers comprise a first gel dispenser and a second gel dispenser,
    -- the dispenser spacing of the first gel dispenser and the second gel dispenser is equal to an odd

integer multiplied by the mould spacing of adjacent moulds, more preferably three times the mould spacing of adjacent moulds.

[0028] The dispenser number can be any integer. The dispenser spacing preferably is an odd integer multiplied by the mould spacing if the dispenser number is even. If the dispenser number is odd, the dispenser spacing preferably is an even integer multiplied by the mould spacing. The dispenser spacing between adjacent dispensers is preferably constant. This allows filling of all moulds while preventing double filling of some moulds.

[0029] In an embodiment of the packaging system according to the invention, the dispenser spacing is defined along the conveying direction and the mould spacing is defined along the conveying direction. Adjacent dispensers are dispensers between which no other dispenser is arranged when seen along the direction along which the dispenser spacing is defined. Adjacent moulds are moulds between which no other moulds are arranged when seen along the direction along which the mould spacing is defined.

[0030] In an embodiment of the packaging system according to the invention, the packaging system comprises multiple first gel dispensers arranged along a first dispenser row and multiple second gel dispensers arranged along a second dispenser row, wherein the first dispenser row extends in a horizontal direction perpendicular to the conveying direction and the second dispenser row extends in the horizontal direction perpendicular to the conveying direction.

[0031] In an embodiment of the packaging system according to the invention, the packaging system comprises a walking device for moving the filling device along the mould trajectory in the conveying direction from a start position into an end position and vice versa, wherein the walking device is configured to move the filling device from the start position to the end position in a synchronised manner with the mould conveyer.

[0032] The step size of the walking device equals the dispenser number multiplied by the mould spacing. The step size is preferably constant, although a varying step size would also be possible. This allows filling of all moulds while preventing double filling of some moulds. Preferably, the walking device and the mould conveyer move at the same speed along the mould trajectory while the walking device moves from the start position to the end position. Preferably, the gel dispensers line up with the moulds while the walking device moves from the start position to the end position. The mould conveyer preferably moves in a continuous manner with a constant speed.

[0033] In an embodiment of the packaging system according to the invention:

- the walking distance along the mould trajectory between the start position and the end position is less than or equal to the dispenser number multiplied by the mould spacing of adjacent moulds,
- preferably:

  -- the dispenser number is 2,
  -- the multiple gel dispensers comprise a first gel dispenser and a second gel dispenser,
  -- the walking distance along the mould trajectory between the start position and the end position is less than or equal to double a mould spacing of adjacent moulds.

[0034] In an embodiment of the packaging system according to the invention:

- the dispenser number is 2,
- the multiple gel dispensers comprise a first gel dispenser and a second gel dispenser,
- the moulds on the mould conveyer comprise even moulds and odd moulds,
- the even moulds and odd moulds are arranged on the mould conveyer in an alternating fashion along the conveying direction,
- the first gel dispenser is configured to dispense gel into odd compartments of the film positioned in odd mould cavities of the odd moulds,
- the second gel dispenser is configured to dispense gel into even compartments of the film positioned in even mould cavities of the even moulds.

[0035] In an embodiment of the packaging system according to the invention:

- the dispenser number is 2,
- the multiple gel dispensers comprise a first gel dispenser and a second gel dispenser,
- the first gel dispenser is configured to, during a filling operation, dispense gel into a first associated compartment of the film positioned in a first associated mould during movement of the filling device from the start position to the end position,
- the second gel dispenser is configured to, during a filling operation, dispense gel into a second associated compartment of the film positioned in a second associated mould during movement of the filling device from the start position to the end position,
- the first gel dispenser is arranged downstream from the second gel dispenser along the conveying direction,
- exactly two intermediate moulds are arranged between the first associated mould and the second associated mould along the conveying direction,
- the two intermediate moulds comprise a first intermediate mould and a second intermediate mould, the first intermediate mould being arranged between the second intermediate mould and the first associated mould along the conveying direction and the second intermediate mould being arranged between the first intermediate mould and the second associ-

ated mould along the conveying direction,

- the first gel dispenser is configured to, during a subsequent filling operation directly following the filling operation, dispense gel into a second intermediate compartment of the film positioned in the second intermediate mould during movement of the filling device from the start position to the end position,
- the second gel dispenser is configured to, during the subsequent filling operation directly following the filling operation, dispense gel into a first further compartment of the film positioned in a first further mould during movement of the filling device from the start position to the end position, wherein the first further mould is arranged upstream from the second associated mould along the conveying direction at two mould spacings from the second associated mould,
- the second gel dispenser is configured to, during a preceding filling operation directly preceding the filling operation, dispense gel into a first intermediate compartment of the film positioned in the first intermediate mould during movement of the filling device from the start position to the end position
- the first gel dispenser is configured to, during the preceding filling operation directly preceding the filling operation, dispense gel into a second further compartment of the film positioned in a second further mould during movement of the filling device from the start position to the end position, wherein the second further mould is arranged downstream from the first associated mould along the conveying direction at two mould spacings from the first associated mould.

[0036] In an embodiment of the packaging system according to the invention:

- the first associated mould, the second intermediate mould, and the second further mould are odd moulds, and
- the first intermediate mould, the second associated mould, and the first further mould are even moulds.

[0037] In an embodiment of the packaging system according to the invention:

- the walking device is configured to repeatedly perform a walking cycle,
- the walking cycle comprises moving the filling device along the mould trajectory from the start position to the end position and subsequently back to the start position,
- the mould conveyer is configured to move the moulds along the mould trajectory over a step distance while the walking device performs exactly one full walking cycle, such that after completing the walking cycle, each gel dispenser is arranged over a respective subsequent associated mould,
- each subsequent associated mould is arranged at the step distance along the conveying direction from the respective associated mould,
- the step distance is equal to the dispenser number multiplied by the mould spacing,
- preferably:

    -- the multiple gel dispensers comprise a first gel dispenser and a second gel dispenser,
    -- the dispenser number is 2,
    -- after completing the walking cycle, the first gel dispenser and the second gel dispenser each are respectively arranged over a subsequent first associated mould and a subsequent second associated mould,
    -- the subsequent first associated mould is arranged at the step distance along the conveying direction from a first associated mould over which the first gel dispenser is arranged upon a start of the walking cycle,
    -- the subsequent second associated mould is arranged at the step distance along the conveying direction from a second associated mould, over which the second gel dispenser is arranged upon the start of the walking cycle.

[0038] In use, the subsequent first associated mould is the second intermediate mould referred to earlier, while the second associated mould is the first further mould.

[0039] In an embodiment of the packaging system according to the invention, the packaging system comprises a further film supplying device configured to position a water-soluble further film on the film and over the gel in the compartments in order to form a web of pouches holding the gel between the film and the further film wherein the packaging system optionally comprises a connecting device to connect the film and the further film to each other.

[0040] The invention also provides a method of producing pouches using a packaging system according to any of the above embodiments according to the invention, the method comprising the steps of:

- before dispensing gel from the nozzles, arranging the pin holder in the inactive position,
- upon stopping operation of the packaging system, arranging the pin holder in the active position, thereby pushing gel out of the nozzle using the pins.

[0041] During operation of the packaging system, the pins are in the inactive position. When the system is stopped, the pin holder is moved into the active position. Gel present in the nozzle through hole is then pushed out of the nozzle by the pins. This prevents the gel from solidifying in the nozzle through holes. When the packaging system is restarted at a later point in time, the pin holder is moved back to the inactive position. The space inside the nozzle through holes that was occupied by the pins while the pin holder was in the active position is

thereby opened, such that gel can flow from the reservoir through the nozzle through hole out o the nozzles. This method thereby prevents clogging of the nozzles during a machine stop, obviating the need for separate unclogging operations. This allows faster restarts after scheduled and unscheduled machine stops.

[0042] In an embodiment of the method according to the invention, the method comprises the steps of:

- performing a filling operation, the filling operation comprising the steps of:

  -- dispensing gel from the first gel dispenser into the first associated compartment of the film positioned in the first associated mould during movement of the filling device from the start position to the end position,
  -- dispensing gel from the second gel dispenser into the second associated compartment of the film positioned in the second associated mould during movement of the filling device from the start position to the end position,

- after completing the filling operation, moving the filling device from the end position to the start position,
- after moving the filling device from the end position to the start position, performing the subsequent filling operation, the subsequent filling operation comprising the steps of:

  -- dispensing gel from the first gel dispenser into the second intermediate compartment of the film positioned in the second intermediate mould during movement of the filling device from the start position to the end position,
  -- dispensing gel from the second gel dispenser into the first further compartment of the film positioned in the first further mould during movement of the filling device from the start position to the end position,

- before performing the filling operation, performing the preceding filling operation, the preceding filling operation comprising the steps of:

  -- dispensing gel from the second gel dispenser into the first intermediate compartment of the film positioned in the first intermediate mould during movement of the filling device form the start position to the end position,
  -- dispensing gel from the first gel dispenser into the second further compartment of the film positioned in the second further mould,

- before performing the filling operation but after performing the preceding filling operation, moving the filling device from the end position to the start position,
- after performing the filling operation but before performing the subsequent filling operation, moving the filling device from the end position to the start position.

[0043] In an embodiment of the method according to the invention:

- the multiple gel dispensers comprise a first gel dispenser and a second gel dispenser,
- the dispenser number is 2,
- the method comprises the steps of:
- performing the walking cycle with the walking device,
- upon starting the walking cycle, arranging the first gel dispenser over the first associated mould and arranging the second gel dispenser over the second associated mould,
- while the walking device moves the filling device from the start position to the end position, moving the moulds along the mould trajectory using the mould conveyer in a synchronised manner and dispensing gel from the first gel dispenser into the first associated compartment of the film positioned in the first associated mould, and dispensing gel from the second gel dispenser into the second associated compartment of the film positioned in the second associated mould,
- when the filling device reaches the end position, moving the filling device back to the starting position using the walking device, thereby arranging the first gel dispenser over the subsequent first associated mould and arranging the second gel dispenser over the subsequent second associated mould.

[0044] In an embodiment of the method according to the invention, the method comprises the steps of:

- performing the walking cycle with the walking device,
- upon starting the walking cycle, arranging each gel dispenser over its respective associated mould,
- while the walking device moves the filling device from the start position to the end position, moving the moulds along the mould trajectory using the mould conveyer in a synchronised manner and dispensing gel from each gel dispenser into the respective associated compartment of the film positioned in the respective associated mould,
- when the filling device reaches the end position, moving the filling device back to the starting position using the walking device, thereby arranging each gel dispenser over the respective subsequent associated mould.

[0045] In an embodiment of the method according to the invention, the method comprises the step of removing fumes originating from the gel dispensed into the first intermediate compartment and the second intermediate compartment via the fume extraction openings.

[0046] These and other aspects of the invention will be more readily appreciated as the same becomes better understood by reference to the following detailed description and considered in connection with the accompanying drawings in which like reference symbols designate like parts.

[0047] It will be clear to the skilled person that the features of any of the above embodiments according to the invention can be combined. In particular, the packaging systems described above can be used in performing the methods described above.

