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(54) Title: CORRUGATOR DEVICE WITH SPECIFIC GUIDANCE OF THE COOLING AIR CIRCUIT

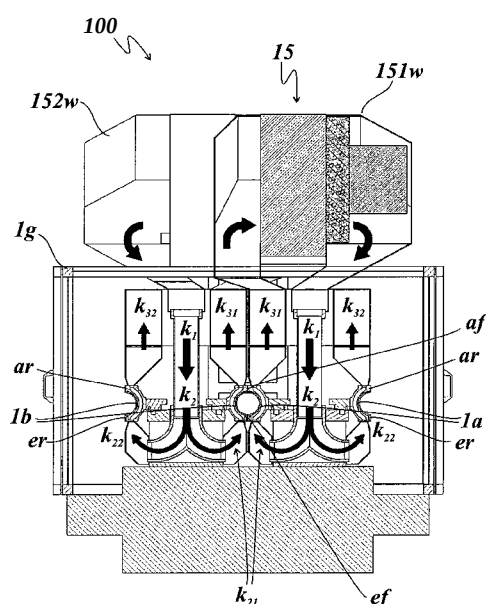


Fig. 3

(57) Abstract: A corrugator device for shaping a corrugated pipe R from a tube of molten plastics material S is described. The corrugator device comprises movably driven molding jaws 1a, 1b with a corrugated molding area 1f. The molding jaws are formed as first and second molding jaws 1a, 1b, which form pairs of molding jaws 11. The corrugator device comprises a molding passage 10, which is formed by traveling pairs of molding jaws 11 arranged one behind the other. Further on the corrugator device comprises an air cooling device 15 for cooling the molding jaws 1a, 1b. It is provided that the air cooling device 15 has at least one first cooling air circuit 151 with a heat exchanger and a blower and at least one second cooling air circuit 152 with a heat exchanger and a blower. Thereby the at least one first cooling air circuit 151 is formed for cooling the first molding jaws 1a of the pairs of molding jaws 11 and the at least one second cooling air circuit 152 is formed for cooling the second molding jaws 1b of the pairs of molding jaws 11.

Corrugator device with specific guidance of the cooling air circuit

The invention relates to a corrugator device for shaping a corrugated pipe from a tube of molten plastics material.

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The invention is based on a known corrugator device with the features of the preamble of patent claim 1. That is a corrugator device which has movably driven molding jaws with a corrugated molding area. The molding jaws are assigned to one another in pairs, in that they are formed as first and second molding jaws which form pairs of molding jaws with one another. Depending on the spatial arrangement of the molding jaws of the pairs of molding jaws in the molding passage, the first and second molding jaws in the molding passage may form right and left molding jaws or upper and lower molding jaws. The corrugator device also has a molding passage, which is formed by traveling pairs of molding jaws arranged one behind the other and comprising the first and second molding jaws. Furthermore, the corrugator device has a return region, which is formed outside the molding passage and in which the molding jaws are returned from the end of the molding passage to the beginning of the molding passage. At the end of the molding passage, the molding jaws are moved apart and, at the beginning of the molding passage, they are brought together again. The corrugator device also has an air cooling device for cooling the molding jaws.

WO 2004/024419 A1 describes a corrugator device of this construction. The document describes embodiments in which the molding jaws are guided in pairs as upper and lower molding jaws in a horizontally directed molding passage. In the case of embodiments that are represented in Figures 3 and 4 of WO 2004/024419 A1, the cooling air device is formed as labyrinth box devices past which the molding jaws are made to pass, resting with their outer sides. The labyrinth box devices consist here in each case of a labyrinth housing with three plate walls, between which a labyrinthine gap is formed. In the case of these two embodiments, the air supply takes place on the outer side of the labyrinth housing. In the case of the one embodiment in Figure 3, the air discharge takes place by way of vacuum channels formed in the lower molding jaw. In the case of the

embodiment in Figure 4, the air discharge takes place at a second, outer opening in the labyrinth housing. In the case of a further exemplary embodiment that is shown in Figure 5 of WO 2004/024419 A1, horizontal channels are formed laterally in the outer region of the opposing sides of the molding jaws, in which
5 horizontal channels that can be supplied with cooling air by way of an external air connection are formed in the outer peripheral region of the opposing outer sides of the molding jaws and are separated from one another in a lamellar manner.

US 3,981,663 likewise describes a corrugator device which has an air cooling
10 device for cooling the molding jaws. The air cooling device is in this case formed such that the molding areas of the molding jaws are blasted with cooling air in the return region of the molding jaws. For this purpose, arranged in the return region of the corrugator device are cooling chambers, through which the molding jaws are made to pass as they are returned. For cooling in the molding passage, there is
15 merely a cooling pin provided with cooling air inside the thermoplastic tube, in order to cool the thermoplastic tube from the inside.

US 2007/0014884 A1 and the corresponding DE 20 2004 000 904 U1 likewise describe a corrugator device with an air cooling device for cooling the molding
20 jaws. The air cooling device cools the molding jaws by the entire corrugator being arranged in an air block housing. This air block housing surrounds the corrugator and forms a cooling chamber in which not only the corrugator but also a number of heat exchangers and a number of blowers are arranged. The air supplied from the outside is cooled by way of the heat exchangers arranged inside. The blowers are
25 arranged on opposing sides of the molding passage in the cooling chamber. They blow cooling air onto the outer sides of the molding jaws guided in the molding passage. Formed on the outer sides of the molding jaws are axially running ribs, onto which the cooling air stream of the blowers is directed.

30 US 5,167,781 likewise describes a corrugator device with an air cooling device for cooling the molding jaws. The molding jaws are formed on two belts like conveyor belts circulating in opposite directions. Arranged in each of the two return regions there is a cooling air blower, which blows cooling air onto the molding areas. In the region of the molding passage, cooling air passes through slits in the conveyor

belts into the region of the molding areas, whereby cooling both of the molding jaws and of the thermoplastic tube in the molding passage takes place.

US 4,439,130 and EP 0 575 065 describe corrugator devices in which the molding
5 jaws in the molding passage are cooled by cooling air from the outside and the molding areas are blasted by cooling air in the opened return of the molding jaws.

The invention is based on the object of developing a corrugator device of the type
10 stated at the beginning in such a way that improved cooling of the molding jaws by way of air cooling is obtained.

This object is achieved by the invention with the subject matter of patent claim 1.

The solution according to the invention is thus a corrugator device for shaping a
15 corrugated pipe from a tube of molten plastics material. The corrugator device has movably driven molding jaws with a corrugated molding area, wherein the molding jaws are formed as first and second molding jaws which form pairs of molding jaws. The corrugator device has a molding passage, which is formed by traveling
20 pairs of molding jaws arranged one behind the other. Furthermore, there is a return region, which is formed outside the molding passage and in which the molding jaws are returned from the end of the molding passage to the beginning of the molding passage. This is achieved by making the molding jaws move apart at the end of the molding passage and making the molding jaws move together again at the beginning of the molding passage. For cooling the molding jaws the
25 corrugator device has an air cooling device.

It is essential in the solution according to the invention that an especially effective
air cooling of the molding jaws is achieved by special guidance of one ore more
cooling circuits assigned to the molding jaws in the molding channel or in the
30 return.

The cooling air guidance according to the invention - in the following called
cooling air circuit guidance A - provides that the air cooling device has at least a
cooling air circuit with a heat exchanger and a blower, which cools at least one

molding jaw in the molding passage and at least one molding jaw in the return region. This means that at least a common cooling air circuit is provided for cooling of molding jaws in the molding channel and for cooling of molding jaws in the return region. In preferred embodiments more cooling air circuits can be provided each with a heat exchanger and a blower. It is essential in these different
5 embodiments with cooling air circuit guidance A that a common cooling circuit or more common cooling circuits are provided each for molding jaws in the molding channel, and for molding jaws in the return region.

10 In a preferred embodiment of the corrugator device the cooling air circuit guidance A can be designed such that in that the cooling air circuit has at least two partial cooling air streams, of which at least a first partial cooling air stream cools the at least one molding jaw in the molding passage and at least a second partial cooling air stream cools the at least one molding jaw in the return region. Alternatively
15 measure A can also be designed such that the cooling air circuit is operated such that the cooling air stream first cools the at least one molding jaw in the return region and then the at least one molding jaw in the molding passage or vice versa, i.e. that the cooling air circuit first cools the at least one molding jaw in the molding passage and then the at least one molding jaw in the return region. Measure A is
20 thus realizable as a partition of the cooling air circuit having in that the cooling air circuit has at least two partial cooling air streams, of which at least a first partial cooling air stream cools the at least one molding jaw in the molding passage and at least a second partial cooling air stream cools the at least one molding jaw in the return region.

25 In an other cooling air circuit guidance - in the following called cooling air circuit guidance B - it is provided that that the air cooling device has at least one first cooling air circuit with a heat exchanger and a blower and at least one second cooling air circuit with a heat exchanger and a blower, wherein the at least one first
30 cooling air circuit is formed for cooling the first molding jaws of the pairs of molding jaws and the at least one second cooling air circuit is formed for cooling the second molding jaws of the pairs of molding jaws. This the first and the second molding jaws of pairs of molding jaw pairs, i.e. depending on the arrangement of the molding jaws in the molding channel, left and right molding jaws or upper and

lower molding jaws of pairs of molding jawy are each cooled by different cooling air circuits.

