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(54) METHOD FOR PRODUCING ROOFING TILES AND DEVICE FOR PRODUCING SAID ROOFING TILES

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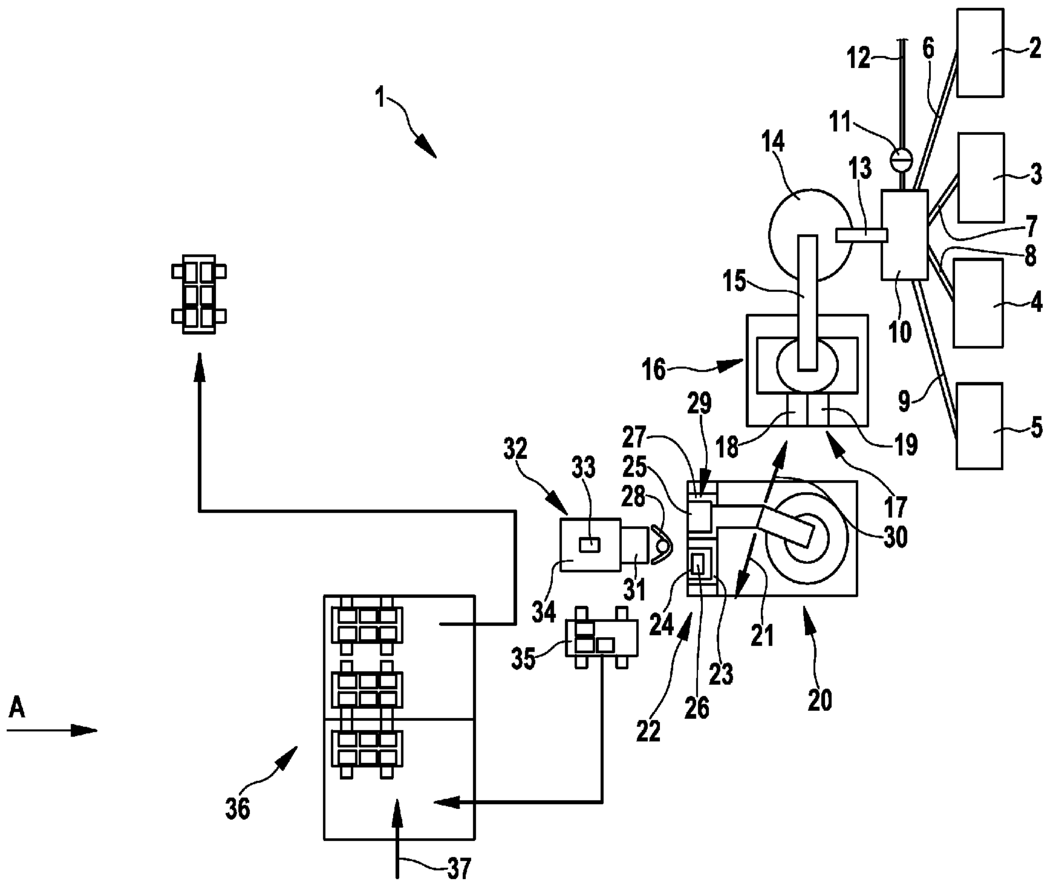
(57) **ABSTRACT**

The invention relates to a method for producing roofing tiles by means of a core shooting device. A core box comprises a mold carrier in the interior thereof. Fresh concrete is introduced into the core box through an injection opening. The core box is ventilated by means of at least one screen nozzle disposed on the mold carrier. The roofing tile produced in the core box is removed from the core box and fed into a cutting device, where protruding burrs of the roofing tile are removed.



