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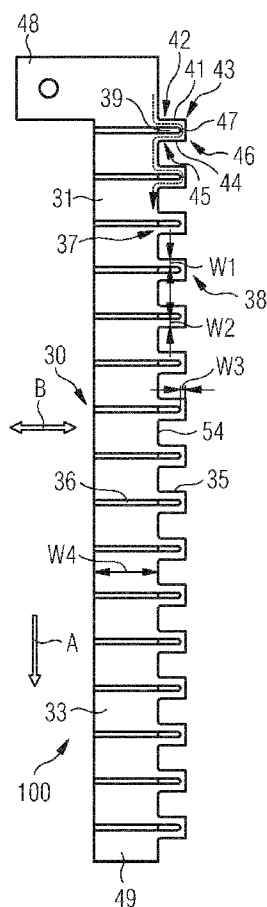
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(54) Title: INDUCTION HEATING SEALING DEVICE

FIG 5



(57) Abstract: An induction heating sealing device (30) for sealing a packaging material comprises an electrically conductive layer and advancing, in use, along a first direction (A), said induction heating sealing device (30) comprising an inductive element (100), said inductive element (100) comprising a first leg (31) and a second leg (32) extending along said first direction (A) and within which, in use, an alternate current flows, said first leg (31) having a first body (33) facing a second body (34) of said second leg (32) and at least one projection (35) laterally projecting from said first body (33) and facing, in use, an area (53) of said packaging material to be sealed and being configured to induce, in use, an eddy current within said area (53).



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INDUCTION HEATING SEALING DEVICE

Technical field

The present invention relates to an induction
5 heating sealing device, in particular an induction
heating sealing device for applying a sealing strip to a
web of packaging material for producing sealed packages
of pourable food products.

Background of Invention

10 As it is known, many food products, such as fruit
juice, pasteurized or UHT (ultra-high-temperature
treated) milk, wine, tomato sauce, etc., are sold in
packages made of sterilized packaging material.

A typical example of this type of package is the
15 parallelepiped-shaped package for liquid or pourable
food products known as Tetra Brik Aseptic (registered
trademark), which is made by folding and sealing a
laminated web of packaging material.

The packaging material has a multilayer structure
20 substantially comprising a base layer for stiffness and
strength, which may be defined by a layer of fibrous
material, e.g. paper, or mineral-filled polypropylene
material; and a number of layers of heat-seal plastic
material, e.g. polyethylene film, covering both sides of
25 the base layer.

In the case of aseptic packages for long-storage
products, such as UHT milk, the packaging material also
comprises a layer of gas- and light-barrier material,
e.g. aluminium foil or ethyl vinyl alcohol (EVOH) film,
30 which is superimposed on a layer of heat-seal plastic
material, and is in turn covered with another layer of
heat-seal plastic material forming the inner face of the
package eventually contacting the food product.

As is known, packages of this sort are produced on fully automatic packaging machines, on which a tube is formed continuously from the web-fed packaging material. More specifically, the web of packaging material is unwound off a reel and fed through an aseptic chamber of the packaging machine, where it is sterilized, e.g. by applying a sterilizing agent such as hydrogen peroxide, which is subsequently evaporated by heating, and/or by subjecting the packaging material to radiation of appropriate wavelength and intensity. The web of packaging material so sterilized is then maintained in a sterile-air environment, and is vertically fed through a number of forming assemblies which interact with the packaging material to fold it gradually from web form into a tube shape.

Afterwards, the tube is filled with the sterilized or sterile-processed food product and is sealed and cut at equally spaced cross sections into pillow-packs, which are subsequently folded mechanically to form parallelepiped packages.

Before reaching the forming assemblies, the web of packaging material is fed through an apparatus for applying a sealing strip made of heat-seal plastic material, to which the packaging material is subsequently heat sealed to form the vertical tube.

More specifically, the sealing strip is normally heat sealed to the inner heat-seal plastic material layer of the web of packaging material at a strip sealing station to which the web of packaging material, heated beforehand, and the sealing strip are fed along different paths, and where the sealing strip is pressed onto a first longitudinal edge of the web of packaging material. After application, the sealing strip has a

first portion heat sealed to the first longitudinal edge of the web, and a second portion projecting therefrom.

On interacting with the forming assemblies, the second longitudinal edge of the web is laid on the
5 outside of the first longitudinal edge with respect to the axis of the tube being formed. More specifically, the sealing strip is located entirely inside the tube, and the face of the second longitudinal edge facing the axis of the tube is superimposed partly on the second
10 portion of the sealing strip, and partly on the face of the first longitudinal edge located on the opposite side to the first portion of the sealing strip.

Packaging machines of the above type are known in which the first longitudinal edge and the second
15 longitudinal edge are heat sealed to form a longitudinal seal along the tube; more specifically, the heat-seal operation comprises a heating step to heat the second longitudinal edge without the sealing strip, and a pressure step to compress the sealing strip, the first
20 longitudinal edge and the second longitudinal edge.

The heating step melts the heat-seal plastic material layer of the second longitudinal edge, which transmits heat by conduction to the first longitudinal edge and the sealing strip, so as to melt the heat-seal
25 plastic material layer of the first longitudinal edge and the heat-seal material of the sealing strip.

During the pressure step, the sealing strip, the first longitudinal edge and the second longitudinal edge are pressed together, so that the heat-seal material of
30 the sealing strip and the heat-seal plastic material layers of the first longitudinal edge and the second longitudinal edge blend completely and form the molecular bonds defining the longitudinal seal of the

tube.

The sealing strip performs the following functions:

- to prevent the edges of the packaging material forming the longitudinal seal from absorbing the packed
5 product;
- to improve the gas barrier properties of the longitudinal seal area;
- to strengthen the longitudinal seal.

In the case of barrier material comprising a sheet
10 of electrically conductive material, e.g. aluminum, the sealing strip is sealed to the first longitudinal edge by induction heat-sealing.

More specifically, the packaging machine comprises a sealing device which faces the web of packaging
15 material.

The sealing device substantially comprises one or more inductive elements electrically fed by a high-frequency alternate current generator.

In use, the alternate current flowing inside the
20 inductive elements generates an alternate magnetic field flux that generates eddy currents in the aluminium layer to melt the heat-seal plastic material locally.

As explained above, during operation of the packaging machine the packaging material is unwound off
25 a reel to form the packages.

As shown in Figure 1, when a reel is exhausted, i.e. almost empty, a trailing edge 101 of the exhausted reel 102 is sealed to a leading edge 103 of a new reel 104, whilst the packaging material is advanced along an
30 advancing direction X. This operation can be carried out automatically, so that the packaging machine does not need to be stopped when the exhausted reel 102 is replaced with the new reel 104.

However, the region at which the trailing edge 101 of the exhausted reel 102 is sealed to the leading edge 103 of the new reel 104 defines a splice area 105 that creates a discontinuity for the eddy currents generated
5 by the inductive element in the packaging material of the exhausted reel 102 and in the packaging material of the new reel 104 during the sealing phase, as described above.