The cooling air circuit guidance B is formed in preferred embodiments such that,
5 from the cooling air of the cooling air circuit leaving the heat exchanger, the at least first partial cooling air stream is supplied to the at least one molding jaw in the molding passage to cool the molding jaw and the at least second partial cooling air stream is supplied to the at least one molding jaw in the return region to cool the molding jaw, where the first partial cooling air stream leaving the at least
10 one molding jaw in the molding passage and the second partial cooling air stream leaving the at least one molding jaw in the return region are supplied to the at least one heat exchanger. Correspondingly it can be provided that the first partial cooling air stream leaving the at least one molding jaw in the molding passage is brought together with the second partial cooling air stream leaving the at least one
15 molding jaw in the return region before the entry into the at least one heat exchanger to form an overall cooling air stream, and the overall cooling air stream is introduced into the at least one heat exchanger. Alternatively it can be provided that the first partial cooling air stream leaving the at least one molding jaw in the molding passage and the second partial cooling air stream leaving the at least one
20 molding jaw in the return region are introduced directly into the at least one heat exchanger as separate partial cooling air streams.

In preferred embodiments with cooling air guidance B it can be provided that the first cooling air circuit and the second cooling air circuit are formed such that the
25 first cooling air circuit supplies cooling air at least to a first molding jaw in the molding passage and/or in the return region and in that at the same time the second cooling air circuit supplies cooling air at least to a second molding jaw in the molding passage and/or in the return region of the same pair of molding jaws.

30 Both cooling air circuit guidances A and B represent so called and/or-alternatives, i.e. they can be realized alone in special embodiments, in other embodiments they can be realized together. This is the case for especially preferred embodiments.

Especially preferred embodiments provide that a number of cooling air circuits and/or a number of heat exchangers are arranged along the molding passage and/or along the return region.

- 5 An especially preferred installation results in embodiments which provide that each cooling circuit has a connection device, which can be temporarily brought into connection or is permanently connected to one or more of the molding jaws running at the time in the molding passage and/or in the return region.
- 10 In preferred embodiments of the corrugator device it is provided that the molding jaws each have at least one cooling air channel to cool the molding jaws from the inside by the cooling air. Concerning the arrangement of the cooling air channel in the molding jaw it is provided that the cooling air channel extends over the entire, or at least almost the entire, diametrical circumferential contour of the molding
- 15 area along the molding area within the wall of the molding jaw and/or within a through-flow housing fastened such that it is resting on the outer side of the molding jaw. Hereby an especially effective and uniformly distributed cooling of the molding jaw in the region of entire molding area is achieved. The cooling air channel of the molding jaw has an inlet and an outlet for the cooling air such that
- 20 a through-flow of the cooling air channel by the cooling air is enabled.

For supplying the molding jaws with cooling air it is provided that the cooling air device has an inlet connection device, at which the inlet of the cooling air channel of the molding jaw can be temporarily connected or is permanently connected,

25 while the respective molding jaw is being guided in the molding passage and/or the respective molding jaw is being guided in the return region. Preferably with a corresponding installation it is provided that the air cooling device has an outlet connection device, at which the outlet of the cooling air channel of the molding jaw can be temporarily connected or is permanently connected, while the molding jaw

30 concerned in the molding passage and/or the molding jaw concerned in the return is or are being guided. This means that the inlet and outlet of cooling air in the cooling channels takes place only temporarily while the molding jaw in the molding passage in the molding channel and/or in the return is or are being guided. In

alternative embodiments a permanent connection to the inlet connection device and/or the outlet connection device can also be provided.

5 In especially preferred embodiments it is provided that at least a main portion of the cooling air channel extends at a constant distance from the molding area. Because of the constant distance of the molding area an especially uniform effective cooling of the entire molding area can be achieved.

10 In further preferred embodiments it is provided that each molding jaw has a number of cooling air channels arranged one behind the other in the axial direction of the molding passage. For an especially uniform cooling the cooling channels can be arranged with distance equal to each other.

15 Advantages concerning the flow in the through-flow cooling result when it is provided that the cooling air channels arranged one behind the other have in each case an identical axial shape and/or identical cross section transversely to their axis.

20 Advantages concerning the manufacturing result when it is provided that the wall of the molding jaw is formed as a hollow wall with a hollow space, which is subdivided by parallel ribs arranged radially perpendicular to the molding area, thereby forming the cooling air channels.

25 An especially uniform cooling of the entire molding jaw is achieved when it is provided that the cooling air channel has over its entire axial extent a substantially constant cross section transversely to its axial extent. In preferred embodiments the clear width of the cross section of the cooling air channel transversely to its axial extent is at least as great as half the total wall thickness of the molding jaw in this cross-sectional plane. In case of an elongate opening cross-section the clear
30 width in direction of the long side of the opening cross-section can preferably be at least as great as half the total wall thickness of the molding jaw in this cross-sectional plane.

It is also advantageous for an effective uniform cooling of the entire molding jaw when it is provided that the clear width of the cross section of the cooling air channel transversely to its axial extent is greater than or equal to the wall thickness of the wall of the molding jaw between adjacent cooling air channels and/or between the cooling air channel and the molding area. Hereby it is advantageous when it is provided that the cooling air channel has over its entire axial extent a substantially constant cross section transversely to its axial extent. In case of an elongate opening cross section it is advantageous when the short side of the opening cross section is greater than or equal to the wall thickness of the wall between adjacent cooling air channels and/or between the cooling air channel and the molding area.

In especially preferred embodiments with an especially uniform cooling distribution over the entire molding jaw it is provided that, in a cross-sectional plane of the molding jaw transverse to the molding jaw axis and/or transverse to the central axis of the molding passage, the ratio of the cross-sectional area of the cooling channel or the sum of the cross-sectional areas of the cooling air channels to the sum of the cross-sectional areas of the solid wall is greater than or equal to 30%, preferably in the range between 40% and 60%.

Correspondingly it is advantageous when it is provided that, in a cross-sectional plane of the molding jaw parallel to the central axis of the molding passage and preferably perpendicular to the parting plane of the pair of molding jaws, the ratio of the cross-sectional area of the cooling air channel or the sum of the cross-sectional areas of the cooling air channels to the sum of the cross-sectional areas of the solid wall is greater than or equal to 30%, preferably between 40% and 60%.

In especially preferred embodiments it is provided that some or all of the cooling air channels of the molding jaws have in each case an inlet and an outlet. Hereby it is enabled to supply the cooling air channels with cooling air in parallel.

In especially preferred embodiments with a temporary cooling air supply of the cooling air channels it can be provided that an inlet opening of the inlet connection

device and/or an outlet opening of the outlet connection device is formed as an opening that is elongate in the opening cross section, extends in the direction of production and/or in the direction of the longitudinal axis of the molding passage and thereby covers over an inlet or a number of inlets or an outlet or a number of outlets of molding jaws in the molding passage. Hereby in a preferred further embodiment it can be provided that the coverage takes place while the molding jaws are passing the inlet connection device or the outlet connection device in the molding passage. It can be provided that the connection is formed by a sliding sealing connection between parts sliding on one another, the one part being formed as a preferably raised sealing border and the other part being formed as a planar sealing area.

In especially preferred further embodiments thereof it can be provided that the planar sealing area is formed on the outer surface of the molding jaw and the preferably raised sealing border is formed as a border of an opening of the inlet connection device of the air cooling device and/or of the outlet connection device of the air cooling device.

In preferred embodiments it can be provided that the inlet and/or the outlet of the cooling air channel of the molding jaw is or are arranged on two separate outer sides of the molding jaw, i.e. either on outer sides adjacent at an angle or outer sides opposite one another of the molding jaw.

In preferred embodiments it can be provided that the inlet connection device of the air cooling device and/or the outlet connection device of the air cooling device and/or the supplying and/or discharging pipes is or are formed in a stationary manner in a frame of the corrugator device.

In especially preferred embodiments it is provided that the cooling air is guided between the heat exchanger and the inlet connection device, at least in certain portions, in at least one pipe or tube. Correspondingly it is advantageous when it is provided that the cooling air is guided between the outlet connection device and the heat exchanger in at least one pipe or tube. Hardware advantages are especially achieved for embodiments with a stationary arranged inlet connection

device and/or stationary arranged outlet connection device, when the tube or the tubes is or are formed as rigid tubes.

An especially compact design is achieved for embodiments in which it is provided that the cooling air channel or the cooling air channels of a molding jaw is or are arranged between the molding area of the molding jaw and a carrier of the molding jaw. Hereby it can be provided that each molding jaw has a carrier and in that the carriers of the molding jaws interact with a guiding device, which determines the path of movement of the molding jaws.

In especially preferred embodiments it can be provided that the molding jaws are guided in circulating paths, in that the first molding jaws of the pairs of molding jaws are guided in a first circulating path and the second molding jaws of the pairs of molding jaws are guided in a second circulating path.

A preferred exemplary embodiment is represented in the figures, in which:

Figure 1 shows a schematic plan view of an exemplary embodiment of the corrugator device with an upstream extruder device;

Figure 2 shows a perspective side view of a detailed embodiment of the corrugator device in Figure 1;

Figure 3 shows a front view of the corrugator device in Figure 2, partly in section;

Figure 4 shows a plan view of the corrugator device in Figure 2, in a view from above;

Figure 5 shows a perspective view of a molding jaw of the corrugator device, in a view obliquely from above;

Figure 6 shows a perspective view of the molding jaw in Figure 5, in a view obliquely from below;

Figure 7 shows a perspective view of the molding jaw in Figure 5, but in section, the sectional plane passing through the wall of the molding jaw parallel to the molding jaw axis and at the same time perpendicularly to the molding jaw parting plane;

Figure 8 shows a perspective view of the molding jaw in Figure 5, but in section, the sectional plane passing through the wall of the molding transversely to the molding jaw axis.