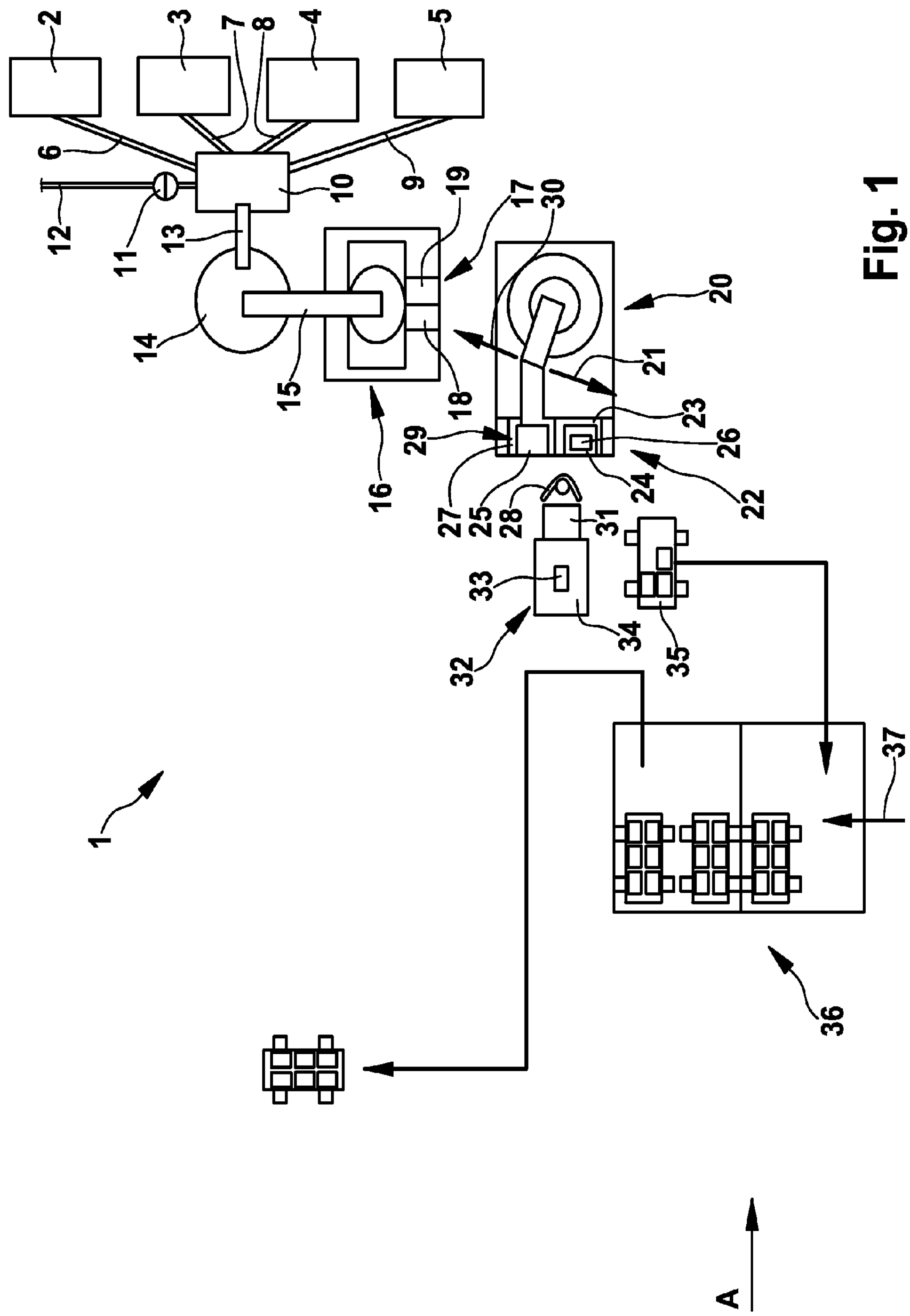

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Fig. 1

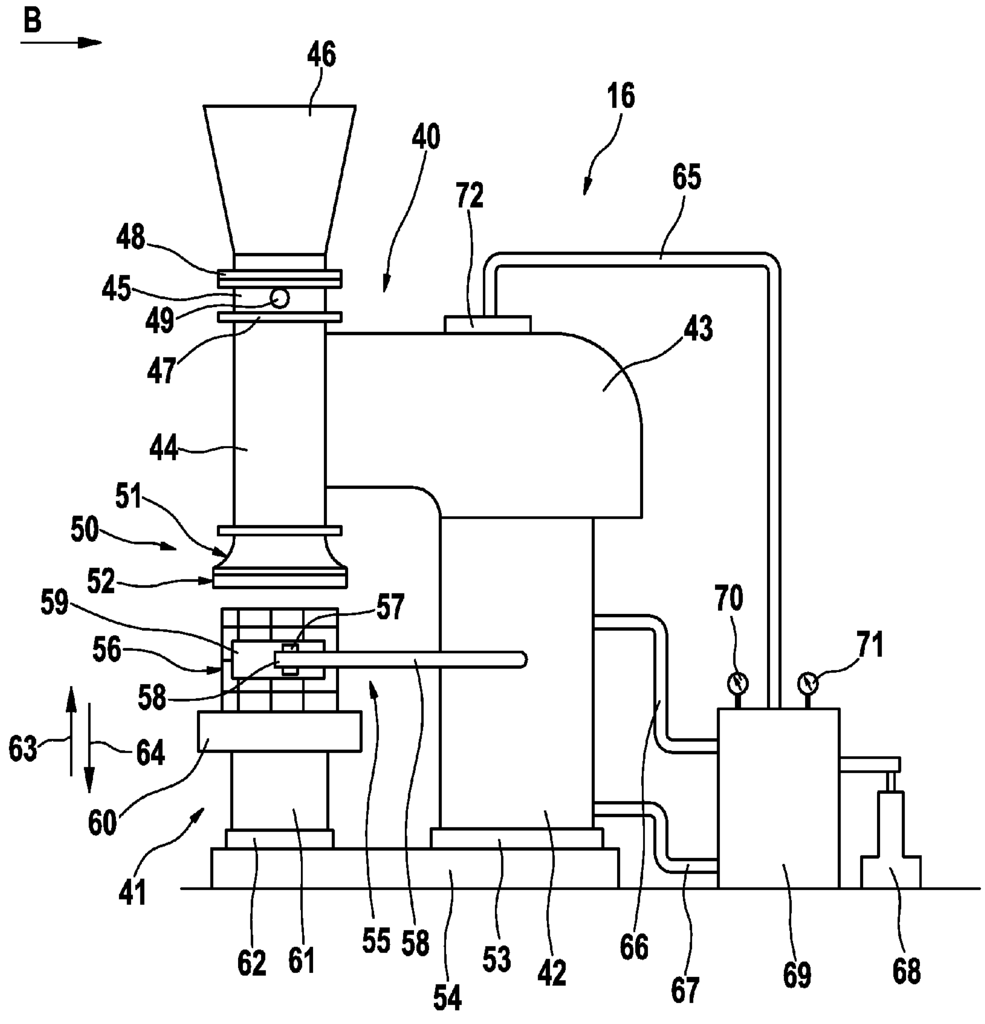
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Fig. 2

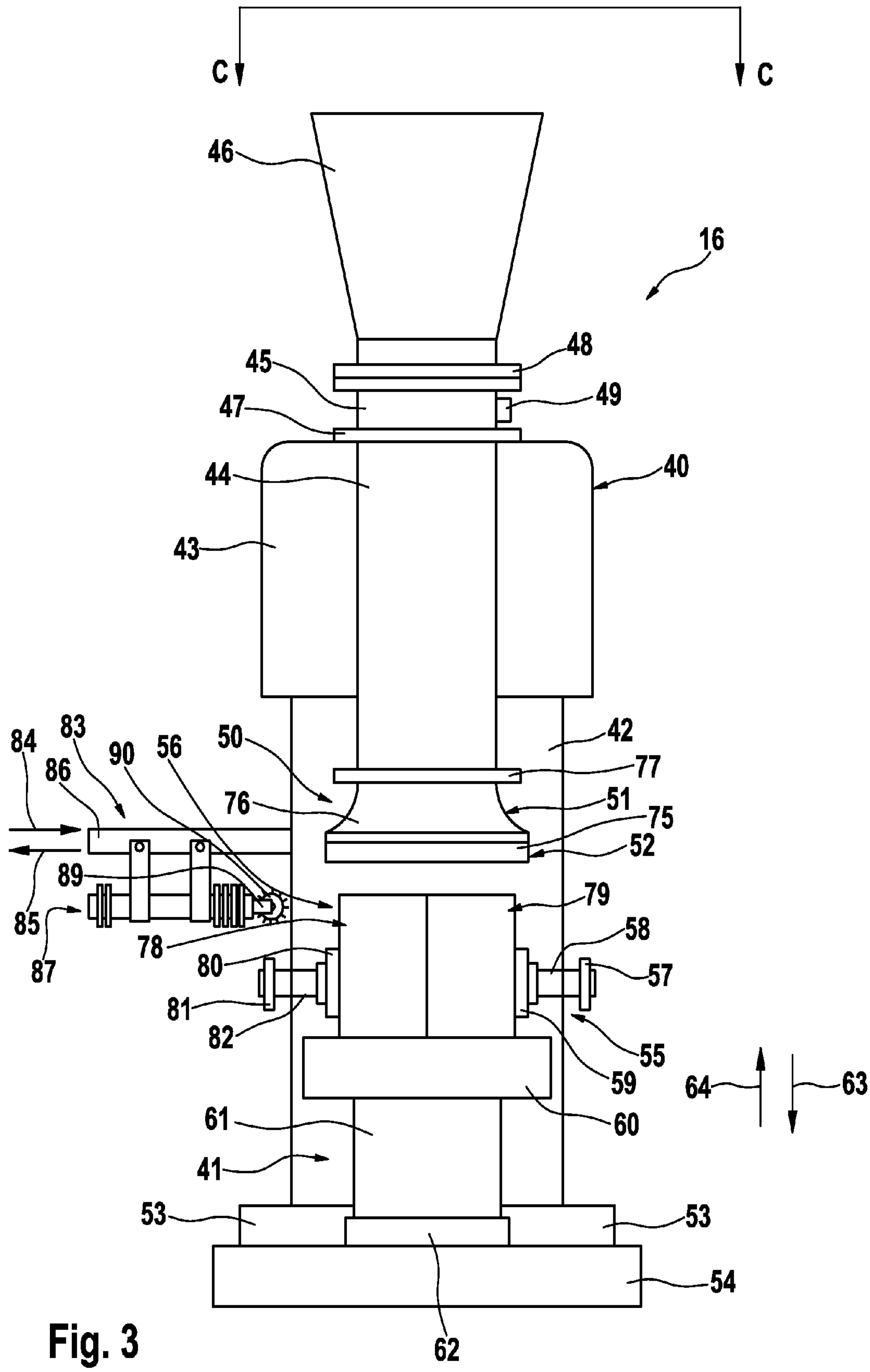
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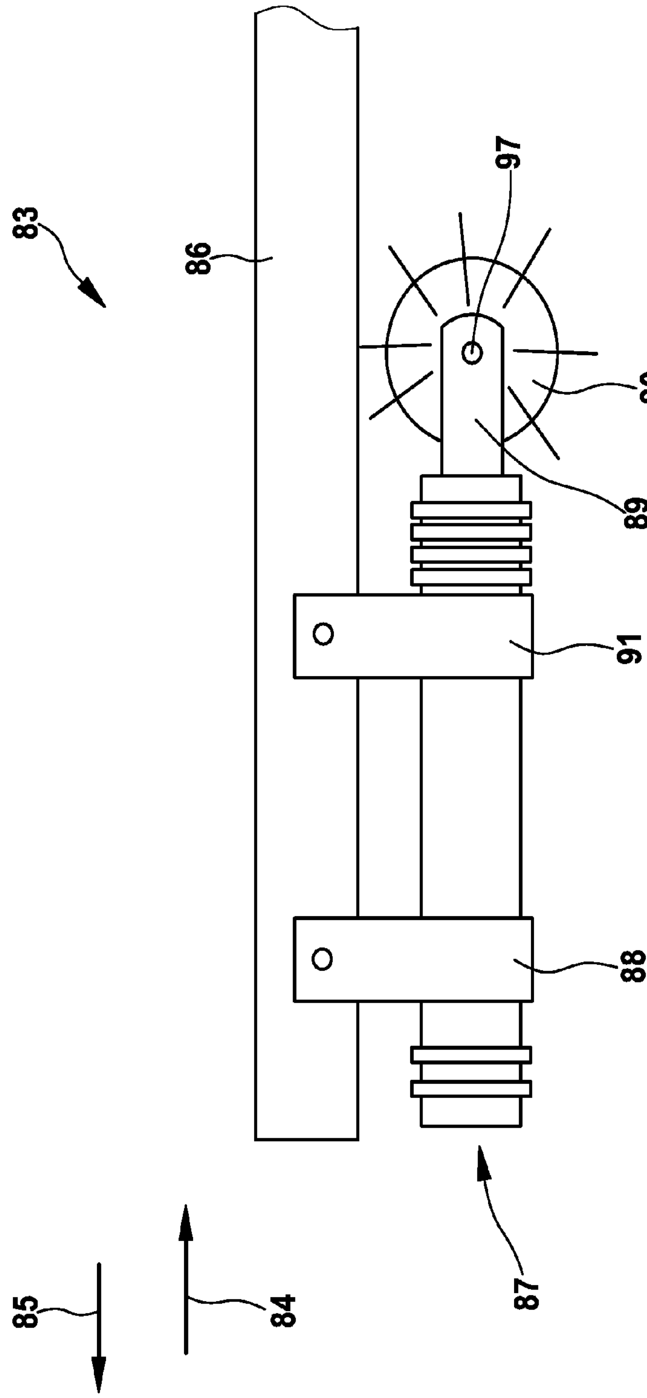
Fig. 3