The inductive element, when heating a continuous,
10 i.e. uninterrupted, web of packaging material, generates eddy currents that are substantially parallel to the advancing direction X.

The inductive element, when heating a portion of packaging material comprising the splice area 105,
15 generates in the trailing edge 101 and in the leading edge 103 eddy currents that do not cross the splice area 105, but define a sort of curved path W. In other words, the splice area 105 creates a border effect of the eddy currents on both the overlapped edges of the splice area
20 105.

In Figure 1, the hatching illustrates the heating pattern generated by the eddy currents. The heating pattern is not uniform along the splice area, i.e. in a transversal direction T, which is perpendicular to the
25 advancing direction X. In particular, the heating pattern has a cold zone 106 positioned close to a side edge 108 of the packaging.

In particular, the temperature of the packaging material at the cold zone 106 can be not high enough to
30 provide a proper melting of the heat-seal plastic material layers and, therefore, a proper sealing.

Disclosure of Invention

An object of the invention is to improve the

induction heating sealing devices for induction heating sealing a packaging material.

Another object of the invention is to provide an induction heating sealing device which generates a more
5 uniform heating pattern - with respect to the known induction heating sealing devices - at a region of a sheet of packaging material at which a portion of the packaging material has been spliced to another portion of the packaging material.

10 According to the present invention, there is provided an induction heating sealing device as claimed in claim 1.

Brief description of the drawings

A preferred, non-limiting embodiment of the
15 invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 schematically shows a heating pattern generated by eddy currents induced by a prior-art induction heating sealing device, in the region of a
20 splice area of a packaging material, at which a trailing edge of an exhausted reel of packaging material is spliced to a leading edge of a new reel of packaging material;

Figure 2 shows a packaging machine comprising an
25 induction heating sealing device according to the invention;

Figure 3 shows a strip sealing station of the packaging machine of Figure 2

Figure 4 shows a heat-sealing station of the
30 packaging machine of Figure 2;

Figure 5 is a top view of the induction heating sealing device according to the invention;

Figure 6 is a bottom view of the induction heating

sealing device of Figure 5;

Figure 7 is a side view of the induction heating sealing device of Figure 5;

Figure 8 schematically shows a heating pattern
5 generated by eddy currents induced by the induction heating sealing device according to the invention, in the region of a splice area of a packaging material, at which a trailing edge of an exhausted reel of packaging material is spliced to a leading edge of a new reel of
10 packaging material.

Detailed description of preferred embodiments

With reference to Figure 2, there is shown a packaging machine 1 for continuously producing sealed packages 2 of a food product from a web 3 of packaging
15 material, which is unwound off a reel 4 and fed along a forming path P.

The packaging machine 1 preferably produces packages 2 of a pourable food product, such as pasteurized or UHT milk, fruit juice, wine, peas, beans,
20 etc.

The packaging machine 1 may also produce packages 2 of a food product that is pourable when producing packages 2, and sets after packages 2 are sealed. One example of such a food product is a portion of cheese,
25 which is melted when producing packages 2, and sets after packages 2 are sealed.

The packaging material has a multilayer structure substantially comprising a base layer for stiffness and strength, which may be defined by a layer of fibrous
30 material, e.g. paper, or mineral-filled polypropylene material; and a number of layers of heat-seal plastic material, e.g. polyethylene film, covering both sides of the base layer.

The packaging material also comprises a layer of gas- and light-barrier material made of electrically conductive material, e.g. aluminium foil, which is superimposed on a layer of heat-seal plastic material, and is in turn covered with another layer of heat-seal plastic material forming the inner face of the package eventually contacting the food product.

More specifically, the web 3 is fed along the forming path P by guide members 5, e.g. rollers or similar, and successively through a number of work stations, of which are shown schematically: a strip sealing station 6 for applying a sealing strip 9 (shown enlarged in thickness in Figure 4 for the sake of clarity) to the web 3, a forming station 7 for forming a tube 10 of packaging material and a heat-sealing station 8 for forming a longitudinal seal 14 along the tube 10. The longitudinal seal 14 is continuous and extends along an advancing direction V parallel to the forming path P.

The packaging machine 1 also comprises a filling device 12 for pouring the sterilized or sterile-processed food product continuously into the tube 10 of packaging material, and a jaw-type forming assembly (not shown) for gripping, sealing, and cutting the tube 10 along equally spaced cross sections to form a succession of packages 2.

More specifically, at the strip sealing station 6, a longitudinal edge 11, parallel to the forming path P, of the web 3 is first heated to melt the heat-seal plastic material layer. The web 3 has a further longitudinal edge 15 opposite to the longitudinal edge 11 and also parallel to the forming path P.

Next, a portion 16 of the sealing strip 9 is first applied to the face of the longitudinal edge 11

eventually facing inwards of the packages 2, while a further portion 17 of the sealing strip 9 projects from the longitudinal edge 11.

Finally, the sealing strip 9 is pressed onto the
5 longitudinal edge 11.

More specifically, the sealing strip 9 is made of heat-seal plastic material.

The sealing strip 9 prevents the longitudinal edge 11 from absorbing the food product once the tube 10 and the longitudinal seal 14 are formed, and also provides
10 for improving the gas-barrier performance and physical strength of the longitudinal seal 14.

With particular reference to Figure 3, the sealing strip 9 is fed within the strip sealing station 6 in an
15 first direction A along an advancing path S having a straight portion C in common with the forming path P, along which the sealing strip 9 is heat sealed under pressure to the longitudinal edge 11 forming the inner face of packages 2 eventually contacting the food
20 product.

More specifically, the advancing path S comprises, in addition to the portion C in common with the forming path P, a straight upstream portion S_1 parallel to the adjacent portion of the forming path P, and an oblique
25 portion S_2 connecting the straight upstream portion S_1 to the straight portion C.

The strip sealing station 6 comprises a pressing device 18 for pressing the sealing strip 9 onto the web 3 and defining the straight portion C of the advancing
30 path S, and an induction heating sealing device 30 for heating the sealing strip 9 along the advancing path S upstream from the pressing device 18.

The pressing device 18 comprises a first pressure

roller 19, having a first axis D, and a second pressure roller 20, having a second axis E parallel to the first axis D.

The first pressure roller 19 and the second pressure roller 20 rotates in opposite directions, and are located adjacent to each other to define a small-section passage through which the sealing strip 9 and a portion 53 of the web 3 containing the longitudinal edge 11 are rolled simultaneously. In particular, the first axis D and the second axis E are parallel to the web 3 and perpendicular to the straight portion C and to the travelling direction of the web 3 and the sealing strip 9 through the first roller 19 and the second roller 20.

In the embodiment shown, the sealing strip 9 extends about the second pressure roller 20 and about a guide roller 28 having an axis G parallel to the first axis D and the second axis E and located at the junction of the straight upstream portion S_1 and the oblique portion S_2 .