The exemplary embodiment represented in the figures is a corrugator device 100 for producing a corrugated pipe R from a tube of molten plastics material S. The corrugator device 100 has a molding section 10 formed by traveling pairs of molding jaws 11. In the case of the exemplary embodiment, the molding jaws forming the pairs of molding jaws are formed as right-hand and left-hand molding jaws 1a, 1b. They may, however, also be formed as upper and lower molding jaws, i.e. the pairs of molding jaws are then respectively formed by a lower and upper molding jaw.

The molding section 10 - also referred to as the molding passage - is arranged horizontally in the exemplary embodiment represented in Figure 1. In the representation in Figure 1, the direction of production runs from right to left. It is depicted in Figure 1 by the arrow X. In Figure 1, the finished corrugated pipe R leaves the end of the molding section 10 on the left. The end of the molding section 10 is designated in the figure by 10e. In Figure 1, the tube of molten plastics material S enters the molding section 10 on the right, the beginning of the molding section. This beginning of the molding section is designated in the figure by 10o.

The corrugator device 100 is preceded on the right in Figure 1 by an extrusion device 2. The extrusion device 2 has an extrusion die 2d, from which the tube of molten plastics material S leaves and is introduced into the molding passage 10 at 10o. For this purpose, the extrusion die 2d is arranged horizontally and aligned with the horizontal molding passage 10. In the case of an alternative

corresponding embodiment, however, it may be provided that the molding passage is vertically aligned. In the case of this embodiment, the pairs of molding jaws are guided in the molding passage such that they are arranged vertically one above the other.

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In the case of the exemplary embodiment represented in Figure 1, the right-hand molding jaws 1a are guided in a closed circulating molding jaw chain 11a and the left-hand molding jaws 1b are guided in a closed circulating molding jaw chain 11b. Each molding jaw chain 11a, 11b is guided here in a driven manner like a conveyor belt, running in each case over two deflecting wheels 111. The molding jaw chains 11a, 11b are guided in such a way that, in a portion forming the horizontal molding passage 10, the right-hand and left-hand molding jaws 1a, 1b are guided in pairs with molding areas facing one another and the right-hand and left-hand molding jaws 1a, 1b thereby form the molding passage 10 with their mutually facing molding areas.

In the exemplary embodiment of the corrugator device that is represented in Figure 1, the molding passage 10 is formed by six traveling pairs of molding jaws 11 arranged one behind the other. At the end 10e of the molding passage 10, the molding jaws 1a, 1b of the pairs of molding jaws 11 are made to move apart. The right-hand molding jaws 1a, guided in the molding jaw chain 11a, return to the beginning 10o of the molding passage by way of the return region 11ar. In a corresponding way, the left-hand molding jaws 1b in the molding jaw chain 11b return to the beginning 10o of the molding passage by way of the return region 11br. At the beginning 10o of the molding passage, the molding jaws of the right-hand and left-hand molding jaw chains 11a, 11b consequently run together again and then travel in pairs, as pairs of molding jaws 11, in the direction of production X, thereby forming the molding passage 10. At the end 10e of the molding passage, the molding jaws then run apart again into the respective return region, thereby forming an endless loop 11a and 11b, respectively.

The shaping of a corrugated pipe R in the molding passage 10 from the tube of molten plastics material S takes place at the molding areas 1f, 1f of the pairs of molding jaws 11. The molding area 1f is represented in Figures 5 to 8, still to be

explained in more detail later. The shaping of the corrugated pipe at the molding areas 1f can then take place in a conventional way by means of specifically controlled application of pressure to the tube of molten plastics material in the molding passage 10, for example by application of positive pressure to the inside
5 of the tube and application of negative pressure between the outside of the tube and the molding areas 1f. In this way, single- and multi-wall corrugated pipes can be formed from one or more coaxially supplied tubes of molten plastics material.

It is important that, in the case of the exemplary embodiment according to the invention, the corrugator device has a cooling air device 15, by means of which the
10 cooling of the thermoplastic material takes place in the molding passage 10 by cooling of the molding jaws. Reference is made to Figures 2 to 4, which show the corrugator device 100 with the cooling air device 15. In the case of the exemplary embodiment represented in Figures 2 to 4, the cooling air device designated by
15 the reference sign 15 comprises a number of cooling air circuits connected one behind the other in the axial direction of the molding passage 10, to be precise separate cooling circuits for the right-hand molding jaws 1a and for the left-hand molding jaws 1b. In the case represented there are four cooling air circuits 151, 152, 153, 154, which respectively have a separate heat exchanger 151w, 152w,
20 153w, 154w with in each case a separate blower. These heat exchangers and the blowers are arranged at the top on the frame 1g of the corrugator device. The heat exchangers 151w, 153w with the associated blowers are assigned to the cooling air circuits 151 and 153, respectively, of the right-hand molding jaws and the heat exchangers 152w, 154w with the associated blowers are assigned to the
25 cooling air circuits 152 and 154, respectively, of the left-hand molding jaws.

To realize the air cooling, it is possible to direct the flow flat against the outer side of the molding jaws, in that the molding jaws 1a, 1b are guided in chambers through which the stream of cooling air flows. In the case of the exemplary
30 embodiment represented in the figures, however, the air cooling is not realized by such a flow being directed against the outer sides of the molding jaws but by the molding jaws 1a, 1b having cooling air channels 1k, through which the cooling air flows. Reference is made in the following to Figures 5 to 8, which show a molding jaw with the cooling air channels 1k in various views, partly also in section. In the

figures, a left-hand molding jaw 1b is shown. However, the right-hand molding jaws 1a are configured in a corresponding mirror image in relation to the parting plane T of the pairs of molding jaws that are shown in Figure 5. As can be seen in Figures 5 to 8, the cooling air channels 1k are formed within the wall of the molding jaw. They extend in the molding jaw wall in each case at an approximately constant distance from the molding area 1f of the respective molding jaw. They extend substantially along the entire diametrical circumferential contour of the molding area 1f. The diametrical circumferential contour is understood as meaning the contour K depicted in Figure 5 of the molding jaw area 1f in a cross-sectional plane transverse to the molding jaw axis F. The molding jaw axis F is likewise depicted in Figure 5. It runs parallel to the axis of the molding passage 10, and consequently also parallel to the axis of the direction of production X, which is depicted in Figure 1.

The cooling air channels 1k have the same path of curvature as the circumferential contour K of the molding area 1f. In the case represented in Figures 5 to 8, the molding area 1f is formed as a half-cylinder area with a half-circle circumferential contour K. The cooling air channels 1k therefore have in their axial extent a corresponding semicircular shape. The semicircular shape extends substantially concentrically around the central axis of the molding passage 10.

As can be seen in particular from Figure 8, the cooling air channels 1k have a central main portion, which extends in the way described with constant curvature, corresponding to the curvature of the molding area. At the ends of these main portions of the cooling air channels, short end portions, running substantially radially in relation to the molding area, are respectively formed, opening outward on the respective outer side of the molding jaws and forming the cooling air outlet or cooling air inlet.

As can best be seen from Figures 7 and 8, the cooling air channels 1k pass through the wall of the molding area relatively decisively and uniformly, at least in the region near the molding area 1f. In the various sectional planes through the molding jaw wall, the ratio of the sum of the cross-sectional area of the cooling air channels 1k to the sum of the cross-sectional area of the solid wall is relatively

great. Reference is made to Figure 7, which is a sectional plane that extends parallel to the molding jaw axis F and at the same time perpendicularly to the parting plane T of the pairs of molding jaws. It can be seen that, in the sectional plane shown, in the region near the molding area 1f the ratio of the sum of the cross-sectional areas of the cooling air channels to the sum of the cross-sectional areas of the solid wall portions is over 50% to 60% and the ratio of the cross-sectional areas of the cooling channels to the sum of the cross-sectional areas of the solid wall portions of the entire wall is approximately 30% to 40%.

Figure 8 shows a sectional plane transversely to the molding jaw axis F. In this sectional plane, the ratio of the cross-sectional area of the cooling channel to the sum of the cross-sectional areas of the solid wall portions is 50%.

The cross-sectional shape of the cooling channels can best be seen in Figure 7. In the actual case concerned, the cross-sectional shape is in each case rectangular. It may, however, also be square or oval or circular or else have an irregular contour.

As can likewise be seen in Figure 7, the cooling air channels are in each case arranged in such a way that their short side runs parallel to the molding area 1f and their long side runs radially to the molding area 1f. The length of the long side of the cooling channel cross section is approximately half the radial total wall thickness r_g of the molding jaw. As can be seen in conjunction with Figure 8, the cross-sectional shape of the cooling air channels is constantly rectangular over their axial length.