Brief description of the figures

[0048] Embodiments of the packaging system according to the invention and the method according to the invention will be described by way of example only, with reference to the accompanying schematic drawings in which corresponding reference symbols indicate corresponding parts, and in which:

Figure 1 schematically shows an overview of a first example of the packaging system according to the invention,
Figure 2 schematically shows an overview of a second example of the packaging system according to the invention,
Figure 3 shows a cross section of an embodiment of the filling device of the packaging system according to the invention,
Figure 4 shows a cross section of a section of the filling device of Figure 3, wherein the pin holder is in the inactive position,
Figure 5 shows a cross section of a section of the filling device of Figure 3, wherein the pin holder is in the active position,
Figure 6 schematically shows a perspective view of a pin holder and reservoir of an embodiment of the packaging system according to the invention,
Figure 7 schematically shows a perspective view of the pin holder and reservoir of Figure 6 from a different viewing angle,
Figure 8 schematically shows a top view of a mould,
Figure 9 schematically shows a bottom view of the reservoir of Figure 6,
Figure 10 schematically shows a perspective view of multiple moulds of a packaging system according to the invention,
Figure 11 schematically shows a bottom view of a filling device of a packaging system according to the invention,
Figure 12A schematically shows a filling operation,
Figure 12B schematically shows a preceding filling operation, performed directly before the filling operation of Figure 12A,
Figure 12C schematically shows a subsequent filling operation, performed directly after the filling operation of Figure 12A.

Detailed description of the figures

[0049] Figure 1 shows an overview of a first example of the packaging system 1 according to the invention. The packaging system 1 is configured produce pouches 2 comprising a water-soluble film 3 and a gel 4. The gel 4 comprises a substrate treatment agent, for example a detergent, rinsing aid, water hardness regulator or color protection agent.

[0050] The packaging system 1 comprises multiple moulds 5. Each mould 5 has a mould cavity 6 for forming a compartment 7 in the film 3.

[0051] A mould conveyor 8 moves the moulds 5 in a conveying direction 9 along a mould trajectory, more specifically an endless mould trajectory. The mould conveyor 8 is configured as a mould conveyor belt 70.

[0052] The moulds 5 are moved along a film supplying device 11 configured to position the film 3 on the moulds 5. Subsequently, a compartment forming device 12 positions parts of the film 3 in the mould cavities 6 to form the compartments 7 in the film 3. After that, a filling device 13 having multiple gel dispensers 15 fills the compartments 7 with the gel 4. Each gel dispenser 15 dispenses gel 4 into an associated compartment 7 of the film 3 positioned in an associated mould 5.

[0053] A further film supplying device 65 positions a water-soluble further film 66 on the film 3 and over the gel 4 in the compartments 7 in order to form a web 67 of pouches 2 holding the gel between the film 3 and the further film 66. The web 67 of pouches 2 can be cut to form individualised pouches 2. The packaging system 1 also comprises a connecting device 68 to connect the film 4 and the further film 66 to each other.

[0054] The mould conveyor 8 is configured to continuously move the moulds 5 in the conveying direction 9 during the filling of the compartments 7. The packaging system 1 comprises a walking device 43 configured to move the filling device 13 over a walking distance 61 from a start position 44 into an end position 45, and vice versa. The walking device 43 is configured to move the filling device 13 along the mould trajectory in the conveying direction 9 from the start position 44 to the end position 45 during the filling of the compartments 7 and from the end position 45 to the start position 44 after the filling of the compartments 7 has been completed in order to start a new filling cycle. This allows synchronous movement of the filling device 13 with the compartments 7 to be filled as the moulds 5 are continuously moved by the mould conveyor 8. During filling, the gel dispensers 15 line up with the compartments 7 and the gel dispensers 15 move in substantially the same direction at substantially the same speed as the moulds 5. The walking distance 61 along the mould trajectory between the start position 44 and the end position 45 is less than or equal to double a mould spacing 39 of adjacent moulds 5.

[0055] Figure 2 shows an overview of a second example of the packaging system 1 according to the invention. The main difference with respect to the packaging system

1 of Figure 1 is that the mould conveyer 8 is configured as a rotary mould drum 71 instead of a mould conveyor belt 70.

[0056] Figure 3 shows a cross section of the filling device 13 of the packaging system 1 of an embodiment according to the invention. Each gel dispenser 15 comprises a reservoir 18 which is in fluid communication with the gel supply 14. The gel supply 14 comprises multiple gel pumps 14A and multiple gel channels 19. Each gel channel 19 connects one of the multiple gel pumps 14A to one of the multiple gel dispensers 15. The gel pumps 14A pump the gel 4 via the gel channels 19 to the reservoirs 18. From the reservoir 19, the gel 4 is dispensed through nozzle openings 22 of nozzles 20 via nozzle through holes 21.

[0057] Each gel dispenser 15 comprises a pin holder 23 holding a pin number of pins 24. The pin number is equal to the number of nozzles 20 (the nozzle number) of the gel dispenser 15, and each pin 24a-g is associated with one of the nozzles 20a-g (see Figure 6). The pin number and the nozzle number are preferably larger than one. The pins 24 are held by a single shared pin holder 23.

[0058] The pin holder is moveable by a pin actuator 25 into an active position 26 and an inactive position 27. In the active position 26, each pin 24 extends into the nozzle through hole 21 of its associated nozzle 22. In the inactive position 27, the pins 24 are arranged in the reservoir 18. Figures 4 and 5 show a cross section of a section of the filling device of 13 Figure 3, wherein the pin holder is in the inactive position 27 and the active position 26, respectively. In the inactive position 27, the nozzle openings 22 are in fluid communication with the reservoir 18, such that gel 4 may flow through the nozzles 20. Upon moving the pin holder 23 from the inactive position 27 to the active position 26, the pins 24 enter the nozzle through holes 21, thereby expelling gel 4 from the nozzle through holes 21. During operation of the packaging system 1, the pin holder 23 is in the inactive position 27. Upon stopping said operation, the pin holder is moved by the pin actuator 25 to the active position, such that gel 4 present in the nozzles 20 is expelled out of the nozzle openings 22. This prevents gel 4 from solidifying inside the nozzle through holes 21. Preventing gel solidification inside the nozzle through holes 21 prevents clogging of the nozzles 20. Upon a restart of said operation, the pin holder 23 is moved back to the inactive position 27, such that a free channel is created in the nozzle through holes 21 where the pins 24 were located when the pin holder 23 was in the active position 26.

[0059] The pins 24 and the nozzle through holes 21 extend parallel to each other. In the active position 26 of the pin holder 23, the pins 24 extend along the complete through hole 21 of their respective associated nozzles 20. More specifically, in the active position 26 of the pin holder 23, the pins 24 extend in a direction from the reservoir 18 to their respective associated nozzle openings 22 along the complete through hole 21 of their respective associated nozzles 20. Optionally, the pins 24 end flush with the nozzle openings 22, as shown in Figure 5. The through holes 21 of the nozzles 20 and the pins 24 have a same shape such as a cylindrical, conical, or pyramid shape. This way, the pins 24 can effectively expel gel 4 from the nozzle through hole 21 upon insertion of the pins 24 into the nozzle through holes 21 by movement of the pin holder 23 from the inactive position 27 to the active position 26.

[0060] Each nozzle opening 22 is configured to dispense the gel 4 out of the respective gel dispenser 15. Each nozzle opening 22 is located at a nozzle through hole end 80 of the respective nozzle through hole 21 (see Figure 4).

[0061] The gel 4 has a viscosity of between 1000 Cp and 3000 Cp. The nozzle diameter 34 of the nozzle openings 22 is between, and including, 1,4 and 2,2 mm, preferably between, and including 1,6 mm and 2,0 mm, more preferably 1,8 mm. Other values may be chosen to optimise for other gel properties and/or other operating conditions of the packaging system 1.

[0062] The viscosity is determined by rheological measurements. The rheological measurements were performed on samples of the gel by using an Anton Paar MCR301 rheometer (SN80108634) equipped with a set-up with a Peltier heated cylinder geometry (P-CTD200 SN81433896) in combination with a cylinder geometry (CC27, SN37581) and solvent trap to avoid evaporation of solvent. Measurements on the samples were performed in rotation as well as in oscillation.

[0063] The gel channel 19 is at least partially straight and at least partially concentric with the pin holder 23. As shown in Figures 3-5, the gel channel 19 may extend at least partially through the pin holder 23. This tends to allow a compact construction. The gel channel 19 is offset with respect to each of the nozzle openings 22 (see also Figure 7).

[0064] The packaging system 1 comprises an upstream heating device 32 for heating the gel 4 between the nozzles 20 and the gel supply 14 to an upstream gel temperature. Additionally or alternatively, the packaging system 1 may comprise a nozzle heating device 33 for heating the gel 4 at the nozzles 20 to a nozzle gel temperature. Preferably, the nozzle gel temperature is higher than the upstream gel temperature.

[0065] The gel supply 14 provides a pressure to dispense the gel 4 from the nozzles 20. When the gel 4 has been dispensed, this pressure is relieved. The stringing time is the time it takes until the gel 4 stops dripping from the nozzles 20 after the pressure has been relieved. It is beneficial to wait until the gel 4 has stopped dripping from the nozzles 20 before dispensing gel 4 into another compartment 7, as this reduced spillage of gel 4. Furthermore, the integrity of the formed pouches 2 may be reduced if gel 4 is leaked onto a sealing area of the pouches 2. Reducing the stringing time thus allows faster operation, as less time is required to wait for the gel 4 to stop dripping from the nozzles 20. Heating the gel decreases the viscosity of the gel, leading to less pressure required to dis-

pense the gel 4 from the nozzles 20. Additionally, the stringing time of the gel 4 is reduced at higher temperatures. However, the gel 4 deteriorates faster at higher temperatures, such that it is desirable to prevent heating the gel 4 too much or for too long. Therefore, it is beneficial to increase the gel temperature just before it is dispensed, e.g. at the nozzles 20.

[0066] Figures 6 and 7 schematically show perspective views of a pin holder 23 and a reservoir 18 of an embodiment of the packaging system 1 according to the invention. The nozzles 20 are arranged in a dispensing shape 30. The nozzles 20 are configured to dispense the gel 4 into the associated compartment 7 in a deposit shape 31. The deposit shape 31 and the dispensing shape 30 may be elongated. Arranging the nozzles 20 in the dispensing shape 30 allows dispensing the gel 4 in a particular shape, such that the gel 4 can be arranged in a particular shape in the finished pouch 2. A recess 31A may be present in the mould 5 in order to further control the final shape of the gel 4 in the finished pouch 2.

[0067] Figure 8 schematically shows a top view of a mould 5. In the imaged embodiment, two recesses 31A are present to form two 'swooshes' in the compartment 7. The gel 4 is dispensed into the compartment 7 formed in the mould 5 in the deposit shape 31. More specifically, the gel 4 is dispensed onto the film 3 in one or both of the recesses 31A, such that the gel 4 follows the 'swoosh' shape in the formed pouch 2. The deposit shape 31 may be any other shape, preferably elongated. Different types of gel 4 may be dispensed in the film in the different recesses 31A. Any number of recesses 31A, including one, may be present in the mould 5. Figure 9 shows a bottom view of the reservoir 18 of Figure 6, where the dispensing shape 30 is clearly visible. The dispensing shape 30 corresponds with the deposit shape 31.

[0068] Figure 10 schematically shows a perspective view of multiple moulds 5 of a packaging system 1 according to the invention. Moulds 5 are arranged along the conveying direction 9 and multiple moulds 5 may also be arranged along the horizontal direction 42 perpendicular to the conveying direction 9. In the imaged embodiment, three moulds 5 are arranged along the horizontal direction 42 perpendicular to the conveying direction 9.

[0069] Figure 11 shows a bottom view of a bottom view of a filling device 13 of a packaging system 1 according to the invention. The bottom of the filling device 13 shown in Figure 11 is facing the moulds 5 during operation of the packaging system 1. Multiple first gel dispensers 40A are arranged along a first dispenser row 40 and multiple second gel dispensers 41A are arranged along a second dispenser row 41. Both the first dispenser row 40 and the second dispenser row 41 extend along the horizontal direction 42 perpendicular to the conveying direction 9. Each dispenser row 40, 41 comprises an equal number of gel dispensers 15, which number is also equal to the number of moulds 5 arranged along the horizontal direction 42 perpendicular to the conveying direction 9 (see also Figure 10). In the imaged embodiment, the two dispenser rows 40, 41 each comprise three gel dispensers 15. This way, more compartments 7 may be supplied with gel 4 simultaneously. This tends to increase a throughput of the packaging system 1.