The induction heating sealing device 30 comprises a an inductive element 100 having a first leg 31 extending along the first direction A (and along the forming path P) and a second leg 32 extending along the first direction A (and along the forming path P).

The first leg 31 has a first body 33 facing a second body 34 of the second leg 32 and at least one projection 35 laterally projecting from the first body 33.

The first leg 31 comprises at least one slit 36 extending through the first body 33.

The at least one slit 36 is arranged in a second direction B transversal to the first direction A. In the embodiment shown, the second direction B is

perpendicular to the first direction A.

The at least one slit 36 also partly extends through the at least one projection 35.

The at least one projection 35 comprises a first
5 portion 41 transversal to the first direction A and
having a first end 42 connected to the first body 33 and
a second end 43 opposite to the first end 42. The first
portion 41 projects from an edge 54 of the first body
33. In the embodiment shown, the first portion 41
10 extends along the second direction B.

The at least one projection 35 comprises a second
portion 44 transversal to the first direction A and
having a further first end 45 connected to the first
body 33 and a further second end 46 opposite to the
15 further first end 45. The second portion 44 projects
from the edge 54 of the first body 33. In the embodiment
shown, the second portion 44 extends along the second
direction B.

The at least one projection 35 comprises a third
20 portion 47 transversal to the first portion 41 and the
second portion 44. The third portion 47 connects the
second end 43 and the further second end 46. In the
embodiment shown, the third portion 47 extends along the
second direction B.

25 The first portion 41, the second portion 44 and the
third portion 47 are arranged on three sides of a
portion 39 of the slit 36 that extends in the at least
one projection 35.

In this way, the at least one projection 35 is C-
30 shaped, with a concave part 37 of the C-shape directed
towards the first body 33 and a convex part 38 of the C-
shape protruding away from the first body 33.

In the embodiment shown, the first leg 31 comprises

a plurality of projections 35 and a plurality of slits 36 arranged so that the first leg 31 has a sealing part 40 - intended to interact with the packaging material to heat the packaging material - which has a polygonal shape.

The polygonal shape is defined by a plurality of straight segments defined by the first portions 41, the second portions 44 and the third portions 47.

The sealing part 40, therefore, has the general shape of a battlement having a plurality of merlons defined by the first portions 41, the second portions 44 and the third portions 47.

The first portion 41 has a first width $W1$ measured along the first direction A.

The second portion 44 has a second width $W2$ measured along the first direction A.

The third portion 47 has a third width $W3$ measured along the second direction B.

The first leg 32 has a width $W4$ measured along the second direction B.

The second leg 32 has a further width $W5$ measured along the second direction B.

In the embodiment shown, the width $W4$ is greater than the first width $W1$, the second width $W2$ and the third width $W3$.

In the embodiment shown, the further width $W5$ is greater than the first width $W1$, the second width $W2$ and the third width $W3$.

In the embodiment shown, the first width $W1$, the second width $W2$ and the third width $W3$ are equal to each other.

In the embodiment shown, the width $W4$ is equal to the further width $W5$.

The first body 33 and the second body 34 are made of electrically conductive material and define an electric circuit within which an alternate current - generated by a high-frequency alternate current generator (not shown) - flows, in use.

In particular, the first body 33 comprises a first end zone 48 intended to be connected to the high-frequency alternate current generator and a second end zone 49 opposite to the first end zone 48. The second body 34 comprises a further first end zone 50 intended to be connected to the high-frequency alternate current generator and a further second end zone 51 opposite to the further first end zone 50.

The second end zone 49 is electrically connected to the further second end zone 51.

The first body 33 and the second body 34 faces one another and an electrically insulating layer 52 is interposed between the first body 33 and the second body 34.

In the embodiment shown, the first leg 31 and the second leg 32 are made of metal plates having substantially the same shape and differing from each other in that the first body 33 is crossed by a plurality of slits 36, extending in the second direction B, and the first leg 31 comprises a plurality of projections 35 that protrude from the first body 33 and are not superimposed to the second body 34.

When the induction heating sealing device is connected to the high-frequency alternate current generator, the alternate current flows in the first leg 31 and - due to the slits 35 that crosses the first body 33 - passes through the first portions 41, the second portions 44 and the third portions 47. Then, since the

second end zone 49 is connected to the further end zone 51, the alternate current flows through the second body 34.

5 The projections 35, i.e. the sealing part 40 of the first leg 31, faces, in use, the area 53 of the packaging material, which comprises the longitudinal edge 11.

10 The first body 33 and the second body 34 do not face, in use, the packaging material, but are arranged on one side of - at a distance from - the packaging material.

15 The first leg 31 and the second leg 32, and therefore the first body 33 and the second body 34, are arranged on the same side of the packaging material. In other words, at the strip sealing station 8, the packaging material defines a plane and the first leg 32 and the second leg 32 are arranged on the same side with respect to such plane.

20 The alternate current that flows inside the second leg 31, i.e. inside the projections 35, generates an eddy current in the aluminium layer that - when the packaging material is advanced along the first direction A - is strong enough to melt the heat-seal plastic material layer at the area 53.

25 The alternate current that flows inside the second leg 32 does not generate any eddy current in the aluminium layer since the second leg does not face - and is at a distance from - the packaging material.

30 In other words, the projection 35 - and the portion of the first body 33 connecting the projections 35 to each other - act as an active branch (i.e. capable of melting the polyethylene layer) of the electric circuit of the induction heating device 30, whilst the second

leg 32 simply acts as a return branch of the electric circuit of the induction heating device 30.

In Figure 8, the hatching illustrates the heating pattern generated by the induction heating sealing
5 device 30 at a splice area 205, i.e. a region at which a trailing edge 201 of an exhausted reel 4a of packaging material is sealed to a leading edge 203 of a new reel 4b of packaging material.

The eddy currents describe a closed loop around
10 each of the projections 35.

In this way, the eddy currents are mainly perpendicular to the first direction A and substantially parallel to the splice area 205. Due to this, very small or negligible border effects are produced.

15 The heating pattern generated by the induction heating sealing device 30, therefore, is substantially uniform both along the first direction A and the second direction B. In particular, the heating pattern does not comprise a cold zone.

20 The forming station 7 comprises a number of forming assemblies 13 arranged successively along the forming path P, and which interact gradually with the web 3 to fold it into the form of the tube 10.

More specifically, the forming assemblies 13
25 comprise a plurality of rollers defining respective compulsory passages for the packaging material. The respective sections of the compulsory passages vary gradually from a C shape to a substantially circular shape.

30 More specifically, the axes of the rollers in each forming assembly 13 lie in a plane that is arranged transversally - perpendicularly in the embodiment shown - to the forming path P.

The forming assemblies 13 gradually form the tube 10, so that the further longitudinal edge 15 is located outwards of the longitudinal edge 11 with respect to the axis of the tube 10. More specifically, when forming the
5 tube 10, the sealing strip 9 is located inside the tube 10, and the inner face of the further longitudinal edge 15 is superimposed partly on the further portion 17 of the sealing strip 9, and partly on the outer face of the longitudinal edge 11 (Figure 4).