As can be seen in Figures 5 to 8, in the molding jaws a number of cooling channels 1k formed with identical shapes are arranged in parallel next to one another in the axial direction of the molding jaw. The cooling air channels 1k consequently form in the molding jaw a row of channels arranged next to one another, the row extending along the molding jaw axis F. In the case represented, eight such cooling channels are provided in the molding jaw (see Figure 7). The cooling air channels 1k are designed identically to one another. Each cooling air channel 1k respectively extends from the underside 1u of the molding jaw to the

upper side 1o of the molding jaw, respectively opening out into the underside 1u or the upper side 1o of the molding jaw with an opening 1ko, 1ku (see Figure 8). These end openings of the cooling air channels are in each case an inlet opening or outlet opening for the cooling air. The opening 1ku on the underside of the molding jaw acts as an inlet opening for the cooling air and the opening 1ko on the upper side of the molding jaw acts as an outlet opening for the cooling air (see Figure 3). This means that the molding jaw has in each case on the underside 1u a row of inlet openings 1ku and on the upper side 1o a row of outlet openings 1ko. As can be seen in Figures 5 and 6, these openings are respectively arranged in a line parallel to the axis F of the molding jaw. The number of openings 1ko, 1ku corresponds to the number of air cooling channels 1k, i.e. in the case represented eight inlet openings and eight outlet openings.

Between the upper side 1o and the underside 1u of the molding jaws there extends the molding area 1f, on the right-hand side in the representation in Figures 5 to 8, in which a left-hand molding jaw 1b is represented. As Figures 5, 6 and 8 show, a coupling element 1p in the shape of a mushroom head is formed on the other side, the left-hand side, in order to couple the molding jaw to a carrier 1t. Figure 3 shows the molding jaws 1a, 1b in the position in which they are coupled to the respective carrier 1t. The carriers 1t are links of the circulating chains 11a, 11b, on which the molding jaws 1a and 1b are respectively guided such that they are arranged in a circulating manner.

The cooling air channels 1k arranged next to one another in the wall of the molding jaws 1a, 1b are realized in the exemplary embodiment of the molding jaws represented by the wall of the molding jaws being formed as a hollow wall, the hollow space of the hollow wall being subdivided by parallel ribs. The respective space between adjacent ribs in each case forms a cooling air channel 1k. This can best be seen in Figure 8, which shows a section of the molding jaws parallel to the ribs. The sectional plane runs transversely to the molding jaw axis F.

The design of the arrangement and cross sections of the cooling air channels 1k in the molding jaw in the case represented in Figure 7 is such that the wall thickness in the sectional plane shown in Figure 7, which lies parallel to the molding jaw axis

F and at the same time perpendicular to the parting plane T of the pairs of molding jaws, between the cooling air channel 1k and the molding area 1f in the region of the corrugation crest is approximately the same as the wall thickness between adjacent cooling channels 1k. The size of this wall thickness in the case
5 represented is about 1/7 of the total wall thickness of the molding jaw in this sectional plane.

In Figures 6 and 8, vacuum channels 1v arranged in the wall of the molding jaw can also be seen. The vacuum channels 1v respectively extend radially from the
10 underside 1u of the molding jaw, perpendicularly to the molding area 1f. The vacuum channels 1v open it in each case in the molding area 1f with a mouth opening. At the other end, in the underside 1u of the molding jaw, they have a connection opening. This can best be seen in Figure 8, which shows one of the vacuum channels 1v in longitudinal section. In Figure 6 it can be seen that the
15 vacuum channels 1v are arranged in a row along the axis of the molding jaw. In Figure 6, the mouth openings arranged in a row in the underside of the molding jaw are shown. In the case represented, ten vacuum channels 1v are arranged in this row, to be precise each corrugation of the molding area 1f being respectively assigned a vacuum channel 1v. As can also be seen in Figure 6, the row of
20 connection openings of the vacuum channels 1v is parallel to the row of inlet openings 1ku likewise formed on the underside 1u of the molding jaw. The vacuum channels open out in the molding area in a vacuum groove running in the corrugation trough along the circumference thereof, so that negative pressure can be applied to the molding area over its entire circumference.

25 In order to introduce the cooling air into the inlet openings of the cooling air channels 1k, the cooling air device 15 has inlet connection devices arranged in a stationary manner. In order to discharge the cooling air from the connection openings of the molding jaws, the cooling air device 15 has outlet connection
30 devices arranged in a stationary manner.

In the exemplary embodiment represented in Figures 2 to 4, the entire cooling air device 15 is arranged in a stationary manner in the frame 1g of the corrugator device. The frame 1g may be formed as a framework with an upper cross

member. In the case represented, lateral sliding doors are arranged on the frame 1g, so that a housing surrounding the corrugator is obtained. In the case represented, the heat exchangers 151w, 152w, 153w, 154w and the respectively assigned blowers are arranged in a stationary manner on the roof, i.e. on the upper cross member of the frame 1g. The heat exchangers are connected to stationary pipelines, in which the cooling air is carried, as cooling air circuits 151, 152, 153, 154.

Reference is made in the following to Figure 3: the cooling air device has in the region of the molding passage 10 stationary inlet connection devices and outlet connection devices and in the region of the molding jaw return regions 11ar, 11br stationary inlet connection devices er and outlet connection devices ar. The inlet connection devices ef, er and the outlet connection devices af, ar are fixedly arranged in the frame 1g in such a way that the molding jaws that are made to pass by them are automatically in connection as they pass by. For this purpose, the connection devices respectively have an elongate connection slot (not represented), which extends in the direction of movement of the molding jaws and is surrounded by a sealing border. Along these connection slots provided with the sealing border run the inlet openings 1ku and the outlet openings 1ko of the passing molding jaws. In this arrangement, these inlet and outlet openings run with their opening cross section congruently on the opening cross section of the connection slot concerned of the connection device. The sealing thereby takes place by the underside 1u of the molding jaws that has the inlet openings 1ku or the upper side 1o of the molding jaws that has the outlet openings 1ko being guided in a sealing, sliding manner on the sealing border of the inlet connection devices ef, er and the outlet connection devices af, ar, respectively. For this purpose, the upper side 1o or underside 1u concerned of the molding jaws is formed as a planar sealing area, which forms a seal with the sealing border of the connection slots. The connection slots are in each case formed with such a length that they are covered simultaneously by the inlet openings 1u and the outlet openings 1o of a number of molding jaws, i.e. at each connection slot there are a number of passing molding jaws in connection at the same time.

The inlet connection devices ef, er and the outlet connection devices af, ar are stationary during the operation of the corrugator device. They may, however, be adjustable for a conversion to large or small molding jaws.

5 In the case represented in the figures, the cooling device 15 when seen in the direction of production X has four cooling circuits 151, 152, 153, 154 arranged one behind the other, with in each case a heat exchanger 151w, 152w, 153w, 154w (see Figures 2 and 4). Each cooling circuit has an inlet connection device ef and an outlet connection device af for the molding jaws in the molding passage 10 and
10 an inlet connection device er and an outlet connection device ar for the molding jaws in the molding jaw return region 11ar, 11br (see Figure 3). This means that four pairs of connection devices, respectively comprising an inlet connection device ef and an outlet connection device af, are arranged one behind the other in the molding jaw guide of the molding passage 10. It also means that four pairs of
15 such connection devices er, ar are also arranged in the return region 11ar, 11br of the molding jaws, to be precise one such connection pair assigned to the molding jaws in the return region in each cooling circuit.

The cooling circuits 151, 152, 153, 154 arranged one behind the other are
20 respectively assigned to the right-hand and left-hand molding jaws 1a, 1b in alternating sequence. Therefore, arranged one behind the other in the molding passage 10 are four pairs of the connection devices ef, af of the cooling circuits 151, 152, 153, 154, alternately assigned to right-hand and left-hand molding jaws 1a, 1b. In the region of the molding jaw return 11ar, 11br, therefore, in the case
25 represented two pairs of connection devices er, ar are provided in the region of the right-hand molding jaw return 11ar, assigned to the cooling air circuits 151, 153, and furthermore two pairs of connection devices er, ar are provided in the region of the left-hand molding jaw return 11br, to be precise assigned to the cooling air circuits 152, 154.

30

The pipelines of the cooling air circuits can best be seen in Figures 2 and 3 for the two first cooling air circuits 151, 152 in the direction of production. As shown in Figure 3, the cooling air line k1 extending from the heat exchanger 151w runs vertically downward as far as a branching point k2. From the branching point k2, a

first pipeline k21 runs to the inlet connection device ef in the region of the molding passage 10 and a second pipeline k22 runs to the inlet connection device er in the molding jaw return region 11a. The cooling air from the actuated molding jaws 1a in the molding passage 10 is returned to the heat exchanger 151w by way of a pipeline k31 carrying the outlet connection device af. The cooling air from the actuated molding jaws 1a in the molding jaw return 11ar is returned to the heat exchanger 151w by way of a pipeline k32 carrying the outlet connection device ar.

The pipelines of the further cooling air circuits 152, 153, 154 are formed correspondingly.