[0070] Fume extraction openings 35 are arranged between the gel dispensers 13, more specifically between the first dispenser row 40 and the second dispenser row 41. The fume extraction openings 35 are in fluid communication with one or more fume extraction channels 36, which are in fluid communication with a flow generating device (not shown) arranged further downstream with respect to the flow through the fume extraction channels 36, such as a motorised fan or low pressure source. Fumes originating from the gel 4 dispensed into the compartments 7 of the film 3 can then be removed via the fume extraction openings 35 and the fume extraction channels 36. The fume extraction channels 36 may be heated, preferably to a temperature above a condensation temperature of the fumes, in order to prevent or at least reduce condensation of the fumes in the fume extraction channels 36.

[0071] The fume extraction openings 35 are arranged above the moulds 5, such that any fumes originating from the gel 4 dispensed into the compartments 7 of the film 3 is extracted close to the source of the fumes, i.e. close to the gel 4 dispensed into the compartments 7 of the film 3. The dispenser spacing 38 between the first gel dispensers 40A and the second gel dispensers 41A is the same for all adjacent gel dispenser pairs. In the imaged embodiment, the dispenser spacing 38 is three times the mould spacing 39. The dispenser spacing 38 is defined along the conveying direction 9 and the mould spacing 39 is also defined along the conveying direction 9.The dispenser spacing 38 may be any odd integer multiplied by the mould spacing 39 if the dispenser number is even like in the imaged embodiment, where the dispenser number is two. If the dispenser number is odd, the dispenser spacing 38 may be any even integer multiplied by the mould spacing 39.

[0072] Figures 12A - 12C schematically show a filling operation, a preceding filling operation and a subsequent filling operation, respectively. Numerous parts of the packaging system 1 are not shown in Figures 12A - 12C in order to ease understanding.

[0073] The packaging system 1 comprises two gel dispensers 15, being a first gel dispenser 40A and a second gel dispenser 41A. The dispenser spacing 38 of the first gel dispenser 40A and the second gel dispenser 41A is equal to an odd integer multiplied by the mould spacing 39 of adjacent moulds 5. In the imaged embodiment, the dispenser spacing 38 is three times the mould spacing 39 of adjacent moulds 5, similar to what is shown in Figure 11.

[0074] In the imaged embodiment, the dispenser number is 2. The multiple gel dispensers 15 thus comprise a first gel dispenser 40A and a second gel dispenser 41A. The first gel dispenser 40A is arranged downstream from the second gel dispenser 41A along the conveying

direction 9. The moulds 5 on the mould conveyer 8 comprise even moulds 46 and odd moulds 47. The even moulds 46 and odd moulds 47 are arranged on the mould conveyer 8 in an alternating fashion along the conveying direction 9. The first gel dispenser 40A is configured to dispense gel 4 into odd compartments of the film 3 positioned in odd mould cavities of the odd moulds 47. The second gel dispenser 41A is configured to dispense gel 4 into even compartments of the film 3 positioned in even mould cavities of the even moulds 46.

[0075] The first gel dispenser 40A and the second gel dispenser 41A are shown in a relative position with respect to the moulds 5. Because the walking device 43 moves the gel dispensers 15 synchronously with the moulds 5 during the filling operations, the relative position of the first gel dispenser 40A and the second gel dispenser 41A with respect to the moulds 5 does not change during dispensing of gel 4 into the compartments 7, but only when the dispensing of the gel 4 during that filling operation has been completed.

[0076] From left to right and starting from the mould 5 arranged below the first gel dispenser 40A in Figure 12A, the moulds 5 comprise a first associated mould 49, a first intermediate mould 53, a second intermediate mould 54 and a second associated mould 51. In the filling operation, gel 4 is dispensed into the first associated compartment 48 of the first associated mould 49 by the first gel dispenser 40A and gel 4 is dispensed into the second associated compartment 50 of the second associated mould 51 by the second gel dispenser 41A. In the preceding filling operation, gel 4 is dispensed into the first intermediate compartment 58 of the first intermediate mould 53 by the second gel dispenser 41A. In the subsequent filling operation, gel 4 is dispensed into the second intermediate compartment 55 of the second intermediate mould 54 by the first gel dispenser 40A. Thus, in three subsequent filling operations, the compartments 48, 50, 58, 55 of the four above mentioned contiguous moulds 49, 53, 54, 51 are supplied with gel. This shows that, in continuous operation of the packaging system 1, the compartments 7 of all moulds 5 are supplied with gel 4, with the possible exception of some moulds near the beginning and end of the production run.

[0077] This can be explained as follows. In each further filling operation, the second gel dispenser 41A dispenses gel 4 into the compartment 7 of a mould 5 two mould spacings 39 away from the mould 5 most recently supplied with gel 4 by the second gel dispenser 41A; the second gel dispenser 41A thus skips one mould 5. The compartment 7 of this skipped mould 5 is supplied with gel 4 by the first gel dispenser 40A in a filling operation directly following said further filling operation. If the dispenser spacing would be one, the compartment 7 of this skipped mould 5 would be supplied with gel 4 by the first gel dispenser 40A in the further filing operation itself. If the dispenser spacing would be five, the compartment 7 of this skipped mould 5 would be supplied with gel 4 by the first gel dispenser 40A in a filling operation not directly following the further filing operation, but one filling operation later.

[0078] Below, the filling procedure is explained in more detail.

[0079] The first gel dispenser 40A is configured to, during the filling operation depicted in Figure 12A, dispense gel into a first associated compartment 48 of the film 3 positioned in a first associated mould 49 during movement of the filling device 13 from the start position 44 to the end position 45. The second gel dispenser 41A is configured to, during the filling operation depicted in Figure 12A, dispense gel 4 into a second associated compartment 50 of the film 3 positioned in a second associated mould 51 during movement of the filling device 13 from the start position 44 to the end position 45. Exactly two intermediate moulds 53, 54 are arranged between the first associated mould 49 and the second associated mould 51 along the conveying direction 9.

[0080] The two intermediate moulds 53, 54 comprise a first intermediate mould 53 and a second intermediate mould 54. The first intermediate mould 53 is arranged between the second intermediate mould 54 and the first associated mould 49 along the conveying direction 9. The second intermediate mould 54 is arranged between the first intermediate mould 53 and the second associated mould 51 along the conveying direction 9.

[0081] The first gel dispenser 40A is configured to, during the subsequent filling operation depicted in Figure 12C, dispense gel 4 into a second intermediate compartment 55 of the film 3 positioned in the second intermediate mould 54 during movement of the filling device 13 from the start position 44 to the end position 45. The second gel dispenser is configured to, during the subsequent filling operation depicted in Figure 12C, dispense gel 4 into a first further compartment 56 of the film 3 positioned in a first further mould 57 during movement of the filling device 13 from the start position 44 to the end position 45. The first further mould 57 is arranged upstream from the second associated 51 mould along the conveying direction 9 at two mould spacings 39 from the second associated mould 51.

[0082] The second gel dispenser 41A is configured to, during the preceding filling operation depicted in Figure 12B, dispense gel 4 into a first intermediate compartment 58 of the film 3 positioned in the first intermediate mould 53 during movement of the filling device 13 from the start position 44 to the end position 45. The first gel dispenser is configured to, during the preceding filling operation depicted in Figure 12B, dispense gel 4 into a second further compartment 59 of the film 3 positioned in a second further mould 60 during movement of the filling device 13 from the start position 44 to the end position 45. The second further mould 60 is arranged downstream from the first associated mould 49 along the conveying direction 9 at two mould spacings 39 from the first associated mould 49.

[0083] During the filling operation depicted in Figure 12A, the fume extraction openings 35 are arranged over

the first intermediate mould 53 and the second intermediate mould 54 (see also Figure 11, which shows that the fume extraction openings 35 are arranged between the first gel dispenser 40A and the second gel dispenser 41A). As the first intermediate compartment 58 of the film 3 positioned in the first intermediate mould 53 holds gel 4 dispensed into it in the preceding filling operation depicted in Figure 12B while the filling operation depicted in Figure 12A is performed, the fume extraction openings 35 are positioned to extract any fumes originating from the gel 4 in the first intermediate compartment 58 close to the first intermediate compartment 58. This tends to reduce the spread of such fumes through the packaging system 1 and its environment, leading to relatively low contamination by fumes and condensed fumes.

[0084] The first associated mould 49, the second intermediate mould 54, and the second further mould 60 are odd moulds 47. The first intermediate mould 53, the second associated mould 51, and the first further mould 57 are even moulds 46. The compartments 7 of odd moulds are supplied with gel by the first gel dispenser 40A, while the compartments 7 of even moulds are supplied with gel 4 b the second gel dispenser 41A.

[0085] As described above, the walking device 43 moves the gel dispensers 15 synchronously with the moulds 5 during the filling operations in repeated walking cycles. Each walking cycle comprises moving the filling device 13 comprising the gel dispensers 15 along the mould trajectory from the start position 44 to the end position 45 and back again after the gel 4 has been dispensed into the moulds 5. In the time it takes the walking device 43 to execute a full walking cycle, the mould conveyer 8 moves the moulds 5 along the mould trajectory over a step distance 61A. In the time it takes the walking device 43 to move the filling device 13 from the start position to the end position, the mould conveyer 8 moves the moulds 5 along the mould trajectory over the walking distance 61, since the walking device 43 moves the filling device 13 in a synchronised manner with the mould conveyer. The mould conveyer 8 may alternatively move the moulds 5 over a slightly different distance from the walking distance 61, as long as the gel 4 can still be dispensed into the compartments 7 without spillage. The step distance 61A is larger than the walking distance 61. The step distance 61A is equal to the number of gel dispensers 15 in the filling device 13 when seen along the conveying direction 9, multiplied by the mould spacing 39. In the imaged embodiment, the filling device 9 has two gel dispensers 40A, 41A when seen along the conveying direction 9, such that the step distance 61A is twice the mould spacing 39.

[0086] Upon starting the walking cycle, the first gel dispenser 40A is arranged over the first associated mould 49 and the second gel dispenser 41A is arranged over the second associated mould 51. While the walking device 43 moves the filling device 13 from the start position 44 to the end position 45, the conveyer 8 synchronously moves the moulds 5 in the conveying direction 9. Simultaneously, the first gel dispenser 40A dispenses gel 4 into the first associated compartment 48 and the second gel dispenser 41A dispenses gel 4 into the second associated compartment 50. Dispensing of gel 4 from the first and second gel dispenser 40A, 41A stops when or before the filling device 13 reaches the end position 45. The walking device 43 moves the filling device 13 back to the start position 44 after the filling device 13 has reached the end position 45. A delay may be present, such that the filling device 13 pauses at the end position 45 or the start position 44 before starting a new walking cycle.

[0087] After completion of the walking cycle, a new walking cycle is started. The first gel dispenser 40A is then arranged over the subsequent first associated mould 63 and the second gel dispenser 41A is then arranged over the subsequent second associated mould 64 and a new walking cycle is started. The subsequent first associated mould 63 is arranged at the step distance 61A along the conveying direction 9 from the first associated mould 49 and the subsequent second associated mould 64 is arranged at the step distance 61A along the conveying direction 9 from the second associated mould 51. The subsequent first associated mould 63 is the second intermediate mould 54 and the subsequent second associated mould is the first further mould 57.

[0088] The packaging system 1 described above ensures that all compartments 7 of the film are filled, with the possible exception of some compartments 7 near the beginning or end of the web of pouches 67. A different number of gel dispensers 15, a different step size, and/or a different dispenser spacing 38 may be used while still attaining this goal. Assuming a constant step size, the dispenser spacing 38 is an odd integer multiple of the mould spacing 39 for an even number of gel dispensers 15 when seen along the conveying direction 9 and the dispenser spacing 38 is an even integer multiple of the mould spacing 39 for an odd number of gel dispensers 15 arranged along the conveying direction 9. The step size equals the number of gel dispensers 15 when seen along the conveying direction 9 multiplied by the mould spacing 39.