10 The heat-sealing station 8 comprises a sealing device (not shown) for heating the further longitudinal edge 15 and locally melting the heat-seal plastic material layer of the further longitudinal edge 15. Heat is transmitted by conduction from the further
15 longitudinal edge 15 to the longitudinal edge 11 and the sealing strip 9, so as to locally melt the heat-seal plastic material layer of the longitudinal edge 11 and the heat-seal material of the sealing strip 9.

The heat-sealing station 8 also comprises a number
20 of forming rollers 21 defining a compulsory circular passage for the tube 10; and one or more pressure rollers 22 for pressing the further portion 17 of the sealing strip 9, and the portion 16 of the sealing strip 9 and the longitudinal edge 11 onto the face of the
25 further longitudinal edge 15 inside the tube 10, so that the heat-seal plastic material layers of the longitudinal edge 11 and the further longitudinal edge 15 and the heat-seal material of the sealing strip 9 blend completely to form the molecular bonds defining
30 the longitudinal seal 14 of the tube 10.

More specifically, the rollers 21 are located outside the tube 10, and the pressure rollers 22 inside the tube 10.

The heat-sealing station 8 also comprises an annular support 29 which surrounds the tube 10 and supports the rollers 21.

During operation of the packaging machine 1 the web 3 is unwound off the reel 4 and fed along path P.

More specifically, the web 3 is fed by the guide members 5 along the path P and, in succession, through the strip sealing station 6, the forming station 7 and the heat-sealing station 8.

At the strip sealing station 6, the longitudinal edge 11 is heated by the induction heating sealing device 30, and - by means of the pressing device 18 - the portion 16 of the sealing strip 9 is applied to the face of the longitudinal edge 11 eventually facing inwards of the packages 2. Once the portion 16 is applied to the longitudinal edge 11 the further portion 17 projects from the longitudinal edge 11.

In particular, the alternate current flowing in the projections 35 generates an eddy current in the packaging material forming the longitudinal edge 11. This eddy current results, in turn, in the heating of the longitudinal edge 11.

Subsequently, the longitudinal edge 11 and the sealing strip 9 are compressed between the first pressure roller 19 and the second pressure roller 20 to blend the heat-seal plastic material layer of the longitudinal edge 11 and the heat-seal material of the sealing strip 9, and so form the molecular bonds.

Next, the web 3 interacts gradually with the forming assemblies 13, and is folded to superimpose the longitudinal edge 11 and the further longitudinal edge 15 and form the tube 10 not yet sealed longitudinally.

More specifically, the forming assemblies 13 fold

the web 3 so that the sealing strip 9 is located inside the as yet unsealed tube 10, the further longitudinal edge 15 is located radially outwards of the longitudinal edge 11 and the further portion 17 with respect to the axis of the tube 10 still to be sealed longitudinally, and the longitudinal edge 11 is located radially outwards of the portion 16.

The seal 14 is formed, in the heat-sealing station 8, by sealing to the inner face of the further longitudinal edge 15 the further portion 17 and the face of the longitudinal edge 11 on the opposite side to the portion 16.

More precisely, there is provided a sealing device (not shown) that heats the further longitudinal edge 15 to melt the heat-seal plastic material layer. Heat is transmitted by conduction from the further longitudinal edge 15 to the longitudinal edge 11 and the sealing strip 9 to melt the polyethylene layer of the longitudinal edge 11 and the heat-seal material of the sealing strip.

The longitudinally sealed tube 10 is filled continuously with the pourable food product by the filling device 12, and is then fed through a jaw-type forming assembly (not shown) where it is gripped, sealed, and cut along equally spaced cross sections to form a succession of packages 2.

The advantages of the induction heating sealing device 30 according to the invention will be clear from the foregoing description.

In particular, the projections 35 define a plurality, or an array, of one-turn inductive elements electrically connected in series to each other by the first body 33 (which acts as a bus bar) facing the

second body 34 (which acts as a return conductor).

The eddy currents are generated in the packaging material substantially only by the first body 33 (especially by the projections 35) and not by the second
5 body 34.

In this way, the eddy currents are essentially perpendicular to the advancing direction of the packaging material and perpendicular to the splice area. The discontinuity formed by the splice area is,
10 therefore, negligible and the heating pattern generated by the eddy currents is rather uniform, and definitely more uniform than the heating pattern obtained with the known induction heating sealing devices.

In this way, the risk that the heat-seal plastic
15 material layer is not properly melt by the eddy currents - and therefore the sealing strip is not properly sealed to the packaging material - is highly reduced with respect to the known induction heating sealing devices.

Clearly, changes may be made to induction heating
20 sealing device as described and illustrated herein without, however, departing from the scope of the present invention as defined in the accompanying claims.

In particular, the induction heating sealing device according to the invention could be used not only in the
25 strip sealing station 6 to seal the sealing strip 9 to the longitudinal edge 11, but also in the heat-sealing station 8 to seal the further longitudinal edge 15 to the longitudinal edge 11 and to the sealing strip 9, so as to form the closed tube 10.

CLAIMS

1. An induction heating sealing device (30) for sealing a packaging material comprising an electrically conductive layer and advancing, in use, along a first direction (A), said induction heating sealing device (30) comprising an inductive element (100), said inductive element (100) comprising a first leg (31) and a second leg (32) extending along said first direction (A) and within which, in use, an alternate current flows, said first leg (31) having a first body (33) facing a second body (34) of said second leg (32) and at least one projection (35) laterally projecting from said first body (33) and facing, in use, an area (53) of said packaging material to be sealed and being configured to induce, in use, an eddy current within said area (53).
2. An induction heating sealing device according to claim 1, wherein said first leg (31) further comprises at least one slit (36) extending through said first body (33).
3. An induction heating sealing device according to claim 2, wherein said at least one slit (36) is arranged in a second direction (B) transversal to said first direction (A).
4. An induction heating sealing device according to claim 3, wherein said second direction (B) is perpendicular to said first direction (A).
5. An induction heating sealing device according to any one of claims 2 to 4, wherein said at least one slit (36) partly extends through said at least one projection (35).
6. An induction heating sealing device according to

any one of claims 3 to 5, wherein said at least one projection (35) comprises a first portion (41) transversal to said first direction (A) and having a first end (42) connected to said first body (33) and a second end (43) opposite to said first end 42, wherein said at least one projection (35) further comprises a second portion (44) transversal to said first direction (A) and having a further first end (45) connected to said first body (33) and a further second end (46) opposite to said further first end (45), and wherein said at least one projection (35) comprises a third portion (47) transversal to said first portion (41) and said second portion (44), said third portion (47) connecting said second end (43) and said further second end (46).

7. An induction heating sealing device according to claim 6, wherein said first portion (41) and said second portion (44) extend along said second direction (B), and wherein said third portion (47) extends along said first direction (A).