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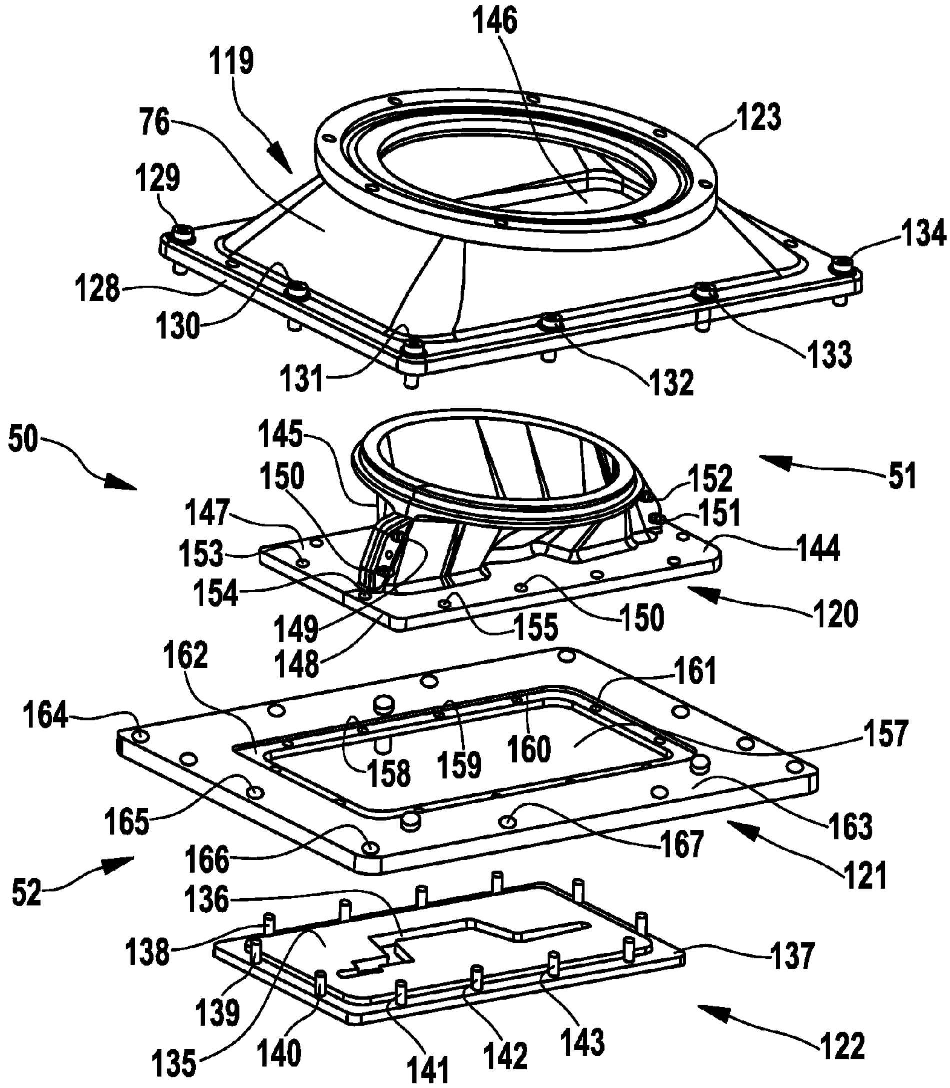
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Fig. 5

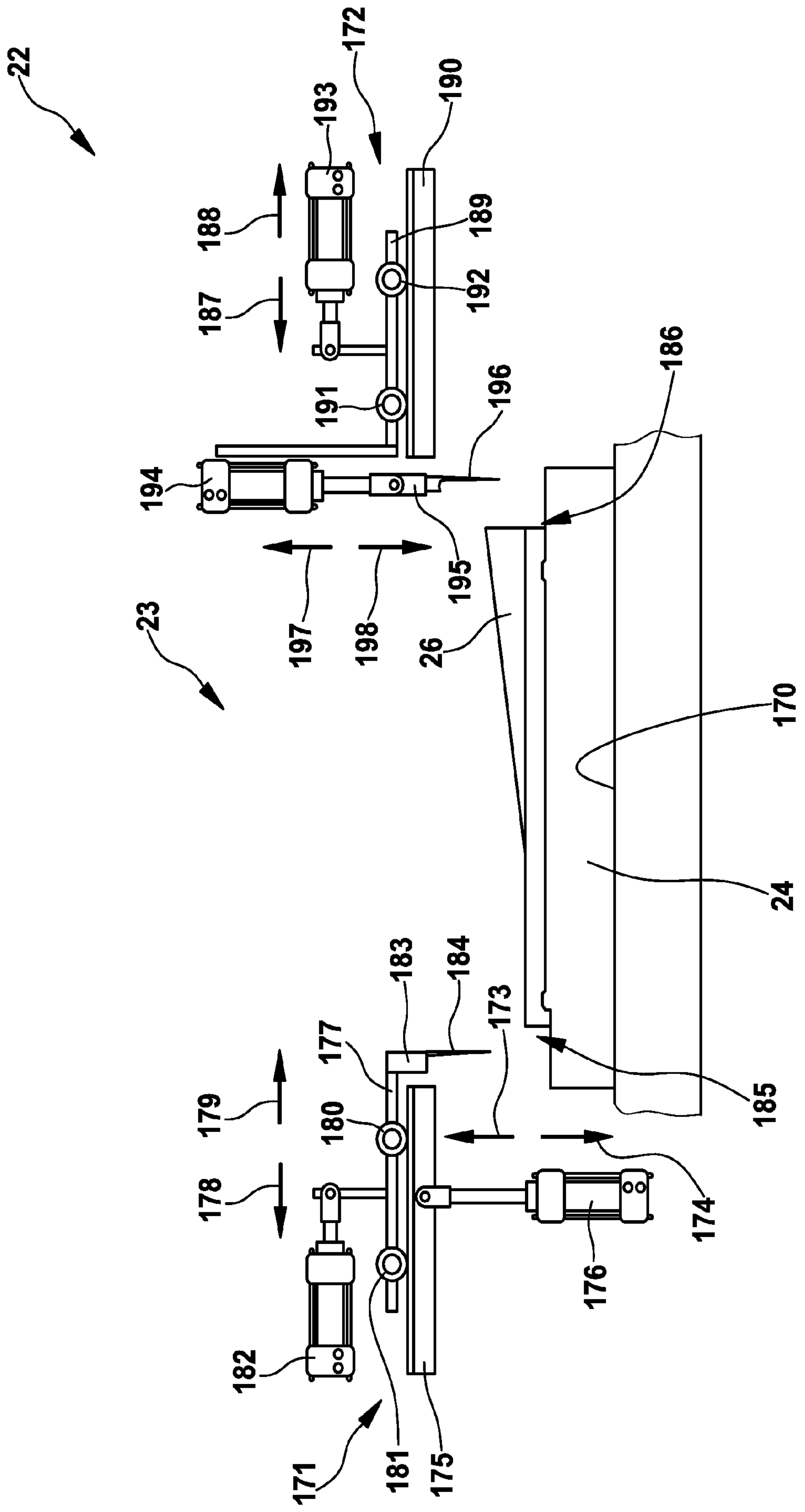
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Fig. 6