[0089] The invention further relates to any of the following clauses.

1. Packaging system for producing pouches comprising a water-soluble film and a gel comprising a substrate treatment agent, the packaging system comprising:

- multiple moulds, each mould having a mould cavity for forming a compartment in the film, and
- a mould conveyer configured to move the moulds in a conveying direction along a mould trajectory, such as an endless mould trajectory, and wherein the moulds are moved along:

-- a film supplying device configured to po-

sition the film on the moulds,
-- a compartment forming device configured to position parts of the film in the mould cavities to form the compartments in the film,
-- a filling device comprising a gel supply and multiple gel dispensers, wherein each gel dispenser is configured to dispense the gel into an associated compartment of the film positioned in an associated mould,

each gel dispenser comprising:

- a reservoir in fluid communication with the gel supply via a gel channel,
- an integer nozzle number of nozzles, each nozzle comprising a nozzle through hole extending from the reservoir to a nozzle opening, the nozzle number being one or more,
- a pin holder arranged in the reservoir holding a pin number of pins, wherein:

-- the pin number is equal to the nozzle number,
-- each pin is associated with one of the nozzles,
-- each nozzle is associated with one of the pins,
-- the pin holder is moveable by a pin actuator from an active position into an inactive position, and vice versa,
-- in the inactive position of the pin holder, the pins are arranged in the reservoir and the nozzle openings are in fluid communication with the reservoir,
-- in the active position of the pin holder, each pin extends into the nozzle through hole of its associated nozzle to expel gel from the nozzle through hole.

2. Packaging system according to claim 1, the nozzle number being larger than one.

3. Packaging system according to claim 2, wherein the pins of each dispenser are held by a single shared pin holder.

4. Packaging system according to any of the preceding claims, wherein, in the active position of the pin holder, the pins extend along the complete through hole of their respective associated nozzles, the pins optionally ending flush with the nozzle openings of their respective associated nozzles.

5. Packaging system according to any of the claims 1-3, wherein, in the active position of the pin holder, the pins extend in a direction from the reservoir to their respective associated nozzle openings along the complete through hole of their respective associated nozzles, the pins optionally ending flush with the nozzle openings of their respective associated nozzles.

6. Packaging system according to any of the preceding claims, wherein each nozzle opening is configured to dispense the gel out of the respective gel dispenser.

7. Packaging system according to any of the preceding claims, wherein each nozzle opening is located at a nozzle through hole end of the respective nozzle through hole.

8. Packaging system according to any of the preceding claims, wherein the through holes of the nozzles and their respective associated pins have a same shape such as a cylindrical, conical, or pyramid shape.

9. Packaging system according to any of claims 2 - 8, and in combination with claim 2, wherein:

- the nozzles are arranged in a dispensing shape,
- the nozzles are configured to dispense the gel into the associated compartment in a deposit shape,
- preferably the deposit shape and the dispensing shape are elongated.

10. Packaging system according to any of the preceding claims, comprising an upstream heating device for heating the gel between the nozzle and the gel supply to an upstream gel temperature.

11. Packaging system according to any of the preceding claims, comprising a nozzle heating device for heating the gel at the nozzle to a nozzle gel temperature.

12. Packaging system according to claim 11, the packaging system also comprising the features of claim 10, wherein the nozzle gel temperature is higher than the upstream gel temperature.

13. Packaging system according to any of the preceding claims, wherein a nozzle diameter of the nozzle openings is between, and including, 1,4 and 2,2 mm, preferably between, and including 1,6 mm and 2,0 mm, more preferably 1,8 mm.

14. Packaging system according to any of the preceding claims, wherein the gel channel is at least partially straight and at least partially concentric with the pin holder.

15. Packaging system according to any of the preceding claims, wherein the gel channel is offset with

respect to each of the nozzle openings.

16. Packaging system according to any of the preceding claims, wherein the pins and the nozzle through holes extend parallel to each other.

17. Packaging system according to any of the preceding claims, wherein:

- the gel supply comprises multiple gel pumps,
- the gel supply comprises multiple gel channels, and
- each gel channel connects exactly one of the multiple gel pumps to exactly one of the multiple gel dispensers.

18. Packaging system according to any of the preceding claims, wherein the gel has a viscosity of between 1000 Cp and 3000 Cp.

19. Packaging system according to any of the preceding claims, the filling device comprising one or more fume extraction openings in fluid communication with one or more fume extraction channels for extracting fumes originating from the gel dispensed by the gel dispenser, wherein optionally the one or more fume extraction channels are heated to a temperature above a condensation temperature of the fumes.

20. Packaging system according to claim 19, wherein the one or more fume extraction channels are in fluid communication with a flow generating device, such as a motorised fan or low pressure source, and the flow generating device is arranged downstream from the one or more fume extraction openings with respect to a flow through the one or more fume extraction channels.

21. Packaging system according to claim 19 or 20, the multiple gel dispensers comprising a dispenser number of gel dispensers, wherein:

- the dispenser number is an integer number of 2 or more,
- the one or more fume extraction openings are arranged between the multiple gel dispensers and above the moulds,
- a dispenser spacing between adjacent gel dispensers is the same for all adjacent dispenser pairs,
- either:

    -- the dispenser spacing between adjacent gel dispensers is an odd integer multiplied by a mould spacing of adjacent moulds and the dispenser number is even, OR
    -- the dispenser spacing between adjacent gel dispensers is an even integer multiplied by a mould spacing of adjacent moulds and the dispenser number is odd,

- preferably:

    -- the dispenser number is 2,
    -- the multiple gel dispensers comprise a first gel dispenser and a second gel dispenser,
    -- the dispenser spacing of the first gel dispenser and the second gel dispenser is equal to an odd integer multiplied by the mould spacing of adjacent moulds, more preferably three times the mould spacing of adjacent moulds.

22. Packaging system according to claim 21, wherein the dispenser spacing is defined along the conveying direction and the mould spacing is defined along the conveying direction.

23. Packaging system according to claim 21 or 22, comprising multiple first gel dispensers arranged along a first dispenser row and multiple second gel dispensers arranged along a second dispenser row, wherein the first dispenser row extends in a horizontal direction perpendicular to the conveying direction and the second dispenser row extends in the horizontal direction perpendicular to the conveying direction.

24. Packaging system according to any of the preceding claims, comprising a walking device for moving the filling device along the mould trajectory in the conveying direction from a start position into an end position and vice versa, wherein the walking device is configured to move the filling device from the start position to the end position in a synchronised manner with the mould conveyer.

25. Packaging system according to claim 24, the packaging system also comprising the features of any of claims 21 - 23, wherein:

- a walking distance along the mould trajectory between the start position and the end position is less than or equal to the dispenser number multiplied by the mould spacing of adjacent moulds,
- preferably:

    -- the dispenser number is 2,
    -- the multiple gel dispensers comprise a first gel dispenser and a second gel dispenser,
    -- the walking distance along the mould trajectory between the start position and the

end position is less than or equal to double a mould spacing of adjacent moulds.

26. Packaging system according to any of claims 21 - 25, wherein:

- the dispenser number is 2,
- the multiple gel dispensers comprise a first gel dispenser and a second gel dispenser,
- the moulds on the mould conveyer comprise even moulds and odd moulds,
- the even moulds and odd moulds are arranged on the mould conveyer in an alternating fashion along the conveying direction,
- the first gel dispenser is configured to dispense gel into odd compartments of the film positioned in odd mould cavities of the odd moulds,
- the second gel dispenser is configured to dispense gel into even compartments of the film positioned in even mould cavities of the even moulds.

27. Packaging system according to claim 25 or 26, wherein:

- the dispenser number is 2,
- the multiple gel dispensers comprise a first gel dispenser and a second gel dispenser,
- the first gel dispenser is configured to, during a filling operation, dispense gel into a first associated compartment of the film positioned in a first associated mould during movement of the filling device from the start position to the end position,
- the second gel dispenser is configured to, during a filling operation, dispense gel into a second associated compartment of the film positioned in a second associated mould during movement of the filling device from the start position to the end position,
- the first gel dispenser is arranged downstream from the second gel dispenser along the conveying direction,
- exactly two intermediate moulds are arranged between the first associated mould and the second associated mould along the conveying direction,
- the two intermediate moulds comprise a first intermediate mould and a second intermediate mould, the first intermediate mould being arranged between the second intermediate mould and the first associated mould along the conveying direction and the second intermediate mould being arranged between the first intermediate mould and the second associated mould along the conveying direction,
- the first gel dispenser is configured to, during a subsequent filling operation directly following the filling operation, dispense gel into a second intermediate compartment of the film positioned in the second intermediate mould during movement of the filling device from the start position to the end position,
- the second gel dispenser is configured to, during the subsequent filling operation directly following the filling operation, dispense gel into a first further compartment of the film positioned in a first further mould during movement of the filling device from the start position to the end position, wherein the first further mould is arranged upstream from the second associated mould along the conveying direction at two mould spacings from the second associated mould,
- the second gel dispenser is configured to, during a preceding filling operation directly preceding the filling operation, dispense gel into a first intermediate compartment of the film positioned in the first intermediate mould during movement of the filling device from the start position to the end position
- the first gel dispenser is configured to, during the preceding filling operation directly preceding the filling operation, dispense gel into a second further compartment of the film positioned in a second further mould during movement of the filling device from the start position to the end position, wherein the second further mould is arranged downstream from the first associated mould along the conveying direction at two mould spacings from the first associated mould.

28. Packaging system according claims 26 or 27, wherein:

- the first associated mould, the second intermediate mould, and the second further mould are odd moulds, and
- the first intermediate mould, the second associated mould, and the first further mould are even moulds.

29. Packaging system according to any of claims 25 - 28, wherein:

- the walking device is configured to repeatedly perform a walking cycle,
- the walking cycle comprises moving the filling device along the mould trajectory from the start position to the end position and subsequently back to the start position,
- the mould conveyer is configured to move the moulds along the mould trajectory over a step distance while the walking device performs exactly one full walking cycle, such that after completing the walking cycle, each gel dispenser is arranged over a respective subsequent associated mould,

- each subsequent associated mould is arranged at the step distance along the conveying direction from the respective associated mould,
- the step distance is equal to the dispenser number multiplied by the mould spacing,
- preferably:

    -- the multiple gel dispensers comprise a first gel dispenser and a second gel dispenser,
    -- the dispenser number is 2,
    -- after completing the walking cycle, the first gel dispenser and the second gel dispenser each are respectively arranged over a subsequent first associated mould and a subsequent second associated mould,
    -- the subsequent first associated mould is arranged at the step distance along the conveying direction from a first associated mould over which the first gel dispenser is arranged upon a start of the walking cycle,
    -- the subsequent second associated mould is arranged at the step distance along the conveying direction from a second associated mould, over which the second gel dispenser is arranged upon the start of the walking cycle.

30. Packaging system according to any of the preceding claims, wherein the packaging system comprises a further film supplying device configured to position a water-soluble further film on the film and over the gel in the compartments in order to form a web of pouches holding the gel between the film and the further film wherein the packaging system optionally comprises a connecting device to connect the film and the further film to each other.