8. An induction heating sealing device according to claim 7, wherein said first portion (41), said second portion (44) and said third portion (47) are arranged on three sides of a portion (39) of said slit (36) that extends in said at least one projection (35), so that said at least one projection (35) is C-shaped with a concave part (37) of the C-shape directed towards said first body (33) and a convex part (38) of the C-shape projecting away from said first body (33).

9. An induction heating sealing device according to any one of claims 2 to 8, wherein said first leg

(31) comprises a plurality of projections (35) and a plurality of slits (36) arranged so that said first leg (31) has a sealing part (40), intended to interact with said packaging material to heat said packaging material, which has a polygonal shape.

5 10. An induction heating sealing device according to claim 9, as appended to any one of claims 6 to 8, wherein said polygonal shape is formed by a plurality of straight segments defined by said first portions (41), said second portions (44) and
10 said third portions (47).

11. An induction heating sealing device according to claim 9, or 10, wherein said first body (33) and said second body (34) are made of electrically
15 conductive material and define an electric circuit within which an alternate current flows, in use, and wherein said first body (33) and said second body (34) face one another and an electrically insulating layer (52) is interposed between said
20 first body (33) and said second body (34), said projections (35) extending from a side edge (54) of said first body (33) and being not superimposed to said second body (34).

12. An induction heating sealing device according to
25 claim 11, wherein said projections (35) define an array of one-turn inductive elements extending along said first direction (A) and electrically connected in series to each other by said first body (33), which acts as a bus bar, said first body
30 (33) facing said second body (34), which acts as a return conductor.

13. An induction heating sealing device according to claim 11, or, 12 wherein said at least one

projection (35) faces, in use, said area (53), and wherein said second body (34) do not face, in use, said packaging material, said second body (34) being arranged on one side of, and at a distance from, said packaging material.

- 5
14. An induction heating sealing device according to any one of claims 11 to 13, wherein said projections (35) act, in use, as an active branch of said electric circuit capable of generating eddy currents in said packaging material, whilst said
- 10
- second leg (32) acts, in use, as a return branch of said electric circuit.
15. An induction heating sealing device according to any one of claims 11 to 14, wherein said first body
- 15
- (33) comprises a first end zone (48) intended to be connected to a high-frequency alternate current generator and a second end zone (49) opposite to said first end zone (48), wherein said second body
- (34) comprises a further first end zone (50)
- 20
- intended to be connected to said high-frequency alternate current generator and a further second end zone (51) opposite to said further first end zone (50), said second end zone (49) being electrically connected to said further second end
- 25
- zone (51).
16. An induction heating sealing device according to any one of the preceding claims, wherein said first leg (31) and said second leg (32) are arranged on the same side with respect to a plane defined by
- 30
- said packaging material.