List of designations

100	Corrugator device
1a	Right-hand molding jaw
1b	Left-hand molding jaw
1f	Molding area
1k	Cooling air channel
1ko	Cooling channel outlet opening
1ku	Cooling channel inlet opening
1v	Vacuum channel
1t	Carrier
1u	Underside of the molding jaw
1o	Upper side of the molding jaw
1p	Coupling element
1g	Frame
10	Molding passage
10o	Beginning of the molding passage
10e	End of the molding passage
11	Pair of molding jaws
11a	Circulating molding jaw chain of right-hand molding jaws
11b	Circulating molding jaw chain of left-hand molding jaws
11ar	Return region of right-hand molding jaws
11br	Return region of left-hand molding jaws
2	Extrusion device
2d	Extrusion die
15	Cooling air device
151	Cooling air circuit
152	Cooling air circuit
153	Cooling air circuit
154	Cooling air circuit
151w	Heat exchanger
152w	Heat exchanger
153w	Heat exchanger

154w Heat exchanger

k1 Pipe

k2 Pipe

k21 Pipe

k22 Pipe

k31 Pipe

k32 Pipe

er Inlet connection device in the molding passage

ar Outlet connection device in the molding passage

ef Inlet connection device in the molding jaw return

af Outlet connection device in the molding jaw return

S Molten tube (in Figure 1)

R Corrugated pipe (in Figure 1)

T Parting plane (in Figure 5)

F Molding jaw axis (in Figure 5)

K Circumferential contour of the molding area (in Figure 5)

Claims

1. A corrugator device

- 5 for shaping a corrugated pipe (R) from a tube of molten plastics material (S) having movably driven molding jaws (1a, 1b) with a corrugated molding area (1f), the molding jaws being formed as first and second molding jaws (1a, 1b), which form pairs of molding jaws (11) comprising first and second molding jaws (1a, 1b),
- 10 having a molding passage (10), which is formed by traveling pairs of molding jaws (11) arranged one behind the other, having a return region (11ar, 11br), which is formed outside the molding passage (10) and in which the molding jaws (1a, 1b) are returned from the end (10e) of the molding passage (10) to the beginning (10o) of the molding
- 15 passage (10), thereby making the molding jaws (1a, 1b) move apart at the end of the molding passage (10) and making the molding jaws (1a, 1b) move together again at the beginning (10o) of the molding passage (10), and having an air cooling device (15) for cooling the molding jaws (1a, 1b), characterized
- 20 A in that the air cooling device (15) has at least one cooling air circuit (151), (152), (153), (154) with a heat exchanger (151w), (152w), (153w), (154w) and a blower, which cools both at least one molding jaw in the molding passage (10) and at least one molding jaw in the return region (11ar), (11br) and/or
- 25 B in that the air cooling device (15) has at least one first cooling air circuit (151) with a heat exchanger and a blower and at least one second cooling air circuit (152) with a heat exchanger and a blower, the at least one first cooling air circuit (151) being formed for cooling the first molding jaws (1a) of the pairs of molding jaws (11) and the at least
- 30 one second cooling air circuit (152) being formed for cooling the second molding jaws (1b) of the pairs of molding jaws (11).

2. The corrugator device as claimed in claim 1 in conjunction with alternative A, characterized

in that the cooling air circuit has at least two partial cooling air streams, of which at least a first partial cooling air stream cools the at least one molding jaw in the molding passage (10) and at least a second partial cooling air stream cools the at least one molding jaw in the return region (11ar), (11br); or

in that the cooling air circuit is operated such that the cooling air stream first cools the at least one molding jaw in the return region (11ar), (11br) and then the at least one molding jaw in the molding passage (10) or vice versa, i.e. that the cooling air circuit first cools the at least one molding jaw in the molding passage and then the at least one molding jaw in the return region.

3. The corrugator device as claimed in one of the preceding claims in conjunction with claim 1, alternative B, characterized

in that, from the cooling air of the cooling air circuit leaving the heat exchanger, the at least first partial cooling air stream is supplied to the at least one molding jaw in the molding passage (10) to cool the molding jaw and the at least second partial cooling air stream is supplied to the at least one molding jaw in the return region (11ar, 11br) to cool the molding jaw, where the first partial cooling air stream leaving the at least one molding jaw in the molding passage (10) and the second partial cooling air stream leaving the at least one molding jaw in the return region (11ar, 11br) are supplied to the at least one heat exchanger (151w, 152w, 153w, 154w).

4. The corrugator device as claimed in claim 3, characterized

in that the first partial cooling air stream leaving the at least one molding jaw in the molding passage (10) is brought together with the second partial cooling air stream leaving the at least one molding jaw in the return region (11ar, 11br) before the entry into the at least one heat exchanger (151w, 152w, 153w, 154w) to form an overall cooling air stream, and the overall cooling air stream is introduced into the at least one heat exchanger; or

in that the first partial cooling air stream leaving the at least one molding jaw in the molding passage (10) and the second partial cooling air stream leaving

the at least one molding jaw in the return region (11ar, 11br) are introduced directly into the at least one heat exchanger (151w, 152w, 153w, 154w) as separate partial cooling air streams.

- 5 5. The corrugator device as claimed in one of the preceding claims in conjunction with claim 1, alternative B, characterized
in that the first cooling air circuit and the second cooling air circuit are formed such that the first cooling air circuit supplies cooling air at least to a first molding jaw (1a) in the molding passage (10) and/or in the return region
10 (11ar) and in that at the same time the second cooling air circuit (152) supplies cooling air at least to a second molding jaw (1b) in the molding passage (10) and/or in the return region (11br) of the same pair of molding jaws (11).
- 15 6. The corrugator device as claimed in one of the preceding claims, characterized in that a number of cooling air circuits (151, 152, 153, 154) and/or a number of heat exchangers (151w, 152w, 153w, 154w) are arranged along the molding passage (10) and/or along the return region (11ar, 11br).
- 20 7. The corrugator device as claimed in one of the preceding claims, characterized in that each cooling circuit (151, 152, 153, 154) has a connection device, which can be temporarily brought into connection or is permanently connected to one or more of the molding jaws running at the
25 time in the molding passage and/or in the return region.
8. The corrugator device as claimed in one of the preceding claims, characterized in that each molding jaw (1a, 1b) has at least one cooling air channel (1k), which extends within the wall of the molding jaw (1a, 1b) and/or
30 within a through-flow housing fastened such that it is resting on the outer side of the molding jaw (1a, 1b).
9. The corrugator device as claimed in claim 8, characterized in that the cooling air channel (1k) extends over the entire, or at least almost the entire,

diametrical circumferential contour of the molding area (1f) along the molding area.

10. The corrugator device as claimed in either of claims 8 and 9, characterized in that at least a main portion of the cooling air channel extends at a constant distance from the molding area.

11. The corrugator device as claimed in one of claims 8 to 10, characterized in that the cooling air channel (1k) of the molding jaw (1a, 1b) has an inlet (1u) and an outlet (1o) for the cooling air,

in that the cooling air device (15) has an inlet connection device (ef, er), at which the inlet (1u) of the cooling air channel (1k) of the molding jaw (1a, 1b) can be temporarily connected or is permanently connected, while the molding jaw (1a, 1b) in the molding passage (10) and/or the molding jaw in the return (11ar, 11br) is or are being guided, and

in that the air cooling device (15) has an outlet connection device (af, ar), at which the outlet (1o) of the cooling air channel (1k) of the molding jaw (1a, 1b) can be temporarily connected or is permanently connected, while the molding jaw (1a, 1b) in the molding passage (10) is being guided and/or the molding jaw in the return (11ar, 11br) is being guided.

12. The corrugator device as claimed in claim 11, characterized in that the cooling air is guided between the heat exchanger and the inlet connection device, at least in certain portions, in at least one pipe.

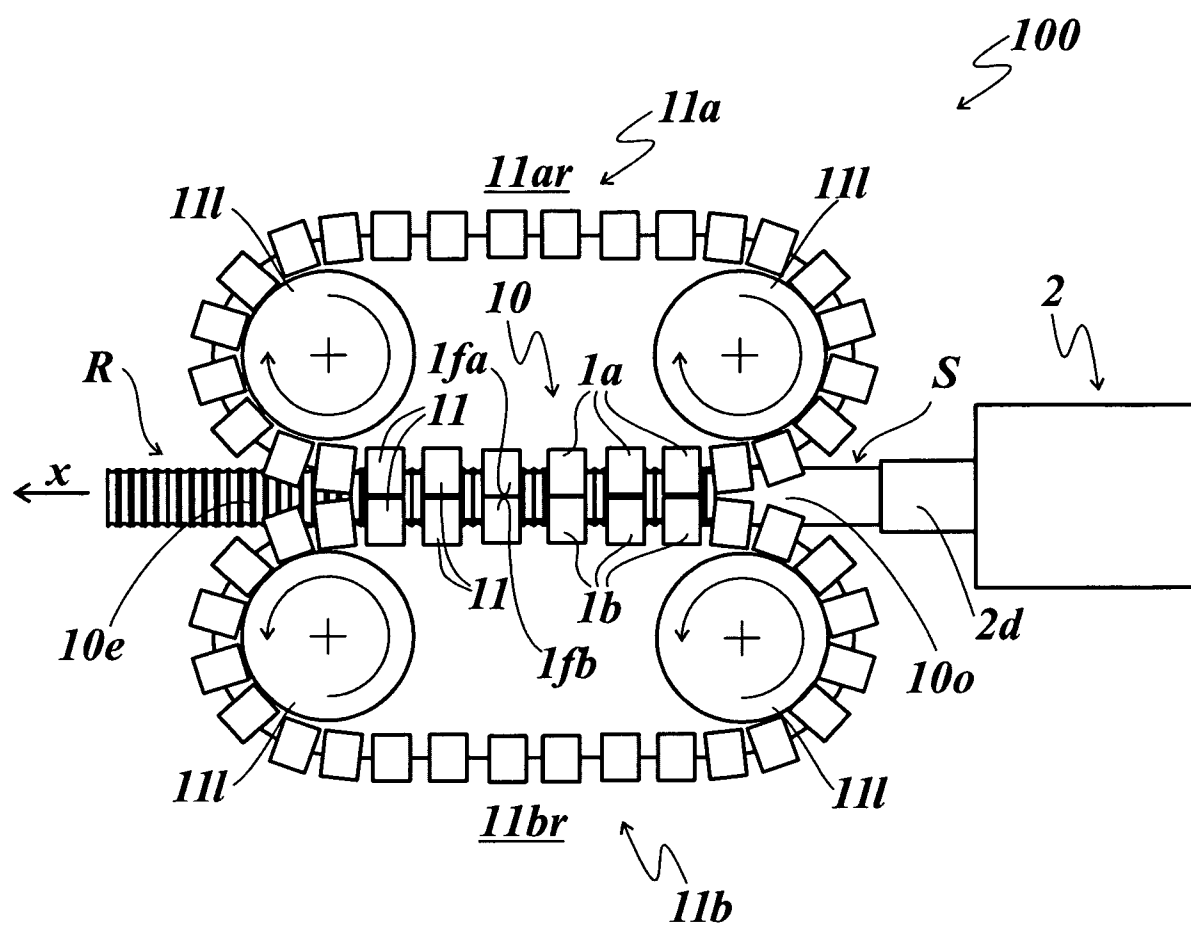
13. The corrugator device as claimed in either of claims 11 and 12, characterized in that the cooling air is guided between the outlet connection device and the heat exchanger, at least in certain portions, in at least one pipe.