31. Method of producing pouches using a packaging system according to any of claims 27 - 30, the method comprising the steps of:

- performing a filling operation, the filling operation comprising the steps of:

    -- dispensing gel from the first gel dispenser into the first associated compartment of the film positioned in the first associated mould during movement of the filling device from the start position to the end position,
    -- dispensing gel from the second gel dispenser into the second associated compartment of the film positioned in the second associated mould during movement of the filling device from the start position to the end position,

- after completing the filling operation, moving the filling device from the end position to the start position,
- after moving the filling device from the end position to the start position, performing the subsequent filling operation, the subsequent filling operation comprising the steps of:

    -- dispensing gel from the first gel dispenser into the second intermediate compartment of the film positioned in the second intermediate mould during movement of the filling device from the start position to the end position,
    -- dispensing gel from the second gel dispenser into the first further compartment of the film positioned in the first further mould during movement of the filling device from the start position to the end position,

- before performing the filling operation, performing the preceding filling operation, the preceding filling operation comprising the steps of:

    -- dispensing gel from the second gel dispenser into the first intermediate compartment of the film positioned in the first intermediate mould during movement of the filling device form the start position to the end position,
    -- dispensing gel from the first gel dispenser into the second further compartment of the film positioned in the second further mould,

- before performing the filling operation but after performing the preceding filling operation, moving the filling device from the end position to the start position,
- after performing the filling operation but before performing the subsequent filling operation, moving the filling device from the end position to the start position.

32. Method of producing pouches using a packaging system according to claim 29, wherein:

- the multiple gel dispensers comprise a first gel dispenser and a second gel dispenser,
- the dispenser number is 2,
- the method comprises the steps of:
- performing the walking cycle with the walking device,
- upon starting the walking cycle, arranging the first gel dispenser over the first associated mould and arranging the second gel dispenser over the second associated mould,
- while the walking device moves the filling device from the start position to the end position, moving the moulds along the mould trajectory using

the mould conveyer in a synchronised manner and dispensing gel from the first gel dispenser into the first associated compartment of the film positioned in the first associated mould, and dispensing gel from the second gel dispenser into the second associated compartment of the film positioned in the second associated mould,

- when the filling device reaches the end position, moving the filling device back to the starting position using the walking device, thereby arranging the first gel dispenser over the subsequent first associated mould and arranging the second gel dispenser over the subsequent second associated mould.

33. Method of producing pouches using a packaging system according to claim 29, the method comprising the steps of:

- performing the walking cycle with the walking device,
- upon starting the walking cycle, arranging each gel dispenser over its respective associated mould,
- while the walking device moves the filling device from the start position to the end position, moving the moulds along the mould trajectory using the mould conveyer in a synchronised manner and dispensing gel from each gel dispenser into the respective associated compartment of the film positioned in the respective associated mould,
- when the filling device reaches the end position, moving the filling device back to the starting position using the walking device, thereby arranging each gel dispenser over the respective subsequent associated mould.

34. Method according to claim 32 or 33, the method comprising the step of removing fumes originating from the gel dispensed into the first intermediate compartment and the second intermediate compartment via the fume extraction openings.

35. Method of producing pouches using a packaging system according to any of the claims 1 - 30, the method comprising the steps of:

- before dispensing gel from the nozzles, arranging the pin holder in the inactive position,
- upon stopping operation of the packaging system, arranging the pin holder in the active position, thereby pushing gel out of the nozzle using the pins.

[0090] As required, detailed embodiments of the present invention are disclosed herein; however, it is to be understood that the disclosed embodiments are merely exemplary of the invention, which can be embodied in various forms. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the present invention in virtually any appropriately detailed structure. Further, the terms and phrases used herein are not intended to be limiting, but rather, to provide an understandable description of the invention.

[0091] The terms "a" or "an", as used herein, are defined as one or more than one. The term plurality, as used herein, is defined as two or more than two. The term another, as used herein, is defined as at least a second or more. The terms including and/or having, as used herein, are defined as comprising (i.e., open language, not excluding other elements or steps). Any reference signs in the claims should not be construed as limiting the scope of the claims or the invention.

[0092] The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

Claims

1. Packaging system for producing pouches comprising a water-soluble film and a gel comprising a substrate treatment agent, the packaging system comprising:

- multiple moulds, each mould having a mould cavity for forming a compartment in the film, and
- a mould conveyer configured to move the moulds in a conveying direction along a mould trajectory, such as an endless mould trajectory, and wherein the moulds are moved along:

-- a film supplying device configured to position the film on the moulds,
-- a compartment forming device configured to position parts of the film in the mould cavities to form the compartments in the film,
-- a filling device comprising a gel supply and multiple gel dispensers, wherein each gel dispenser is configured to dispense the gel into an associated compartment of the film positioned in an associated mould,

each gel dispenser comprising:

- a reservoir in fluid communication with the gel supply via a gel channel,
- an integer nozzle number of nozzles, each nozzle comprising a nozzle through hole extending from the reservoir to a nozzle opening, the nozzle number being one or more,

- a pin holder arranged in the reservoir holding a pin number of pins, wherein:

  -- the pin number is equal to the nozzle number,
  -- each pin is associated with one of the nozzles,
  -- each nozzle is associated with one of the pins,
  -- the pin holder is moveable by a pin actuator from an active position into an inactive position, and vice versa,
  -- in the inactive position of the pin holder, the pins are arranged in the reservoir and the nozzle openings are in fluid communication with the reservoir,
  -- in the active position of the pin holder, each pin extends into the nozzle through hole of its associated nozzle to expel gel from the nozzle through hole.

2. Packaging system according to claim 1, the nozzle number being larger than one.

3. Packaging system according to claim 2, wherein the pins of each dispenser are held by a single shared pin holder.

4. Packaging system according to any of the preceding claims, wherein, in the active position of the pin holder, the pins extend along the complete through hole of their respective associated nozzles, the pins optionally ending flush with the nozzle openings of their respective associated nozzles.

5. Packaging system according to any of the claims 1-3, wherein, in the active position of the pin holder, the pins extend in a direction from the reservoir to their respective associated nozzle openings along the complete through hole of their respective associated nozzles, the pins optionally ending flush with the nozzle openings of their respective associated nozzles.

6. Packaging system according to any of claims 2 - 8, and in combination with claim 2, wherein:

- the nozzles are arranged in a dispensing shape,
- the nozzles are configured to dispense the gel into the associated compartment in a deposit shape,
- preferably the deposit shape and the dispensing shape are elongated.

7. Packaging system according to any of the preceding claims, comprising an upstream heating device for heating the gel between the nozzle and the gel supply to an upstream gel temperature.

8. Packaging system according to any of the preceding claims, the filling device comprising one or more fume extraction openings in fluid communication with one or more fume extraction channels for extracting fumes originating from the gel dispensed by the gel dispenser, wherein optionally the one or more fume extraction channels are heated to a temperature above a condensation temperature of the fumes.

9. Packaging system according to claim 8, the multiple gel dispensers comprising a dispenser number of gel dispensers, wherein:

- the dispenser number is an integer number of 2 or more,
- the one or more fume extraction openings are arranged between the multiple gel dispensers and above the moulds,
- a dispenser spacing between adjacent gel dispensers is the same for all adjacent dispenser pairs,
- either:

  -- the dispenser spacing between adjacent gel dispensers is an odd integer multiplied by a mould spacing of adjacent moulds and the dispenser number is even, OR
  -- the dispenser spacing between adjacent gel dispensers is an even integer multiplied by a mould spacing of adjacent moulds and the dispenser number is odd,

- preferably:

  -- the dispenser number is 2,
  -- the multiple gel dispensers comprise a first gel dispenser and a second gel dispenser,
  -- the dispenser spacing of the first gel dispenser and the second gel dispenser is equal to an odd integer multiplied by the mould spacing of adjacent moulds, more preferably three times the mould spacing of adjacent moulds.

10. Packaging system according to any of the preceding claims, comprising a walking device for moving the filling device along the mould trajectory in the conveying direction from a start position into an end position and vice versa, wherein the walking device is configured to move the filling device from the start position to the end position in a synchronised manner with the mould conveyer.

11. Packaging system according to claim 10, the packaging system also comprising the features of claim

9, wherein:

- a walking distance along the mould trajectory between the start position and the end position is less than or equal to the dispenser number multiplied by the mould spacing of adjacent moulds,
- preferably:

-- the dispenser number is 2,
-- the multiple gel dispensers comprise a first gel dispenser and a second gel dispenser,
-- the walking distance along the mould trajectory between the start position and the end position is less than or equal to double a mould spacing of adjacent moulds.

12. Packaging system according to any of claims 9 - 11, wherein:

- the dispenser number is 2,
- the multiple gel dispensers comprise a first gel dispenser and a second gel dispenser,
- the moulds on the mould conveyer comprise even moulds and odd moulds,
- the even moulds and odd moulds are arranged on the mould conveyer in an alternating fashion along the conveying direction,
- the first gel dispenser is configured to dispense gel into odd compartments of the film positioned in odd mould cavities of the odd moulds,
- the second gel dispenser is configured to dispense gel into even compartments of the film positioned in even mould cavities of the even moulds.

13. Packaging system according to claim 11 or 12, wherein:

- the dispenser number is 2,
- the multiple gel dispensers comprise a first gel dispenser and a second gel dispenser,
- the first gel dispenser is configured to, during a filling operation, dispense gel into a first associated compartment of the film positioned in a first associated mould during movement of the filling device from the start position to the end position,
- the second gel dispenser is configured to, during a filling operation, dispense gel into a second associated compartment of the film positioned in a second associated mould during movement of the filling device from the start position to the end position,
- the first gel dispenser is arranged downstream from the second gel dispenser along the conveying direction,
- exactly two intermediate moulds are arranged between the first associated mould and the second associated mould along the conveying direction,
- the two intermediate moulds comprise a first intermediate mould and a second intermediate mould, the first intermediate mould being arranged between the second intermediate mould and the first associated mould along the conveying direction and the second intermediate mould being arranged between the first intermediate mould and the second associated mould along the conveying direction,
- the first gel dispenser is configured to, during a subsequent filling operation directly following the filling operation, dispense gel into a second intermediate compartment of the film positioned in the second intermediate mould during movement of the filling device from the start position to the end position,
- the second gel dispenser is configured to, during the subsequent filling operation directly following the filling operation, dispense gel into a first further compartment of the film positioned in a first further mould during movement of the filling device from the start position to the end position, wherein the first further mould is arranged upstream from the second associated mould along the conveying direction at two mould spacings from the second associated mould,
- the second gel dispenser is configured to, during a preceding filling operation directly preceding the filling operation, dispense gel into a first intermediate compartment of the film positioned in the first intermediate mould during movement of the filling device from the start position to the end position
- the first gel dispenser is configured to, during the preceding filling operation directly preceding the filling operation, dispense gel into a second further compartment of the film positioned in a second further mould during movement of the filling device from the start position to the end position, wherein the second further mould is arranged downstream from the first associated mould along the conveying direction at two mould spacings from the first associated mould.

14. Method of producing pouches using a packaging system according to claim 13, the method comprising the steps of:

- performing a filling operation, the filling operation comprising the steps of:

-- dispensing gel from the first gel dispenser into the first associated compartment of the

film positioned in the first associated mould during movement of the filling device from the start position to the end position,

-- dispensing gel from the second gel dispenser into the second associated compartment of the film positioned in the second associated mould during movement of the filling device from the start position to the end position,

- after completing the filling operation, moving the filling device from the end position to the start position,
- after moving the filling device from the end position to the start position, performing the subsequent filling operation, the subsequent filling operation comprising the steps of:

-- dispensing gel from the first gel dispenser into the second intermediate compartment of the film positioned in the second intermediate mould during movement of the filling device from the start position to the end position,

-- dispensing gel from the second gel dispenser into the first further compartment of the film positioned in the first further mould during movement of the filling device from the start position to the end position,

- before performing the filling operation, performing the preceding filling operation, the preceding filling operation comprising the steps of:

-- dispensing gel from the second gel dispenser into the first intermediate compartment of the film positioned in the first intermediate mould during movement of the filling device form the start position to the end position,

-- dispensing gel from the first gel dispenser into the second further compartment of the film positioned in the second further mould,

- before performing the filling operation but after performing the preceding filling operation, moving the filling device from the end position to the start position,
- after performing the filling operation but before performing the subsequent filling operation, moving the filling device from the end position to the start position.