FIG 1

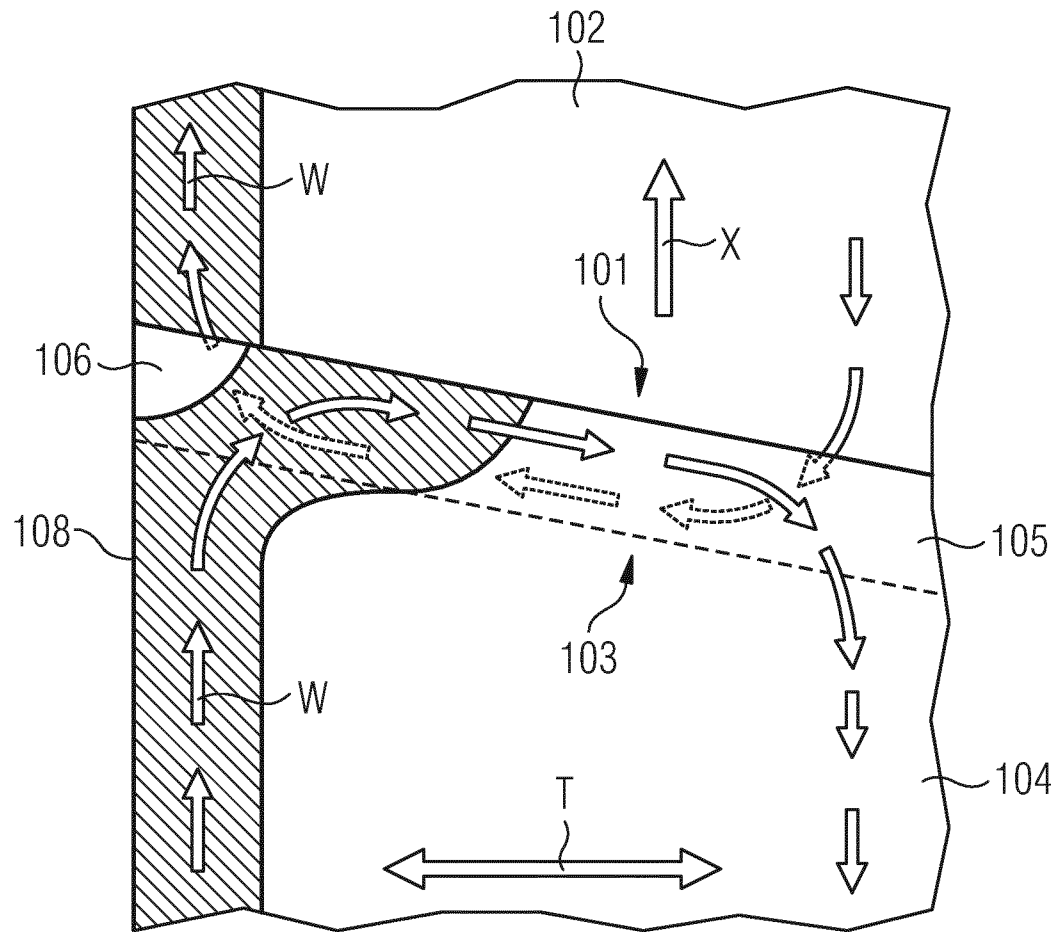


FIG 2

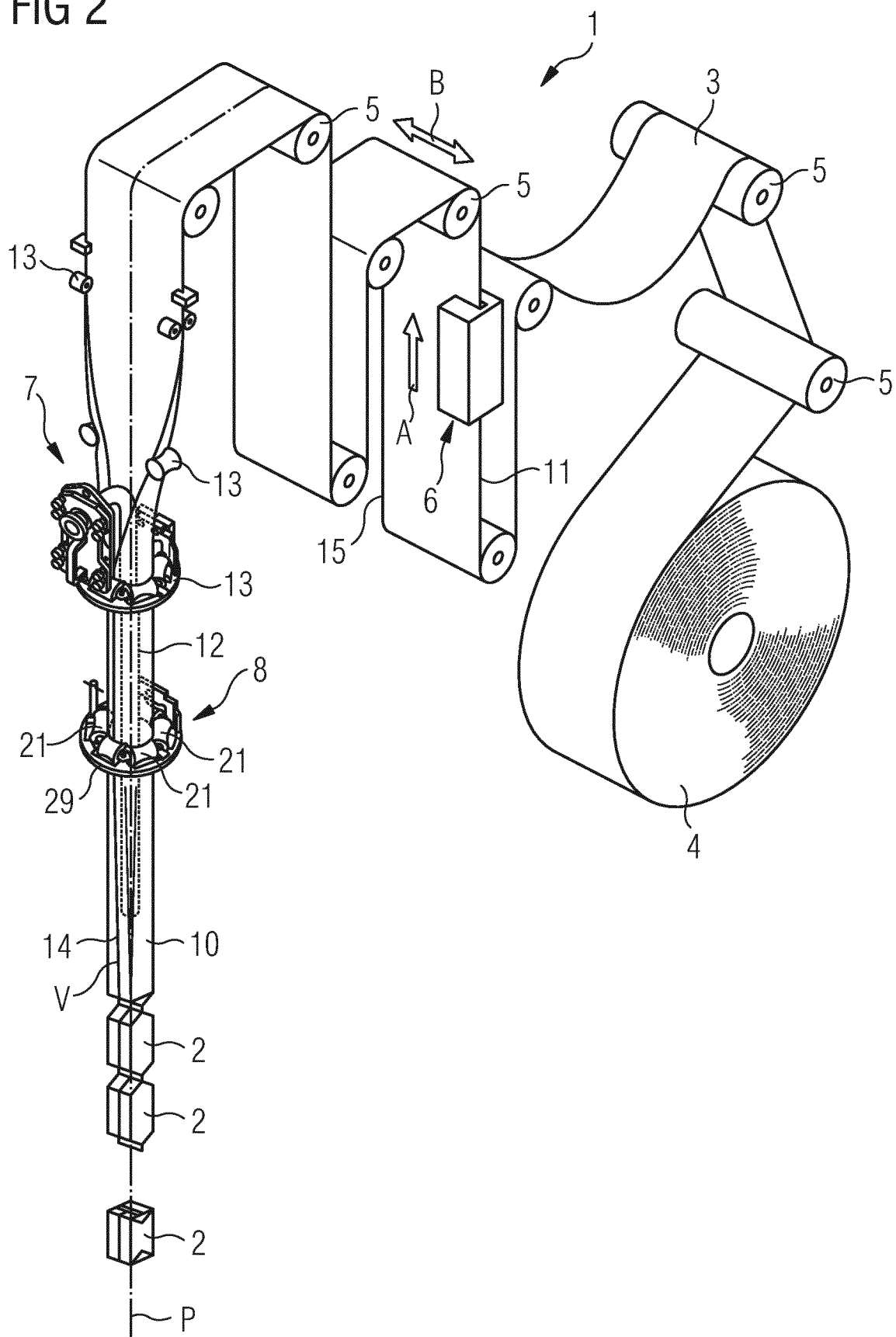
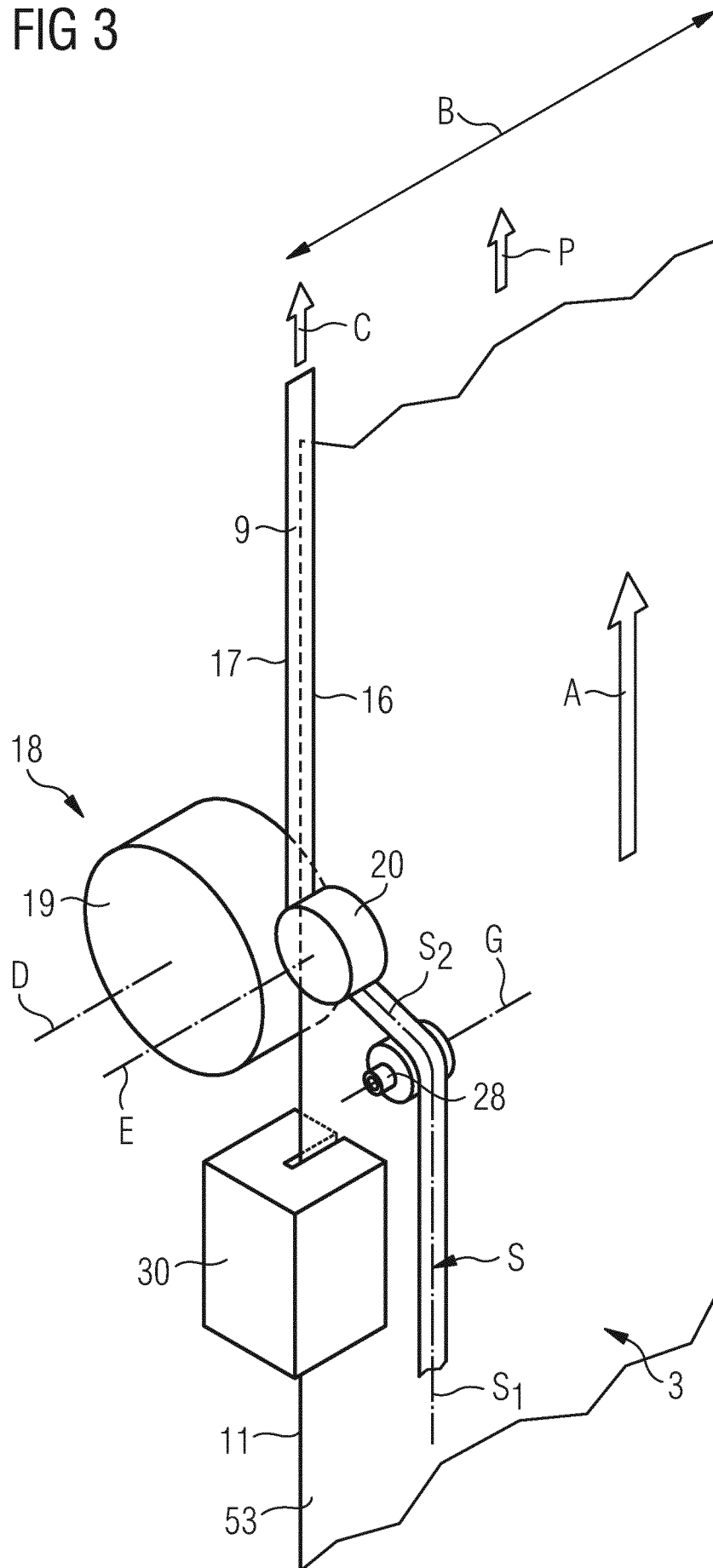