14. The corrugator device as claimed in one of claims 8 to 13, characterized in that each molding jaw has a number of cooling air guiding channels arranged one behind the other in the axial direction of the molding passage.

15. The corrugator device as claimed in one of claims 8 to 14, characterized in that some or all of the cooling air guiding channels of the molding jaws have in each case an inlet and an outlet.
- 5 16. The corrugator device as claimed in one of claims 11 to 15, characterized in that an inlet opening of the inlet connection device and/or an outlet opening of the outlet connection device is formed as an opening that is elongate in the opening cross section, extends in the direction of production and/or in the direction of the longitudinal axis of the molding passage and thereby covers
10 over an inlet or a number of inlets or an outlet or a number of outlets of molding jaws in the molding passage.
17. The corrugator device as claimed in claim 16, characterized in that the coverage takes place while the molding jaws are passing the inlet connection
15 device or the outlet connection device in the molding passage.
18. The corrugator device as claimed in one of claims 11 to 17, characterized in that the connection between the air channels of the molding jaws and the inlet connection devices and/or the outlet connection devices is formed by a
20 sliding sealing connection between parts sliding on one another, the one part being formed as a raised sealing border and the other part being formed as a planar sealing area.
19. The corrugator device as claimed in claim 18, characterized in that the planar
25 sealing area is formed on the outer surface of the molding jaw and the raised sealing border is formed as a border of an opening of the inlet connection device (ef, er) of the air cooling device (15) and/or of the outlet connection device (af, ar) of the air cooling device (15).
- 30 20. The corrugator device as claimed in one of claims 8 to 19, characterized in that the inlet (1u) and/or the outlet (1o) of the cooling air carrying channel (1k) of the molding jaw (1a, 1b) is or are arranged on two separate outer sides of the molding jaw, to be precise either on outer sides adjacent at an angle or outer sides opposite one another of the molding jaw (1a, 1b).

21. The corrugator device as claimed in one of claims 11 to 20, characterized in that the inlet connection device (ef, er) of the air cooling device (15) and/or the outlet connection device (af, ar) of the air cooling device (15) and/or the pipes (k1 , k2, k21 , k22, k31 , k32) is or are formed in a stationary manner in a frame of the corrugator device.

22. The corrugator device as claimed in one of the preceding claims 8 to 21, characterized in that the cooling air channel or the cooling air channels of a molding jaw is or are arranged between the molding area of the molding jaw and a carrier of the molding jaw.

**Fig. 1**

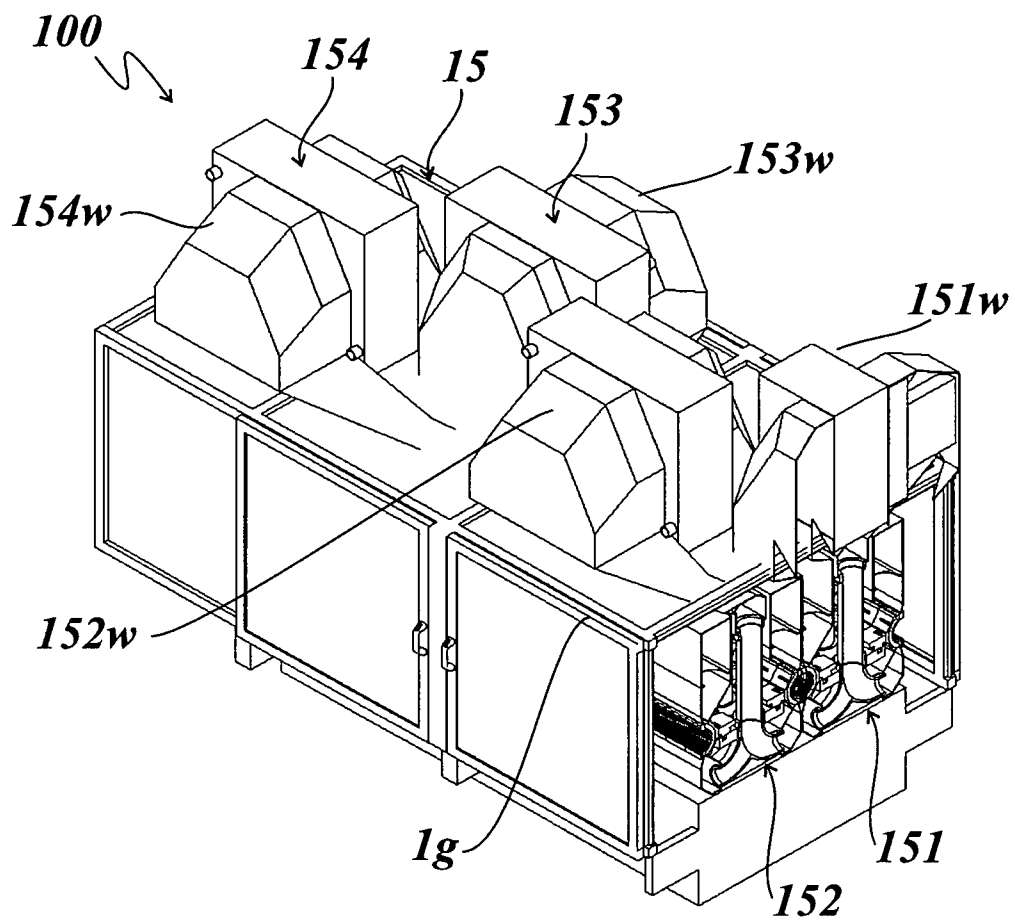
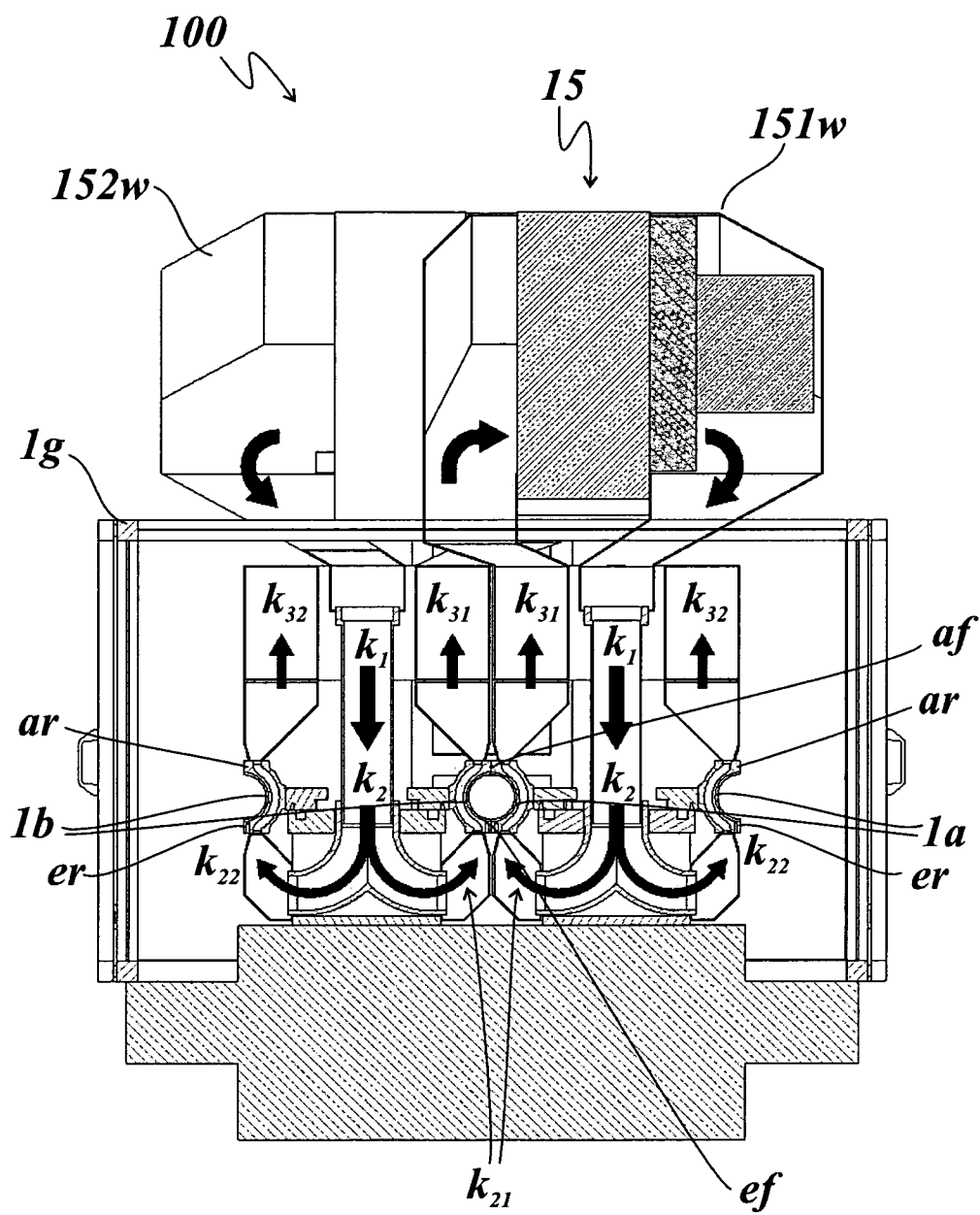
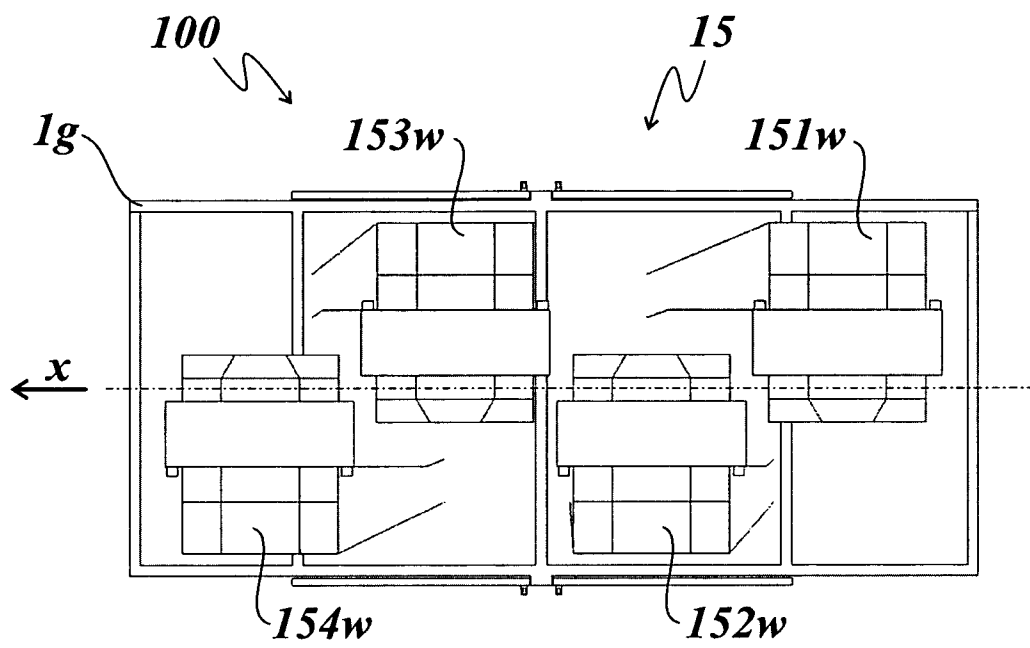