15. Method of producing pouches using a packaging system according to any of the claims 1 - 30, the method comprising the steps of:

- before dispensing gel from the nozzles, arranging the pin holder in the inactive position,
- upon stopping operation of the packaging system, arranging the pin holder in the active position, thereby pushing gel out of the nozzle using the pins.

Fig. 1

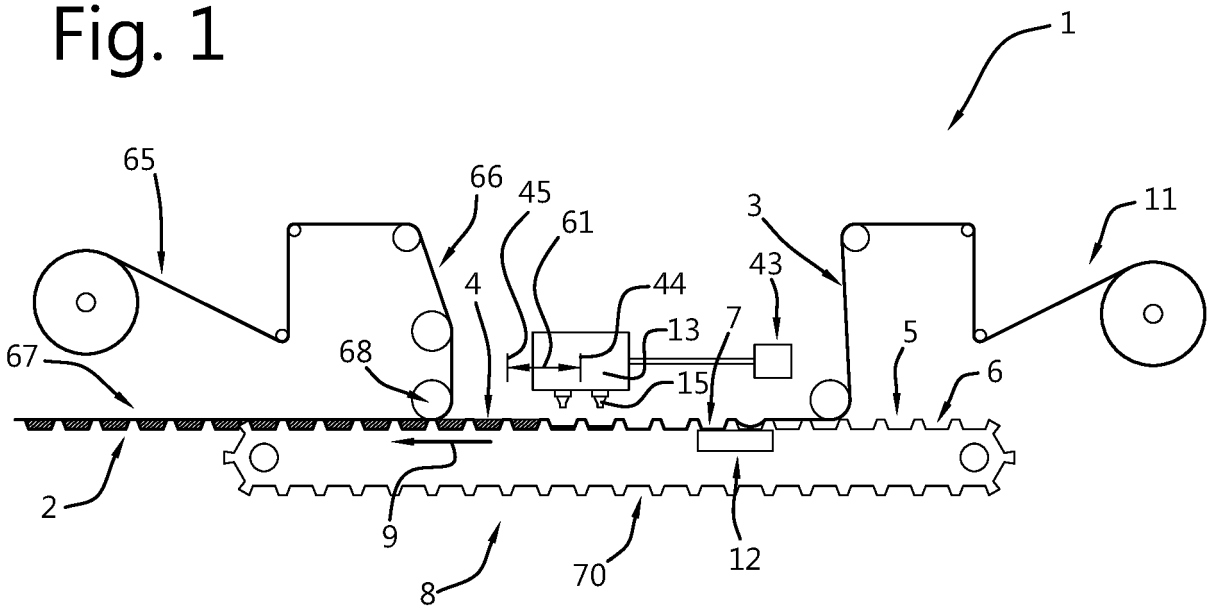

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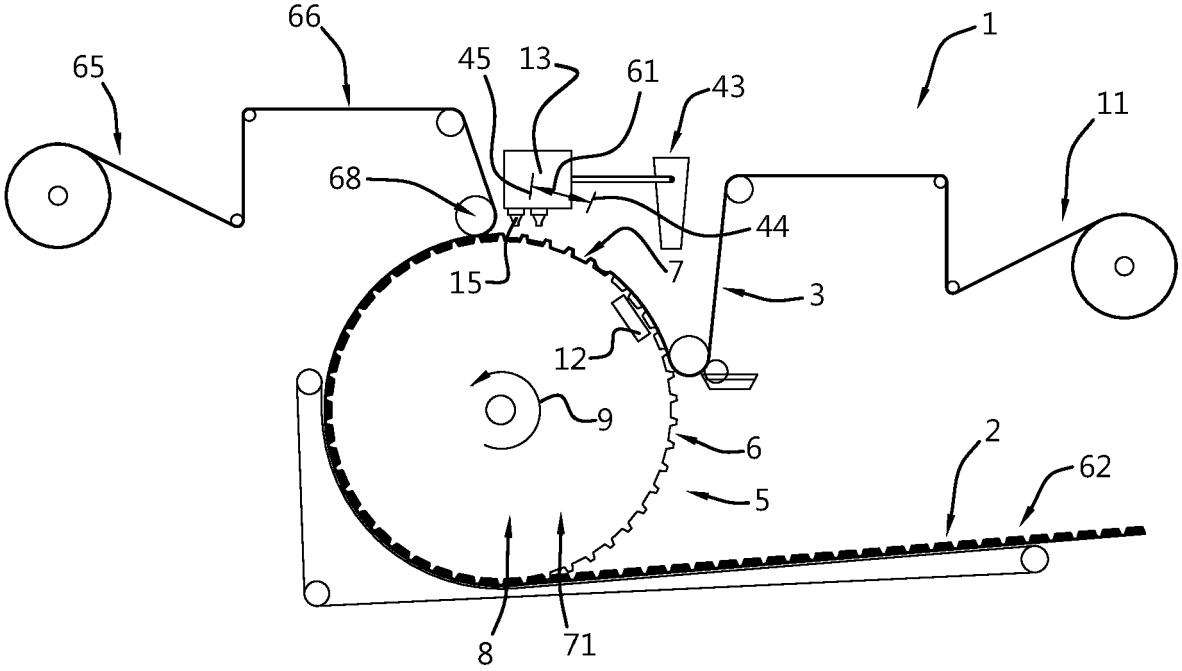
Fig. 2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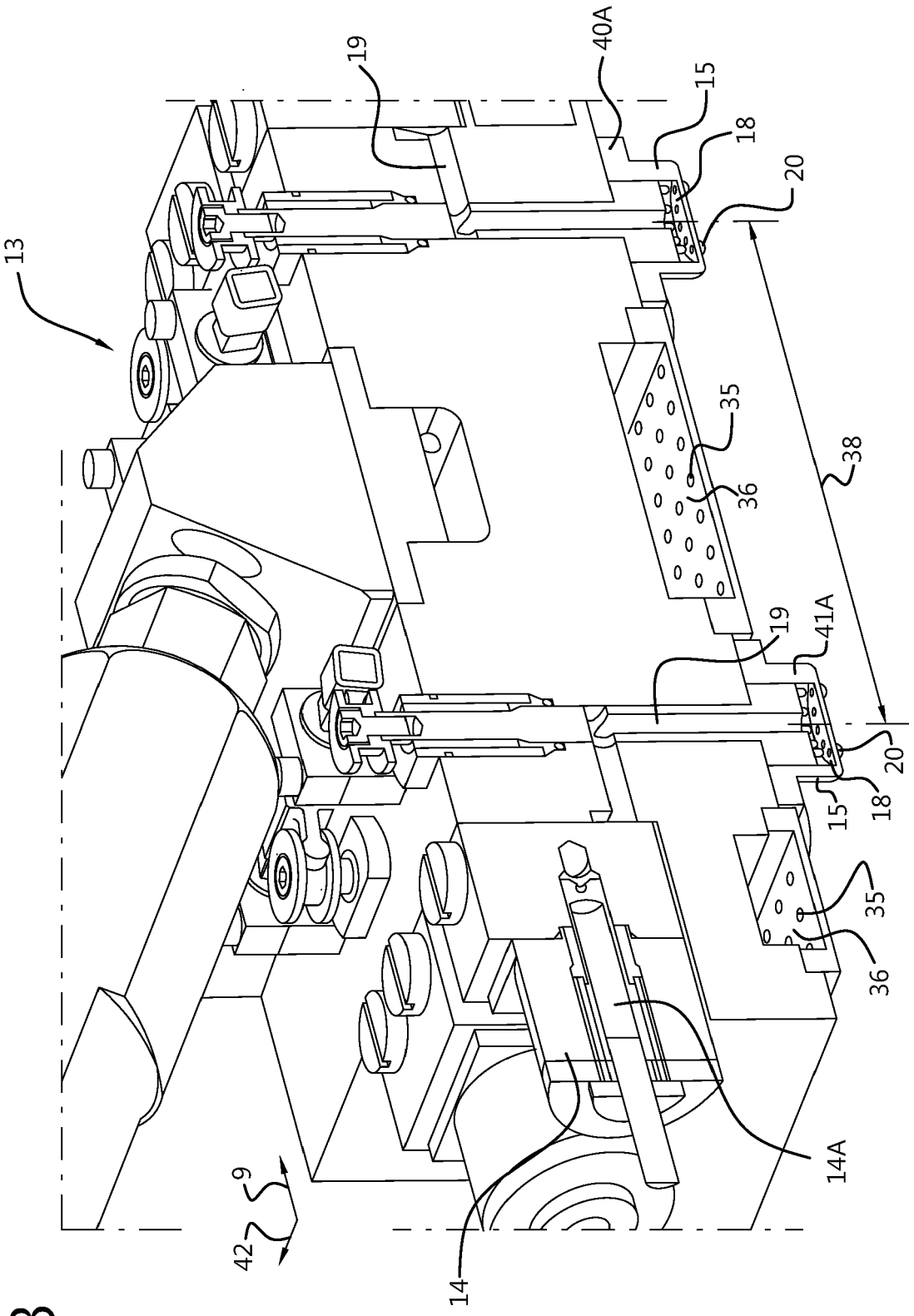