FIG 3



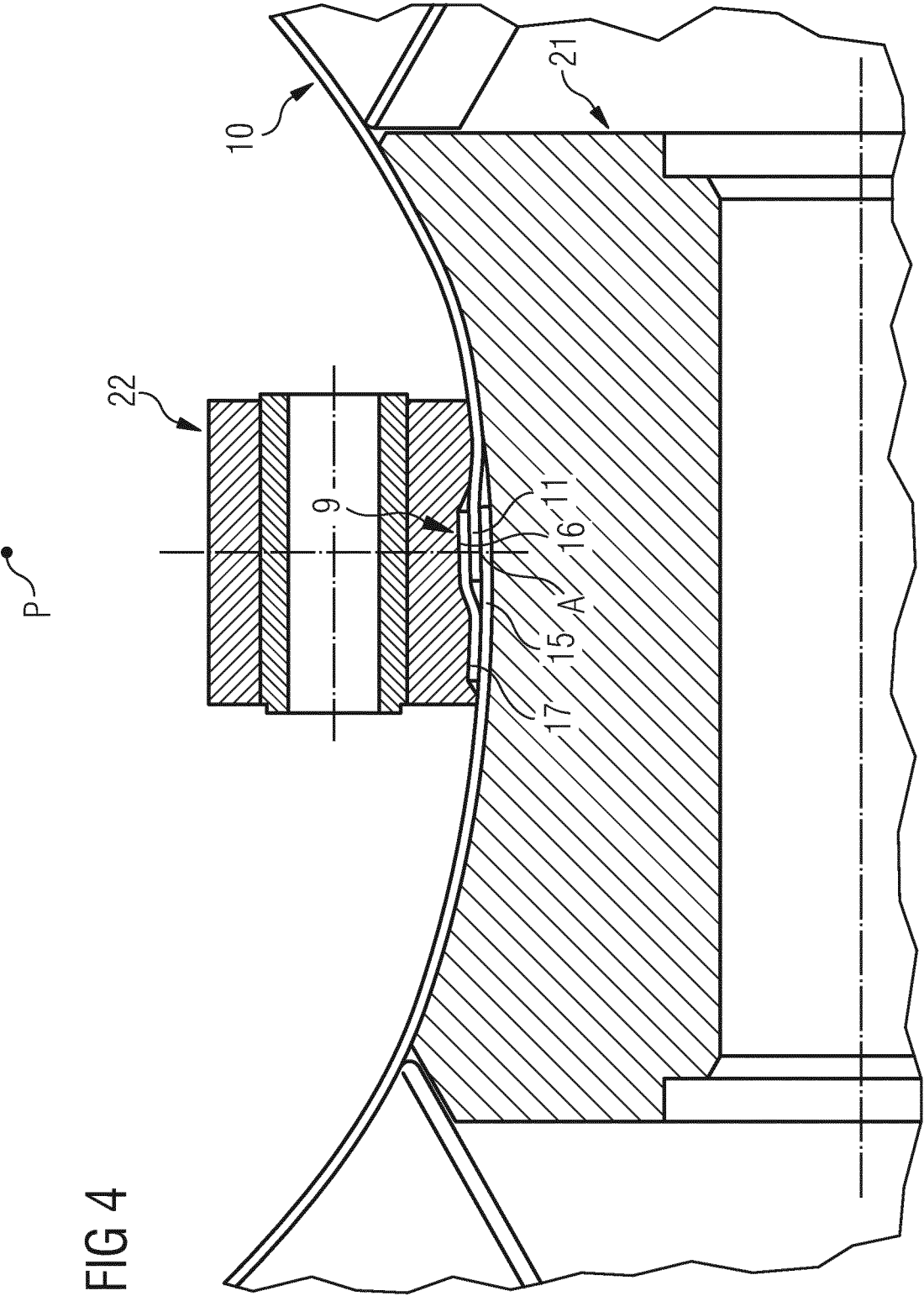


FIG 5

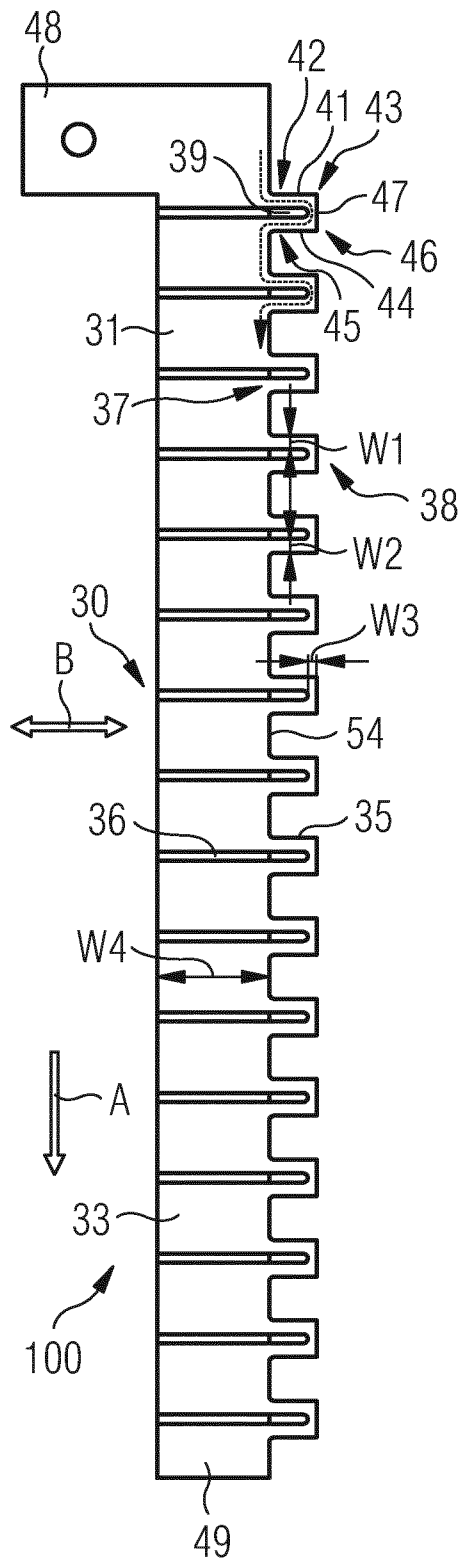


FIG 6

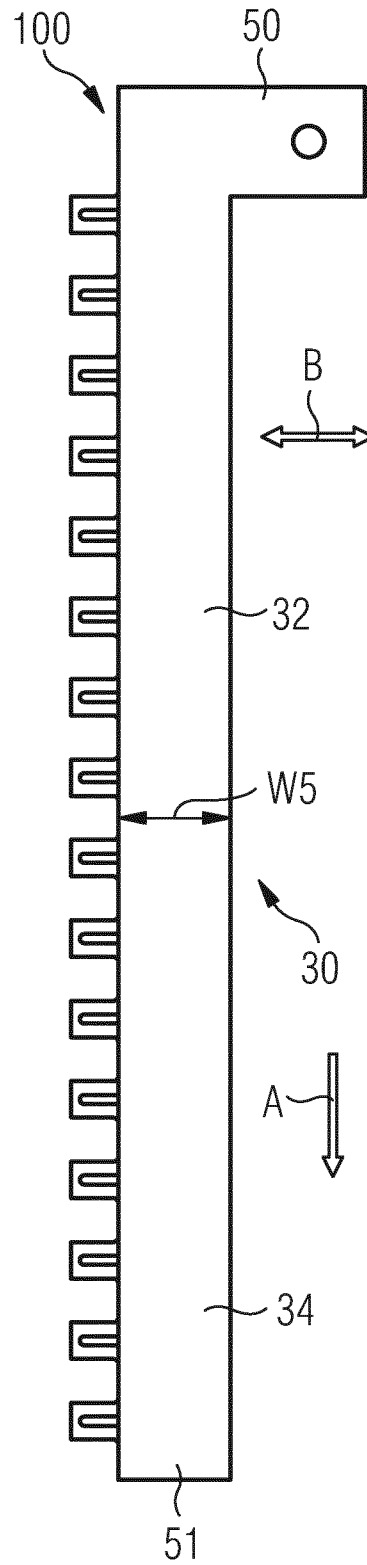


FIG 7

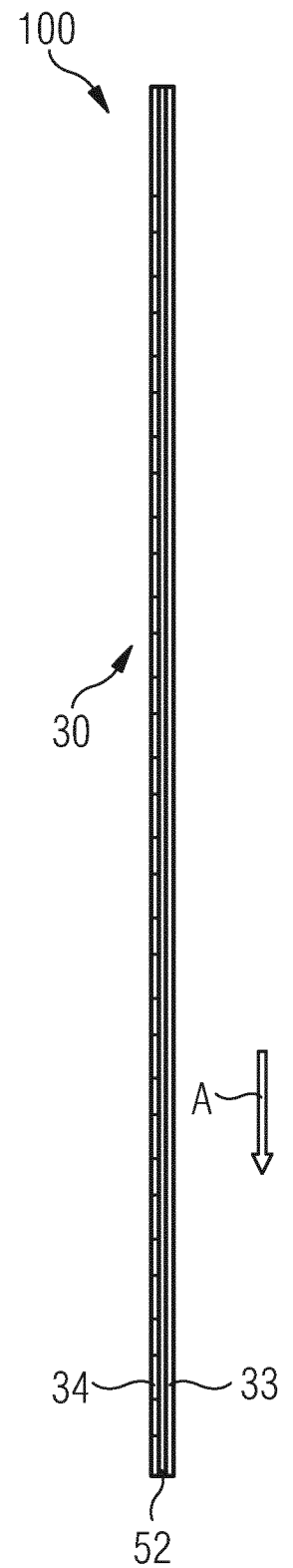
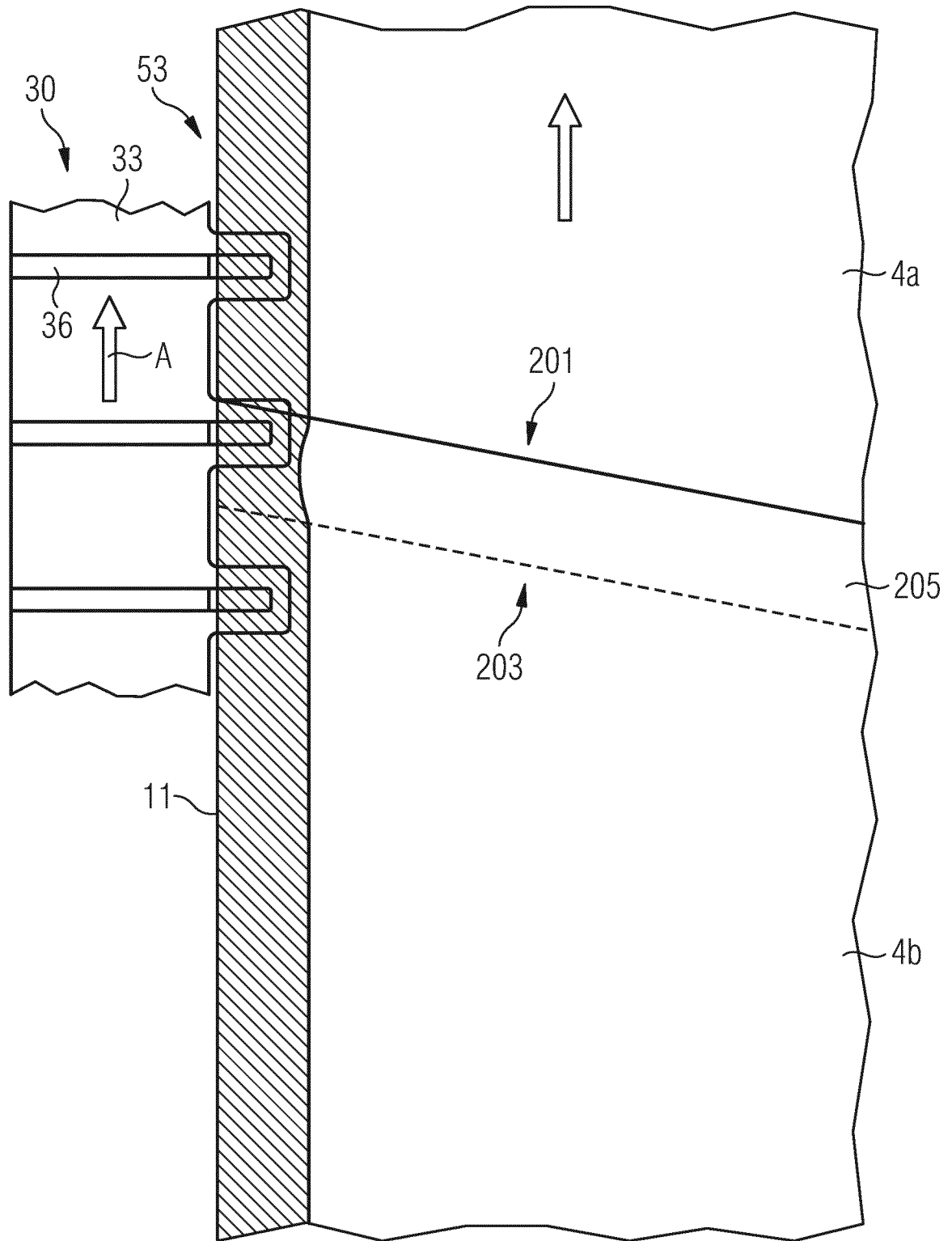


FIG 8



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2016/059494

A. CLASSIFICATION OF SUBJECT MATTER

INV. B29C65/36 B65B51/22
ADD. B29C65/50 B65H19/00 B29L9/00 B29K705/00 B29K705/02
B29K711/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B29C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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X,P	WO 2015/078907 A1 (TETRA LAVAL HOLDINGS & FINANCE [CH]) 4 June 2015 (2015-06-04) figures	1-16
A	EP 2 520 417 A1 (TETRA LAVAL HOLDINGS & FINANCE [CH]) 7 November 2012 (2012-11-07) figures	1-16
A	EP 2 520 416 A1 (TETRA LAVAL HOLDINGS & FINANCE [CH]) 7 November 2012 (2012-11-07) figures	1-16



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

6 July 2016

Date of mailing of the international search report

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Carré, Jérôme

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2016/059494

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