Fig. 2

**Fig. 3**

**Fig. 4**

5/8

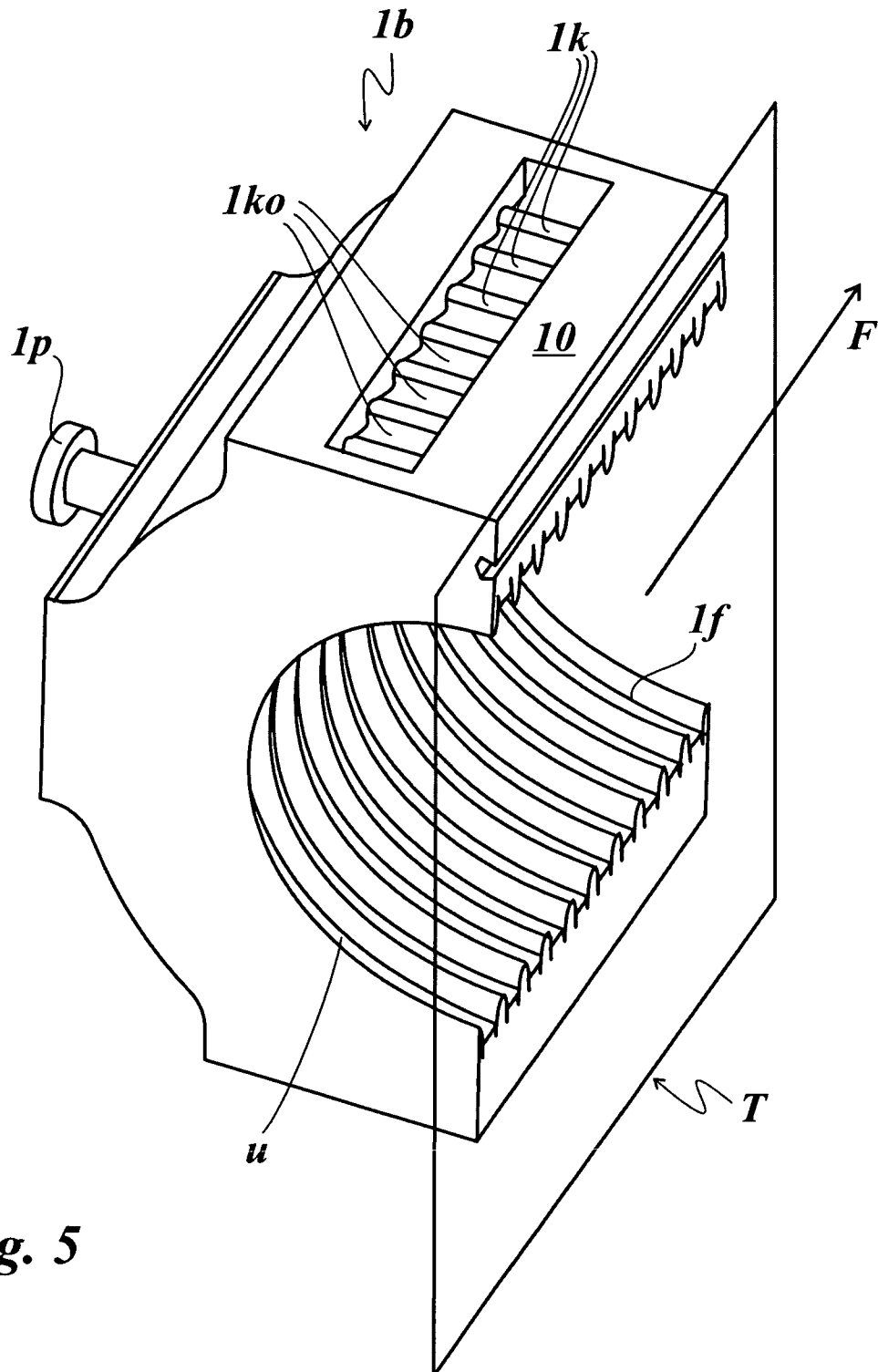
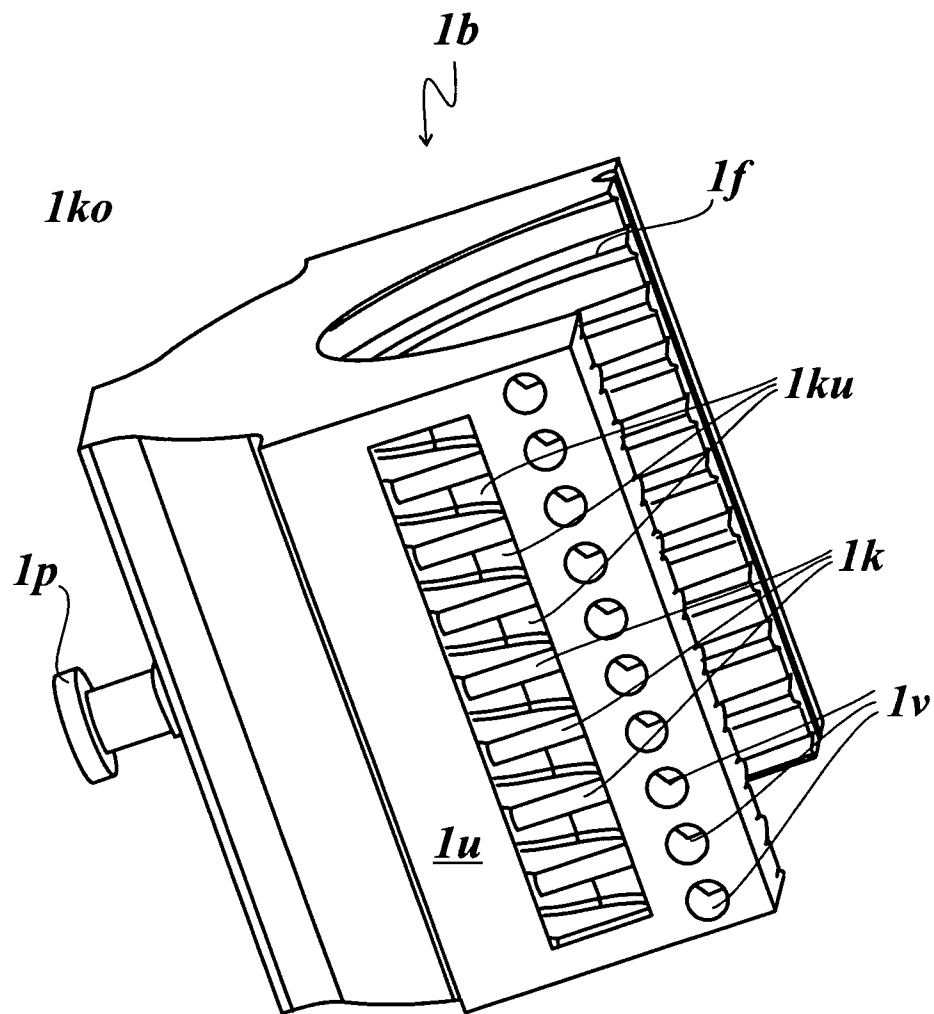