Fig. 3

Fig. 4

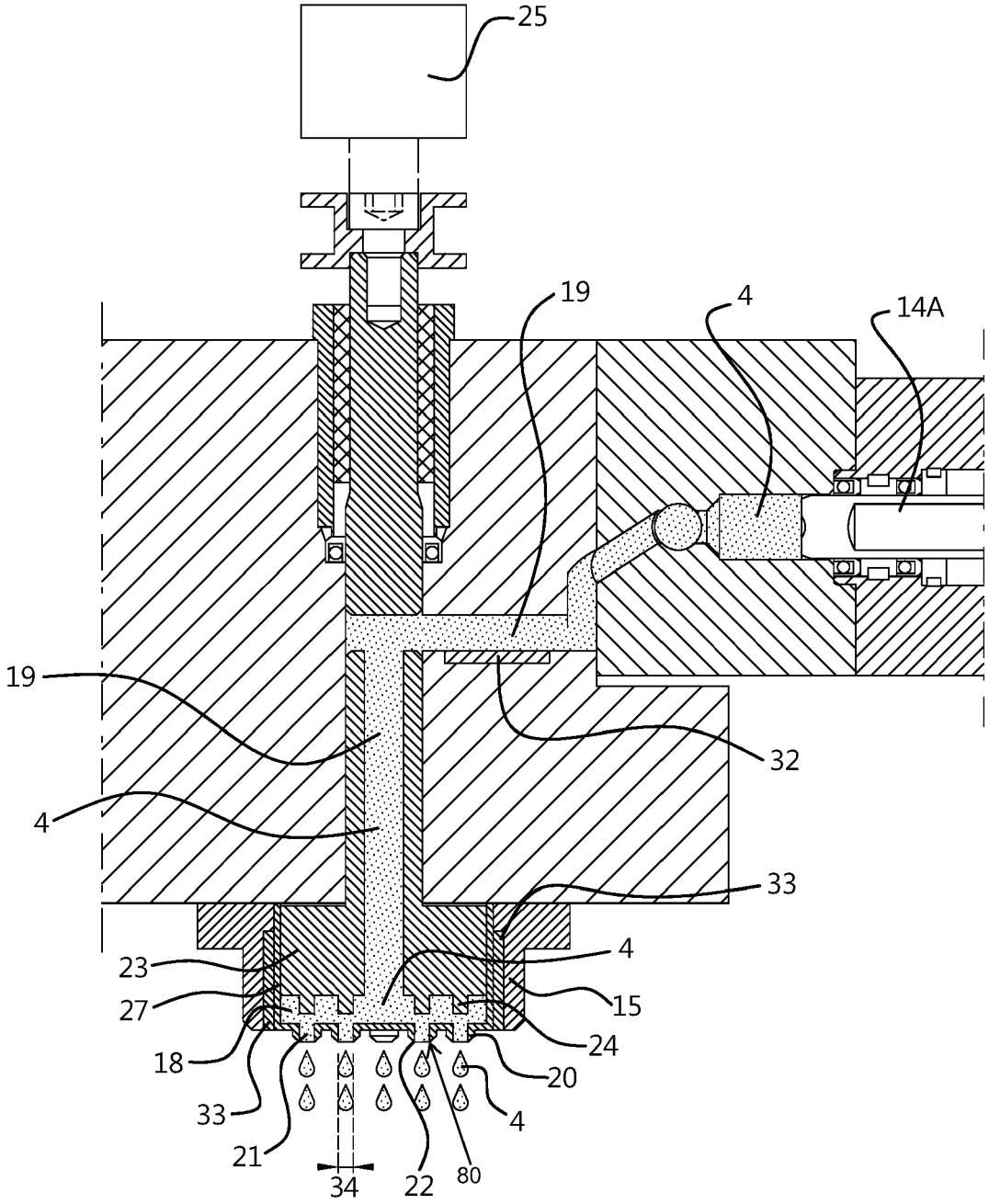

Fig. 5

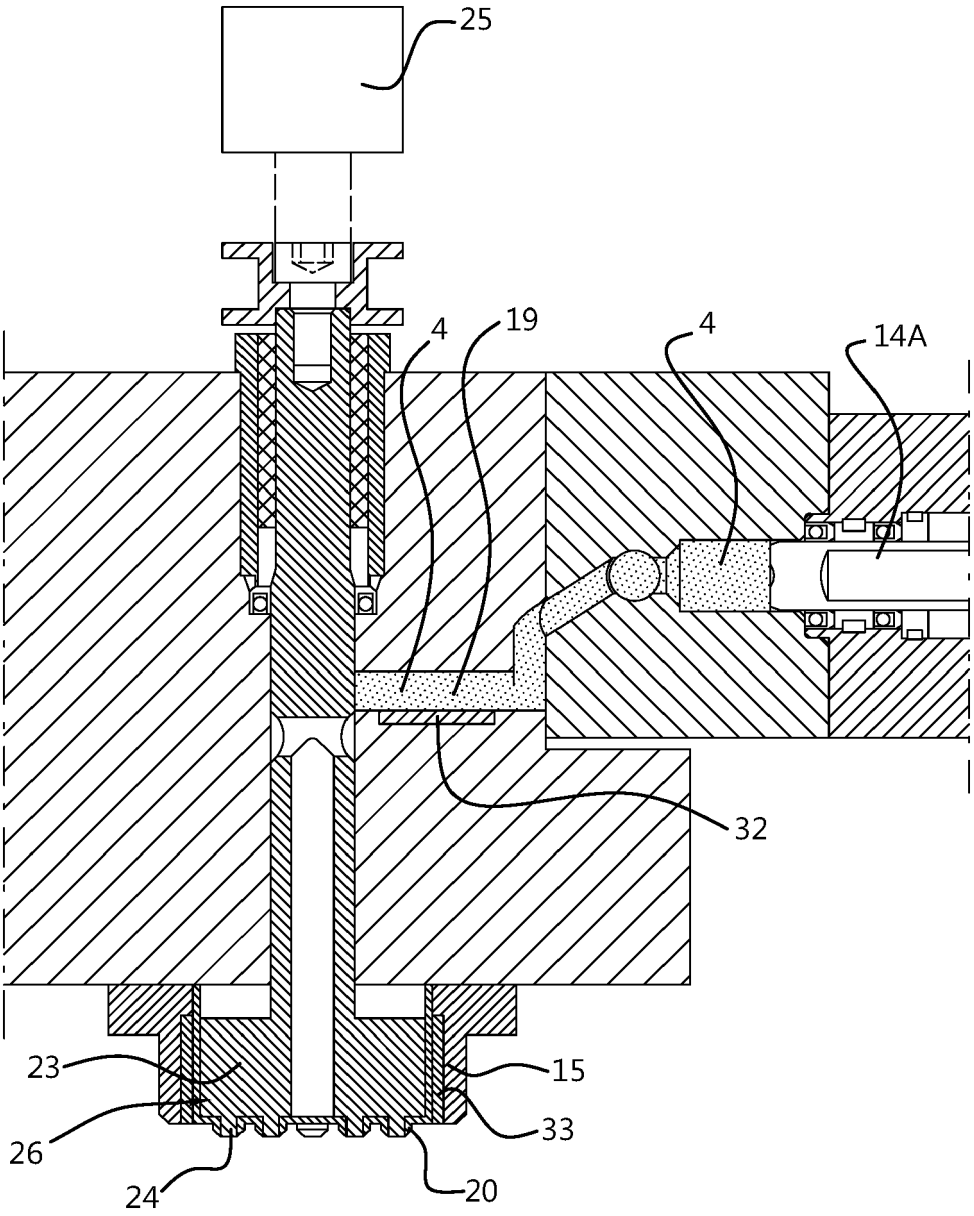

Fig. 6

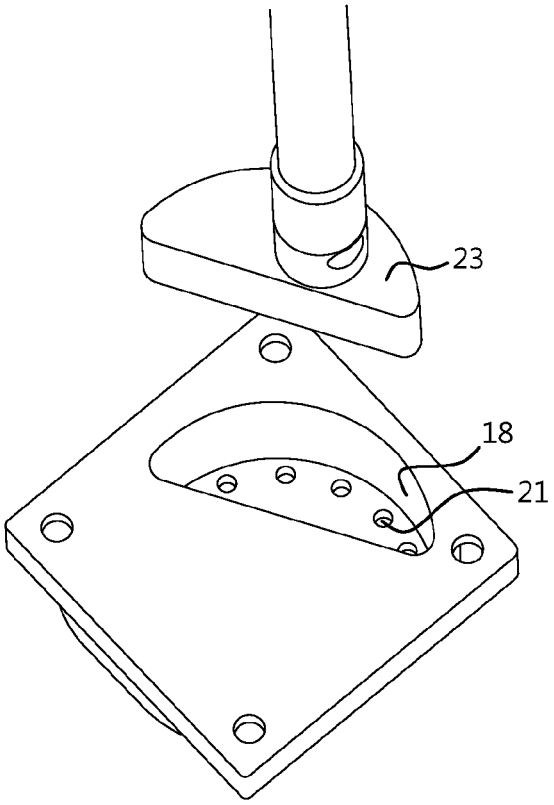
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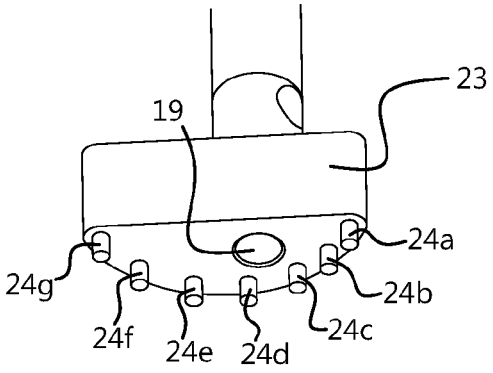
Fig. 7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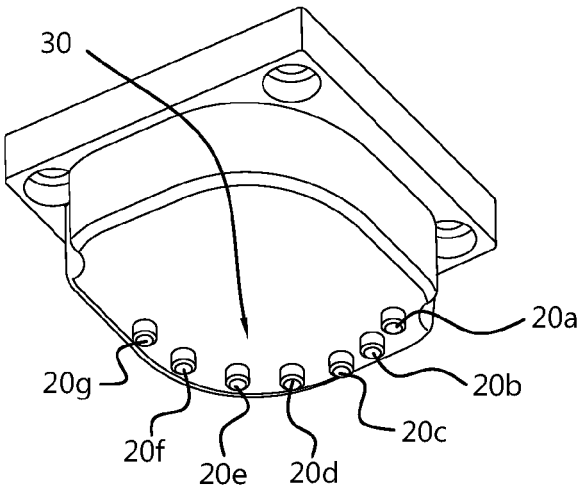
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Fig. 8