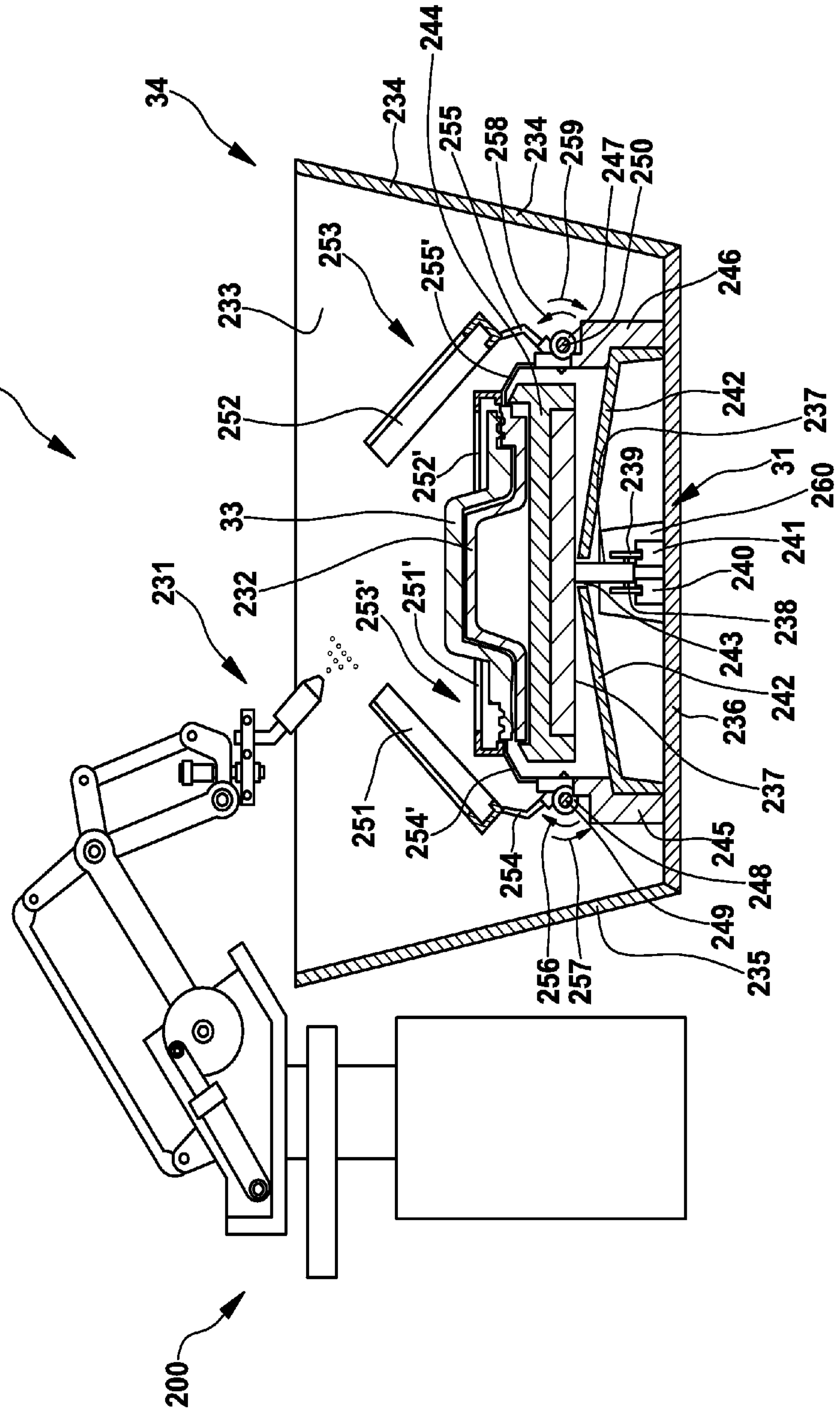
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Fig. 7

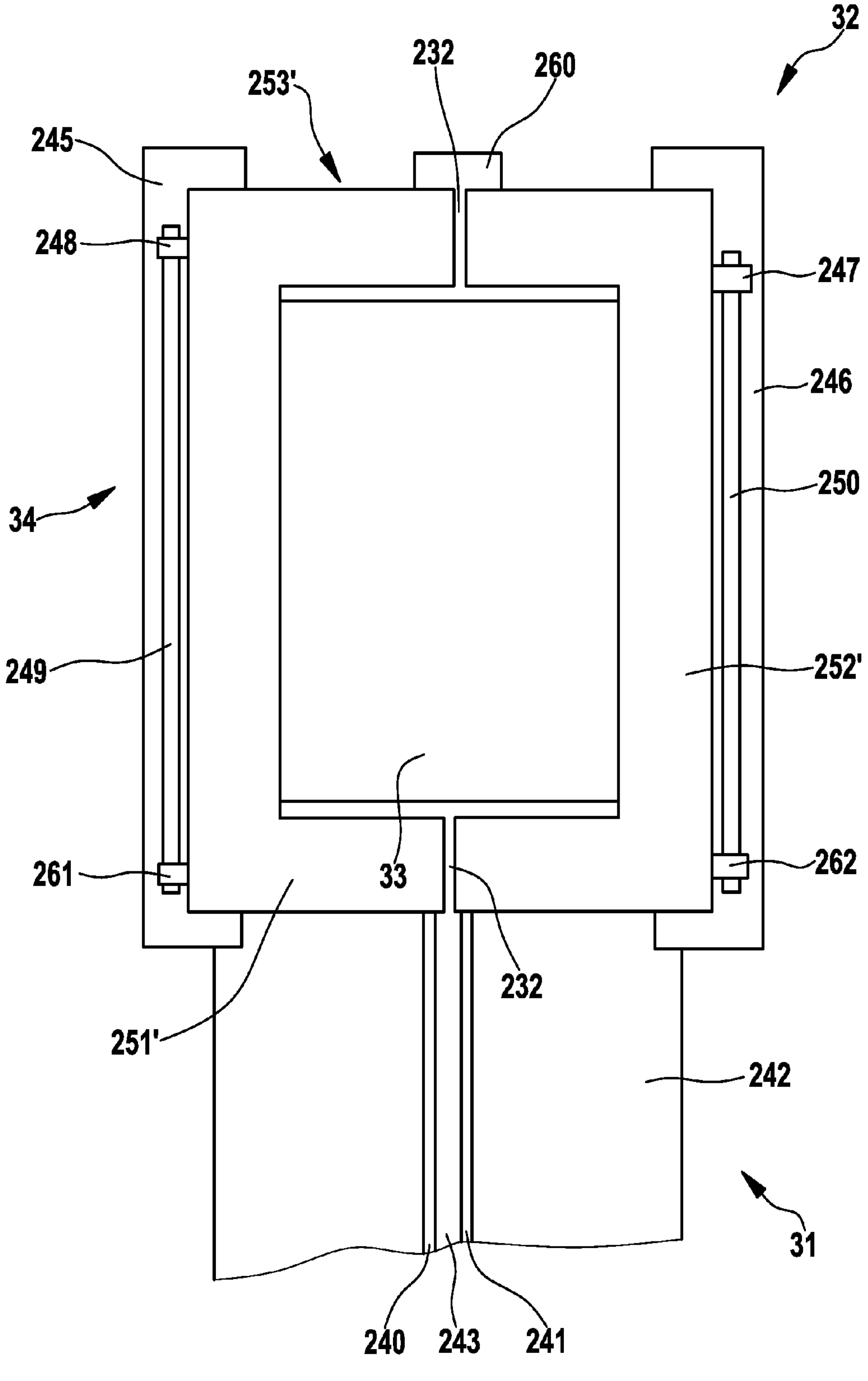
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Fig. 8