Fig. 5

**Fig. 6**

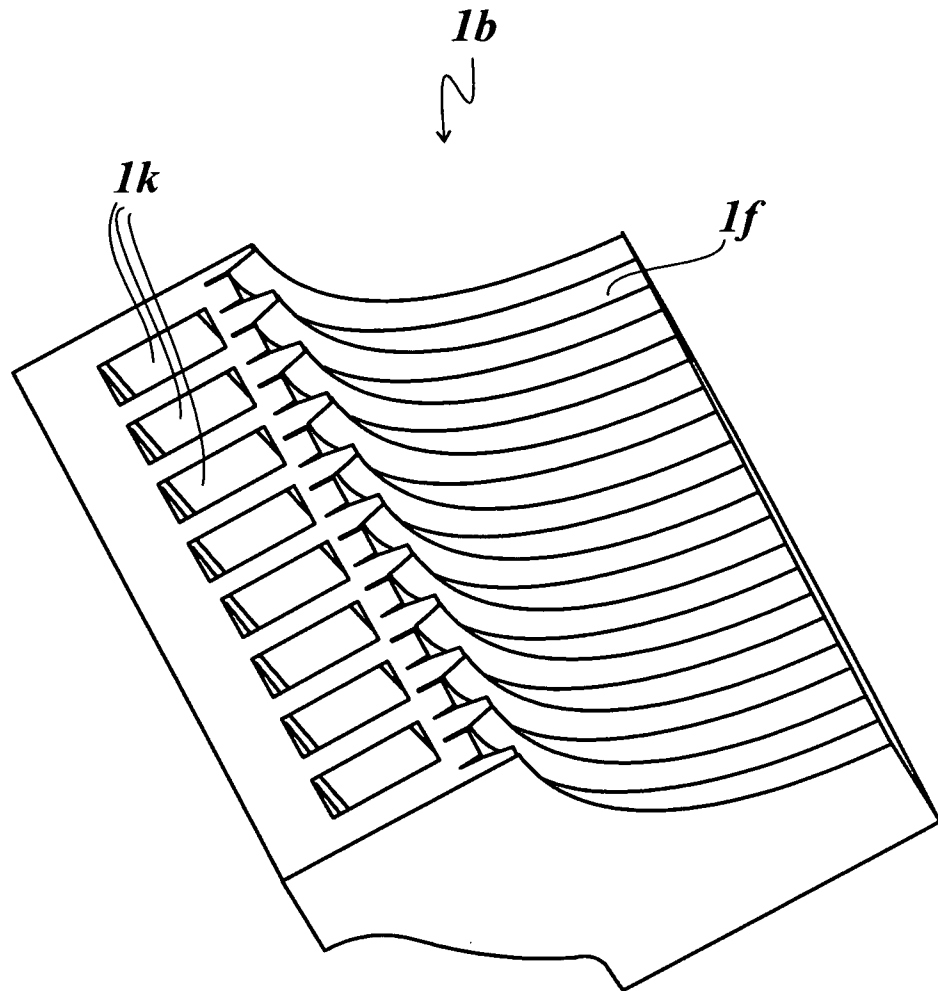


Fig. 7

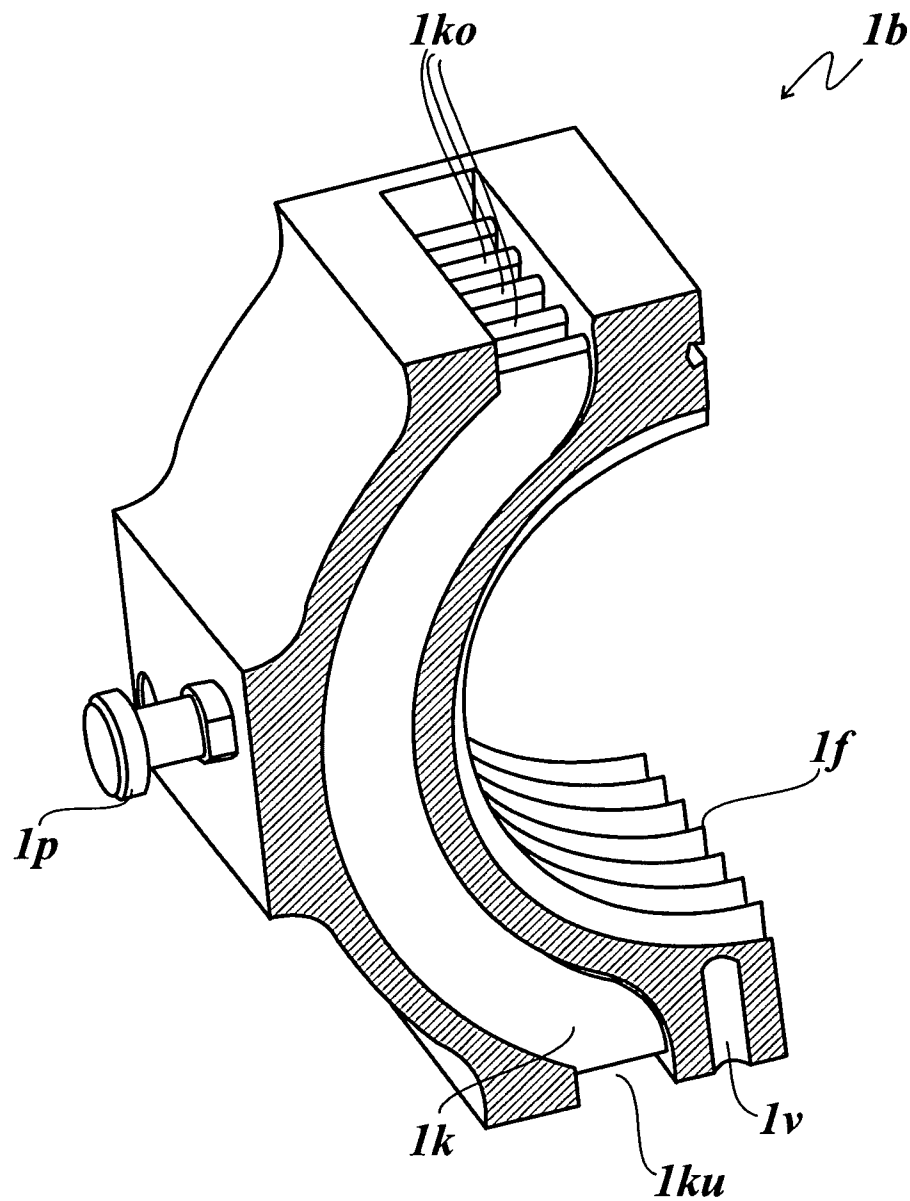


Fig. 8

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2010/004231

A. CLASSIFICATION OF SUBJECT MATTER

INV. B29C49/00

B29C49/48

B29C47/12

B29C47/88

ADD. B29C35/16

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 practical, search terms used)

EPO-Internal , WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 072 453 A (OLTMANN HEINRICH ET AL) 7 February 1978 (1978-02-07) claims 1,5-7 ; figures 1,3-5 column 3, line 37 - column 4, line 21 column 4, lines 41-65 column 5, line 40 - column 6, line 30 -----	1-13 , 15-17 , 20-22
X	JP 2 125715 A (MIRAI IND) 14 May 1990 (1990-05-14)	1
A	abstract; figures 2,7-12 , 15 , 18-21 -----	16, 17
X	JP 59 111821 A (MIRAI IND) 28 June 1984 (1984-06-28)	1
A	abstract; figures 1-8 -----	16, 17
X	EP 0 359 089 A2 (LUPKE MANFRED ARNO ALFRED) 21 March 1990 (1990-03-21)	1
A	column 4, lines 26-40; figures 1-4 -----	18, 19



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

17 August 2011

Date of mailing of the international search report

25/08/2011

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Authorized officer

Baran , Norbert

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2010/004231

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☒ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos. :

16-19

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos. :

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-13, 15, 20, 21(completely) ; 22(parti ally)

A corrugator device.

2. claims: 1, 8, 14, 15(completely) ; 22(parti ally)

A corrugator device with a number of cooling air guiding channels in each molding jaw.

3. claims: 1, 8, 11, 15-17

A corrugator device with an inlet opening of the inlet connection device and/or an outlet opening of the outlet connection device with a specific opening cross section.

4. claims: 1, 8, 11, 15, 18, 19

A corrugator device with a specific connection between the air channels of the molding jaws and the inlet and/or outlet connection devices.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2010/004231

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