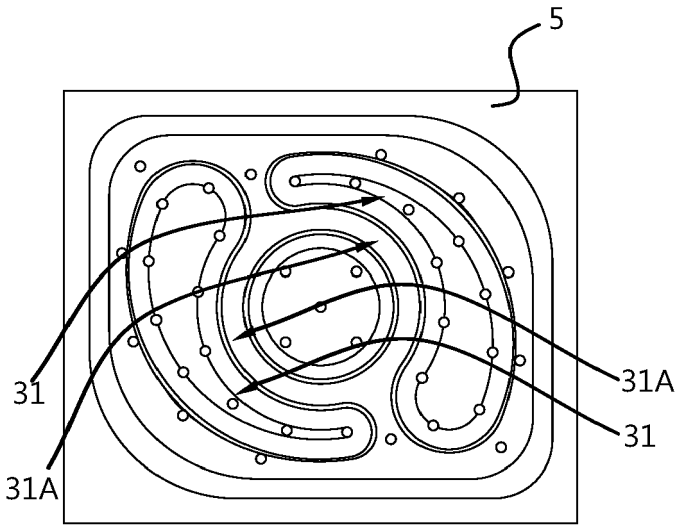

Fig. 9

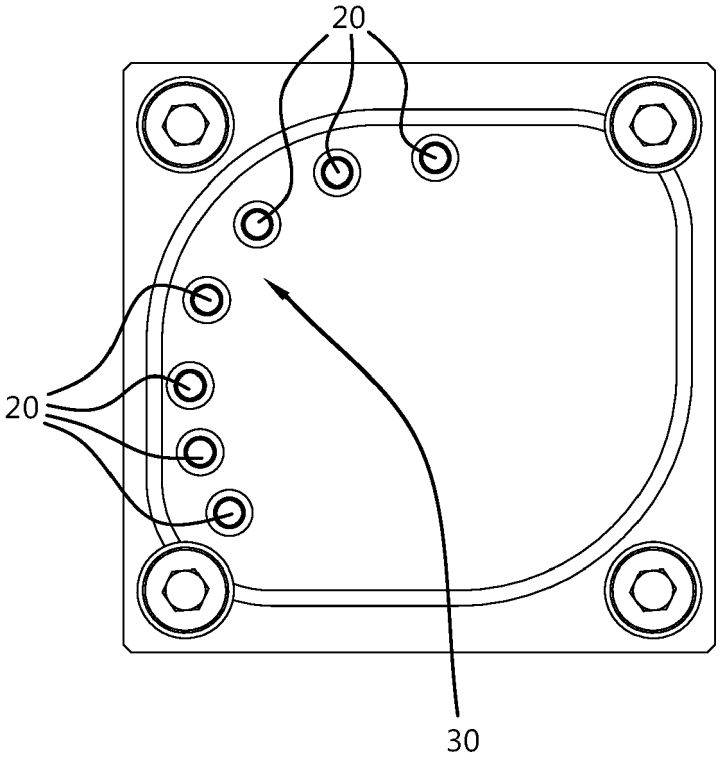

Fig. 10

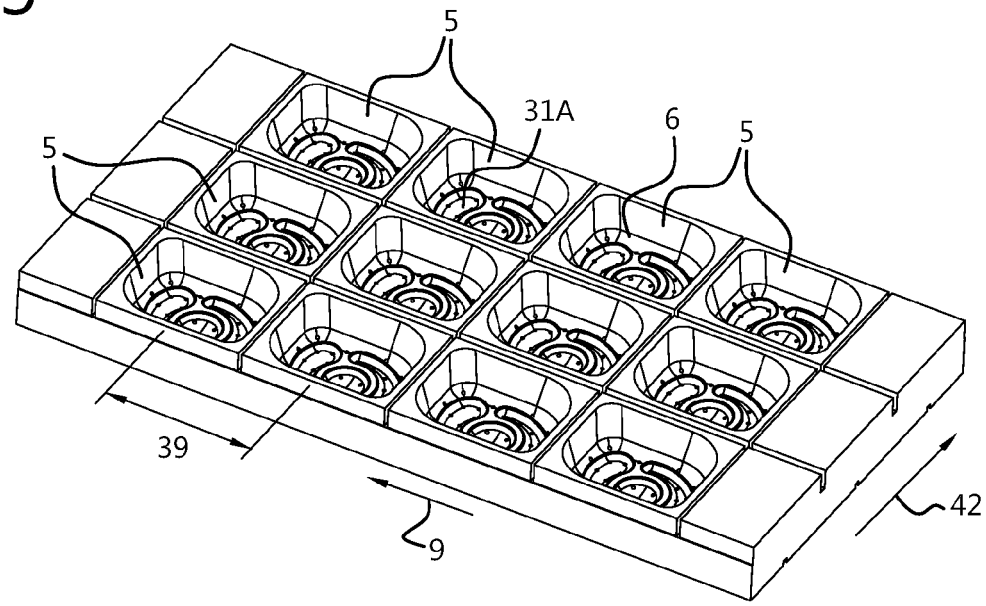
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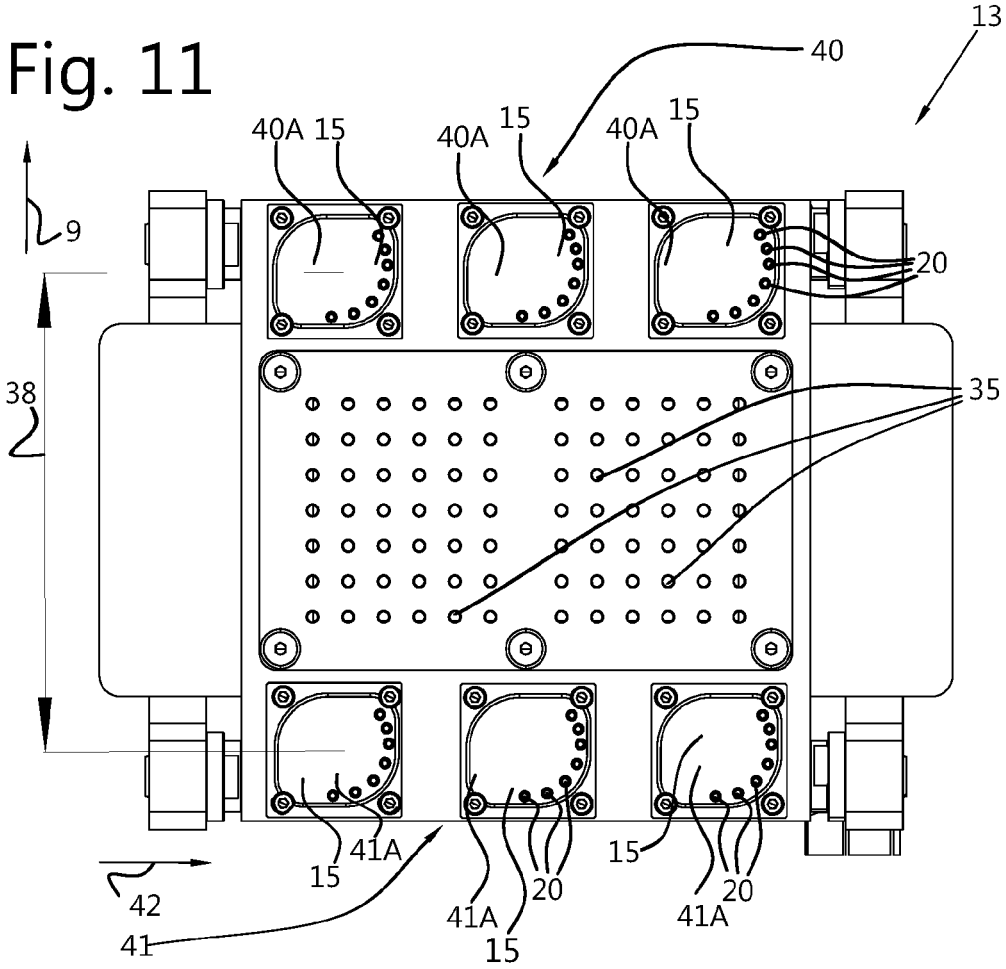
Fig. 11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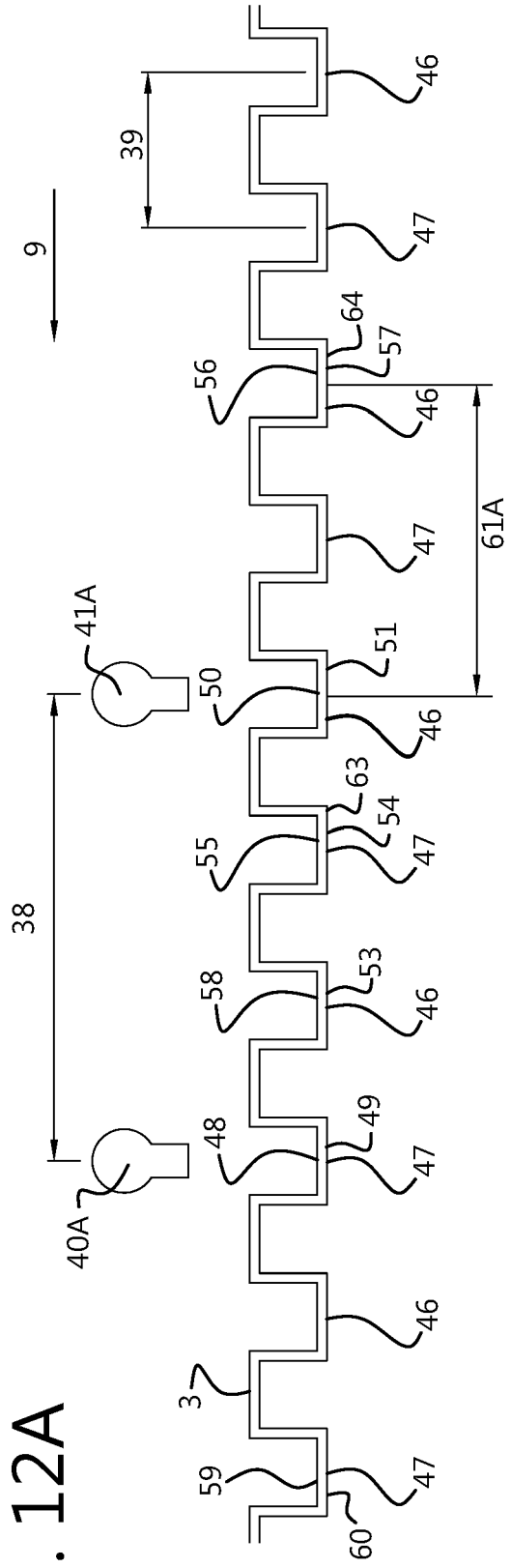

Fig. 12A

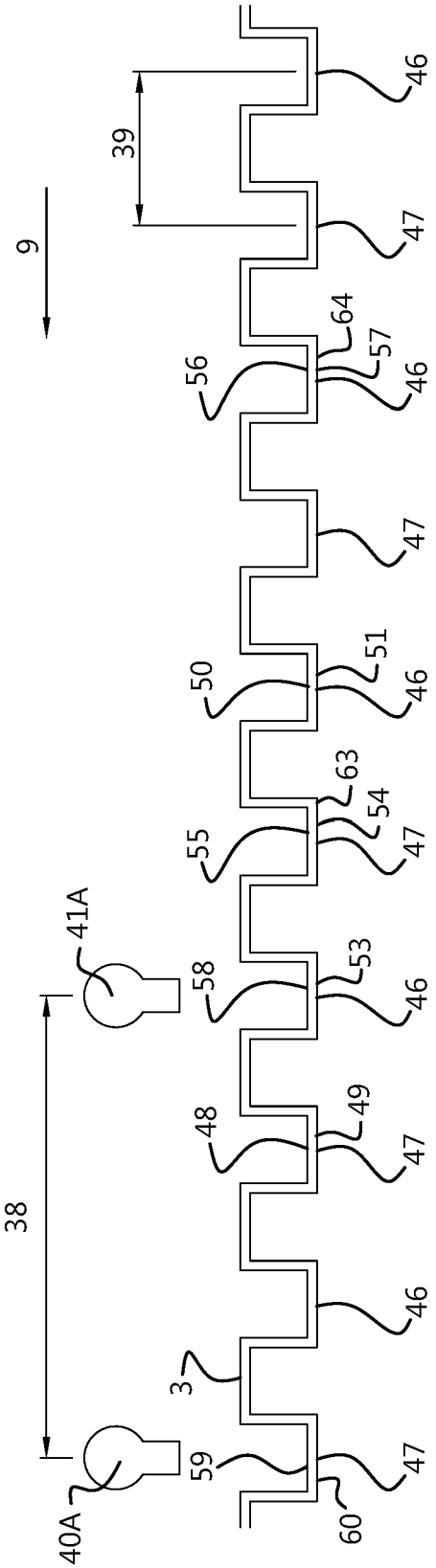

Fig. 12B

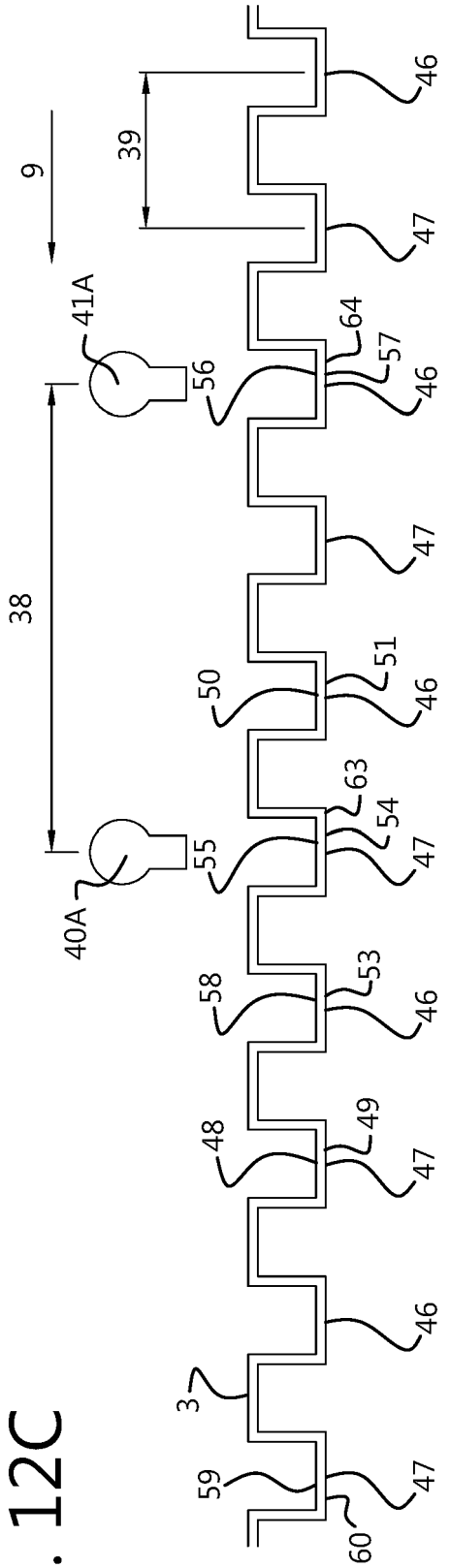

Fig. 12C