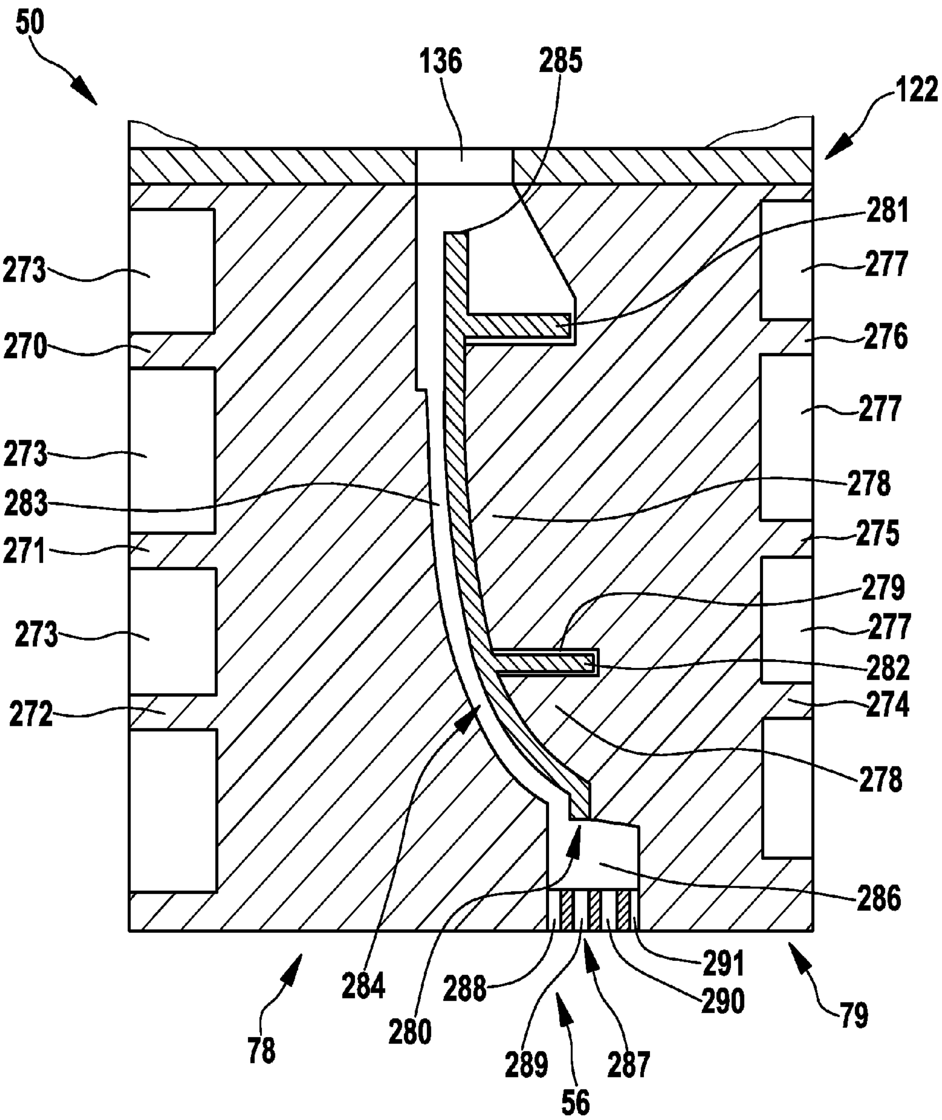
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Fig. 9

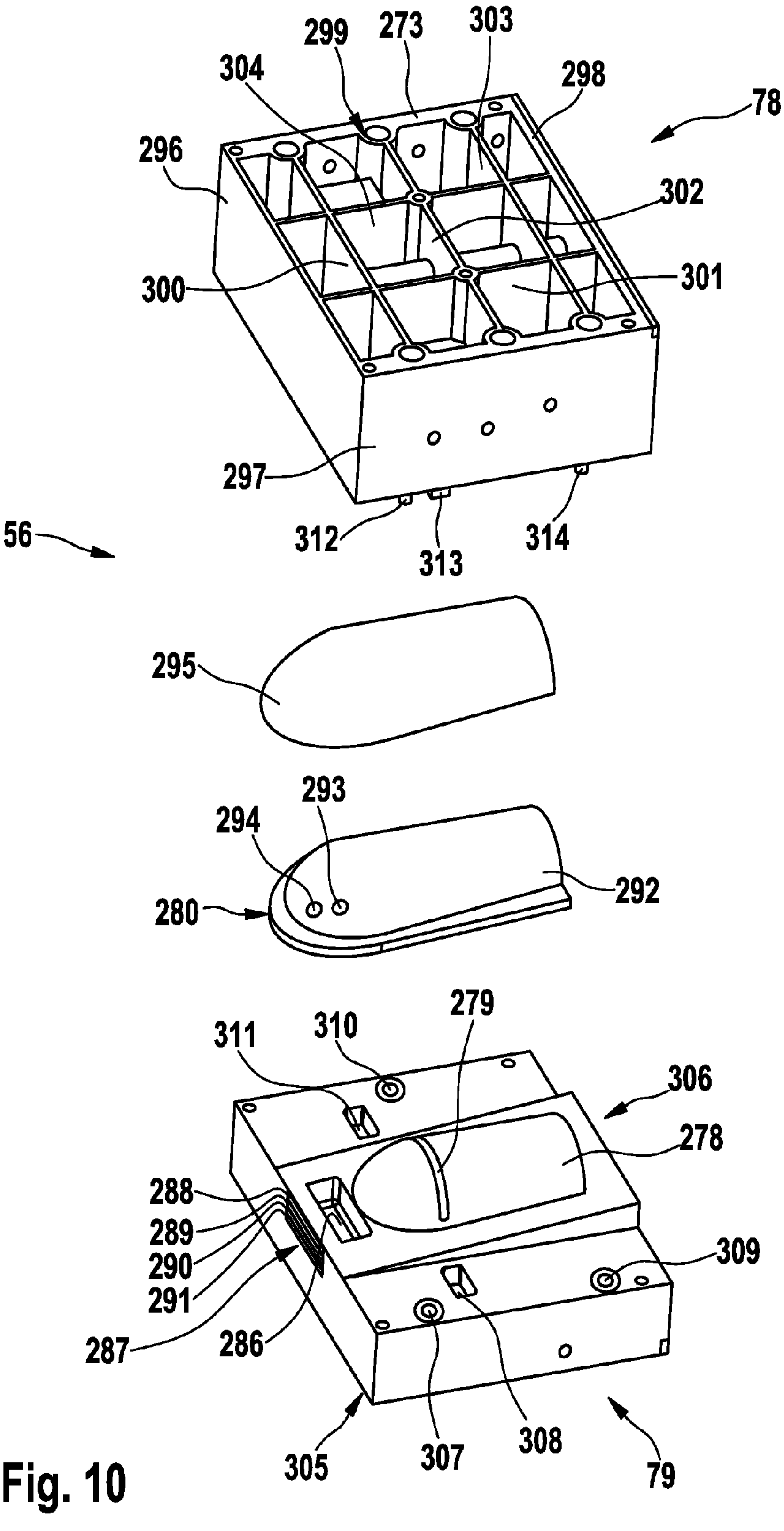
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Fig. 10

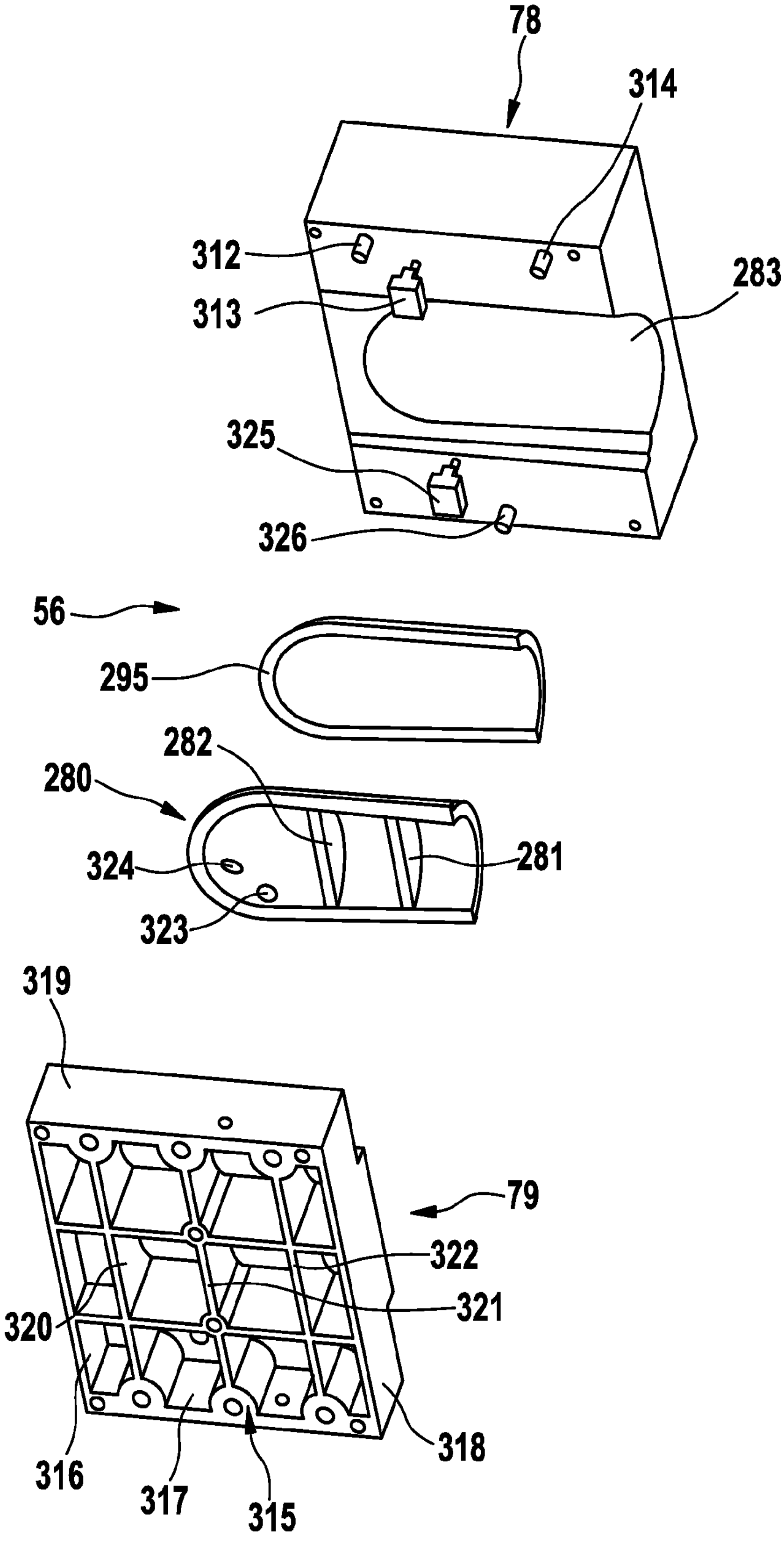
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Fig. 11

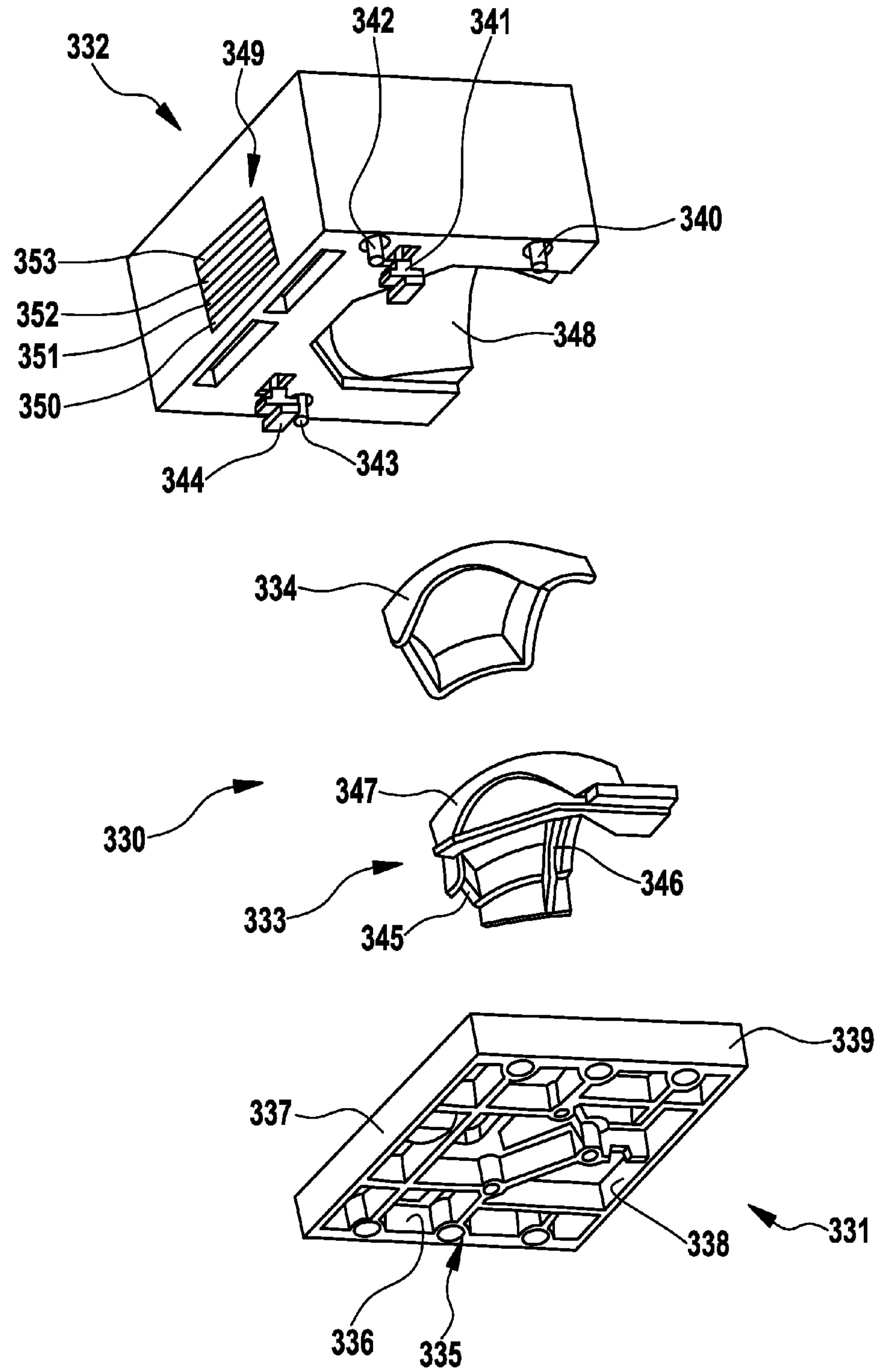
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Fig. 12

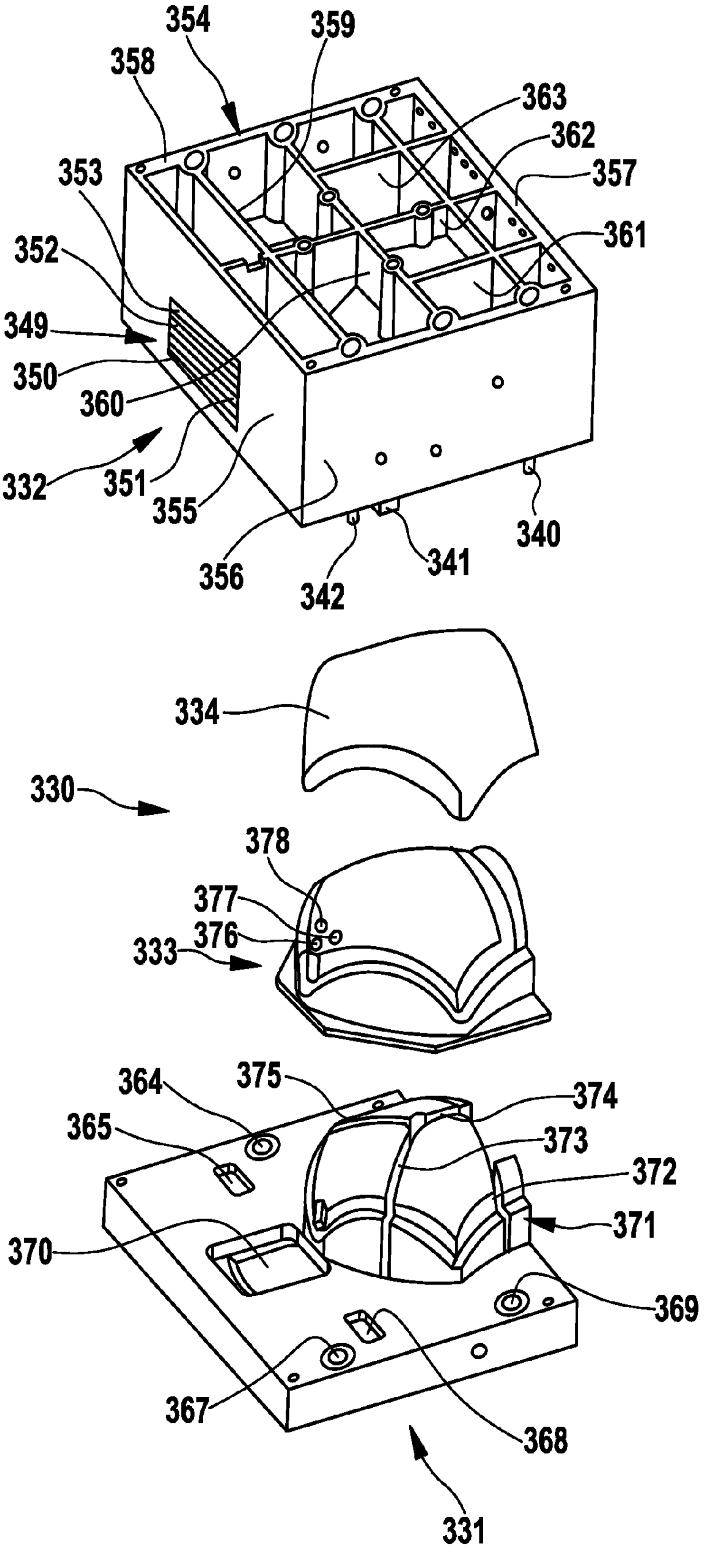
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Fig. 13

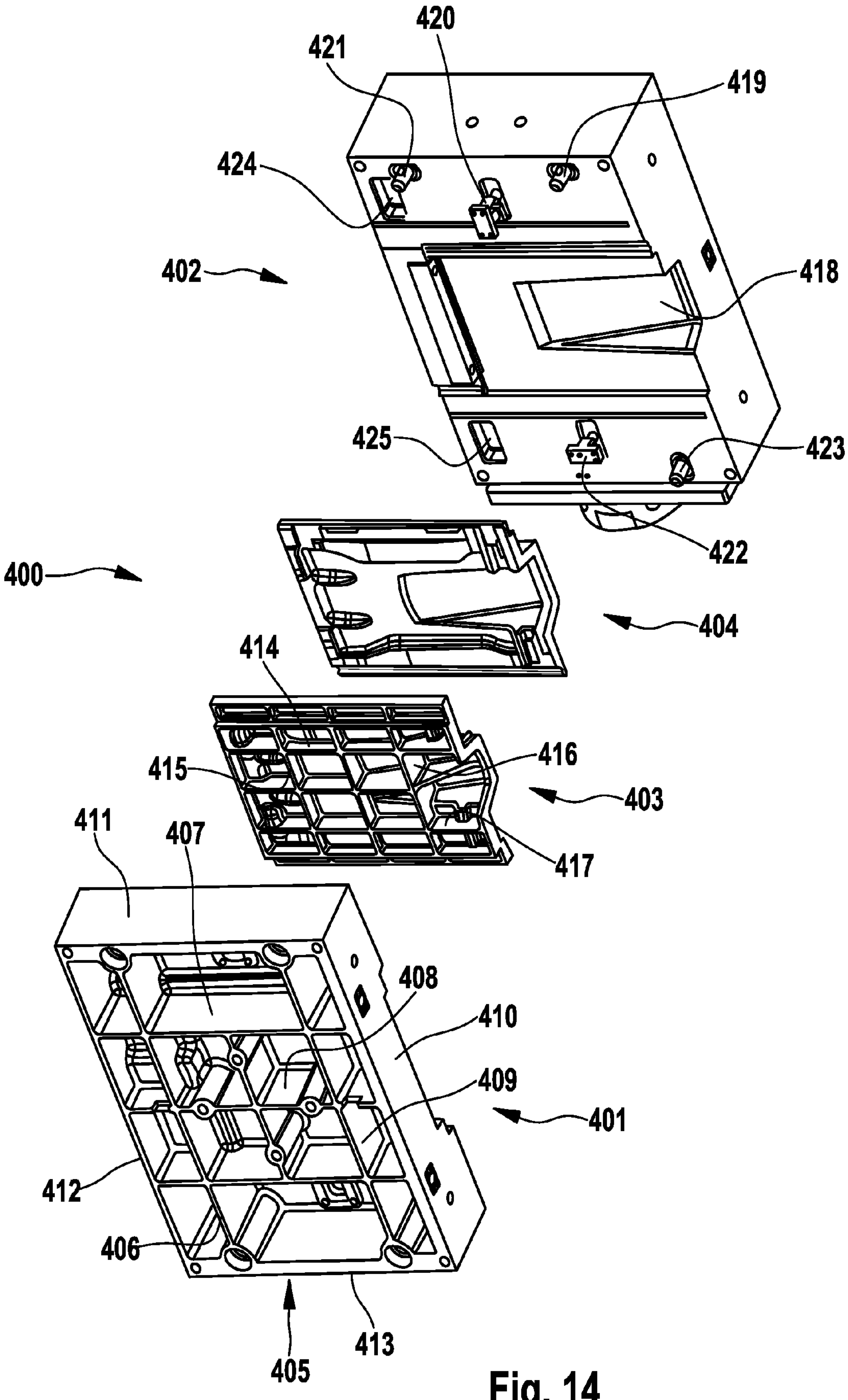
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Fig. 14

METHOD FOR PRODUCING ROOFING TILES AND DEVICE FOR PRODUCING SAID ROOFING TILES

[0001] The invention relates to a method for the production of roofing tiles according to the preamble of claim **1** as well as to a device for the production of these roofing tiles according to the preamble of claim **16**.

[0002] In the case of pitched roofs the major portion of the roof surface is covered with flat roofing tiles. However, for the roofing of certain regions of the roof and for satisfying specific technical functions, the flat roofing tiles are installed in combination with accessory tiles. Accessory tiles are, for example, the ridge and arris starting tiles to be installed in the ridge and arris regions as well as the hip caps. Among the accessory tiles with technical function are, in contrast, snow guard tiles, venting tiles and [foot-]standing tiles. Since accessory tiles have markedly more complex geometries compared to flat roofing tiles, the production of flat roofing tiles and accessory tiles prove to be highly different.

[0003] Flat roofing tiles are produced using extrusion molding, such as is described in the German [laid open] application DE 35 22 846 A1. Herein green cement is placed onto a continuous belt of bottom dies and pressed into the bottom die by means of a profiled roller such that a continuous belt of compacted green concrete is generated, whose cross sectional profile corresponds to that of the future flat roofing tile. The continuous belt is subsequently cut such that each bottom die bears a single molded flat roofing tile blank. While the extrusion molding method ensures the efficient production of the flat roofing tiles, however only simple geometries can be produced since the forming by means of a roller and a bottom die does not permit providing the flat molded roofing tile blank with contours extending transversely to the direction of extrusion. However, many accessory tiles require such contours.

[0004] An alternative method which permits a greater degree of freedom of the forming, is the core shooting method disclosed in EP 1 106 281 B1, in which by means of compressed air a molding material with delayed curing properties is injected into a core box and subsequently removed from it. To inject the molding material, the core box is substantially positioned in a perpendicular with respect to the longitudinal direction of the body to be formed and swivelled substantially into a horizontal for the removal of the molded body. The molding material described in EP 1 106 281 B1 can be a green concrete, whereby the invention can be employed in the production of roofing tiles.

[0005] In practice accessory tiles are produced manually which is time consuming and cost intensive. Ridge and arris starting tiles are produced using a two-part molding box, wherein the lower half of the molding box forms the underside and the upper half of the molding box the upper side of the ridge or arris starting tile. After placing the green concrete manually into the lower half, the upper half of the molding box is placed onto it and pressed against it. The densification of the green concrete subsequently takes place thereby that the molding box is placed onto a vibrating table. Depending on the dwelling time on the vibrating table, the densification of the green concrete yields different results such that the ridge and arris starting tiles vary with respect to their freeze-thaw cycling resistance.

[0006] The methods for the production of snow guard tiles, venting tiles and standing tiles are very similar. In the production of snow guard tiles, first, a rib serving as a snow barrier is formed from the green concrete, which rib subsequently is adhered in the foot-end region onto the top side of the flat roofing tile. The production of standing tiles takes place by prefabricating the bracket comprising the climbing step and adhering it onto the roofing tile. For the production of a venting tile, a venting opening is cut centrally out of the flat roofing tile, which opening is subsequently covered with a separately fabricated venting hood against the penetration of rain. For this purpose the venting hood is adhered onto the top side of the flat roofing tile. The adhesive bonding in such accessory tiles represents a mechanical weak spot, which tends toward the formation of cracks. Through the penetration of moisture, frost bursting can occur and the further weakening of the adhesive bond. Under the action of an external force, for example when a roofer walks on the roof during an inspection, there is the risk that the adhered joined part (snow barrier, bracket, venting hood) become detached from the flat roofing tile. Since the flat roofing tiles and the joined parts are produced separately, their color coatings are also carried out independently of one another. The color of the flat roofing tiles and that of the joined parts therefore vary such that the finished accessory parts also do not exhibit a uniform appearance. It is not possible to produce a faultless esthetic appearance even with an additional color coating of the finished accessory tile.

[0007] The present invention therefore addresses the problem of providing a method and an installation which make feasible the economically more efficient production of accessory roofing tiles and simultaneously the enhancement of the quality of the produced accessory structural tiles.

[0008] The problem addressed by the invention is resolved according to the features of patent claims **1** and **16**.

[0009] The invention thus relates to a method for the production of roofing tiles by means of a core shooter [device]. Herein a core box is provided which includes in its interior a mold carrier. Through an injection opening of the core box green concrete is introduced into the core box. Venting the core box takes place via at least one screen nozzle disposed in the mold carrier. The roofing tile generated in the core box is removed from the core box and transferred to a cutting device, where projecting burrs of the roofing tile are cut off

[0010] According to the invention the green concrete is shot or injected at high kinetic energy via a compressed air percussion into the molding box of a core shooter for the production of accessory tiles, whereby a compaction is attained that is markedly higher than is the case when using the conventional densification of the green concrete on a vibrating table. Due to the higher compaction of the green concrete, the accessory tiles have a lesser porosity and therewith a higher freeze-thaw cycling resistance (according to DIN EN 490, tested according to DIN EN 491).

[0011] Since the cavity of the molding box receiving the green concrete corresponds to the finished accessory tile, monolithic accessory tiles are generated. The separate production and the time-consuming adhesion of flat roofing tiles and joined parts become superfluous, and the accessory tile accordingly also no longer has a weakening adhesive bond.

[0012] After the injection step, the molding box can be removed from the core shooter and be disassembled. The accessory tile is subsequently removed from the molding box and transferred promptly to a coating station, such that the color application takes place on the still wet green concrete of the not yet cured accessory tile. This process is referred to as wet coating. Color variations, such as were previously unavoidable due to the separate color coating of the flat roofing tiles and of the joined parts, are in this way avoided. Wet coating, moreover, permits the optimal cross-linking of the coloring agent, which conventionally is a polymer dispersion coloring agent, with the surface of the accessory tile such that improved adhesion and durability of the color coating is attained. A single color application is sufficient for an esthetic appearance of the accessory tile.

[0013] Several embodiments of the invention will be explained in conjunction with the Figures and explained in the following in further detail. In the drawing depict:

[0014] FIG. **1** an installation for the production of accessory tiles in schematic representation;

[0015] FIG. **2** a side view of a core shooter with a core box located within the installation shown in FIG. **1**;

[0016] FIG. **3** a front view of the core shooter shown in FIG. **2** with core box viewed in direction B;

[0017] FIG. **4** a re-pressing unit;

[0018] FIG. **5** an exploded representation of a shooting unit;

[0019] FIG. **6** two cutting tools disposed in a receiving device according to FIG. **1**;

[0020] FIG. **7** a color coating installation of the installation according to FIG. **1**;

[0021] FIG. **8** a top view onto a spray chamber disposed in the color coating installation according to FIG. **7**;

[0022] FIG. **9** a section C-C through the core box shown in FIG. **3** with a portion of the core shooter according to FIG. **3**;

[0023] FIG. **10** an exploded representation of the core box shown in FIG. **9**;

[0024] FIG. **11** a different view of the core box according to FIG. **10**;

[0025] FIG. **12** an exploded representation of a variant of the core box shown in FIG. **10**;

[0026] FIG. **13** a different view of the core box according to FIG. **12**;

[0027] FIG. **14** an exploded representation of a further variant of the core box shown in FIG. **10**.

[0028] FIG. **1** depicts schematically an installation **1** for the production of accessory tiles. The method for the production of accessory tiles will be described in the following in conjunction with FIG. **1**. The installation **1** comprises four silos **2** to **5**, in which the components for the production of a green concrete mixture are stored. The silo unit **2** contains pigments and additives, the silo unit **3** sand of several particle-size distribution curves, the silo unit **4** cement and the silo unit **5** aggregates. The silo units **2** to **5** are connected via worm conveyors **6** to **9** with a weighing and dosing device **10**, such that the components can be supplied from the silo units **2** to **5** to the weighing and dosing device **10**. The weighing and dosing device **10** is furthermore connected to a water conduit **12** provided with a shut-off valve **11**, via which conduit the water can be obtained which is required for mixing the green concrete mixture. Part of the weighing and dosing device **10** is a computing unit in which the formula for the green concrete mixture is stored and with which the worm conveyors **6** to **9** and the shut-off valve **11** can be driven. The weighing and dosing device **10** can in this manner assemble the individual components according to the formula and supply them to a mixer **14** via a feed line **13**. To the mixer **14** are first supplied the solid components and, with the start of the mixing process, the addition of the liquid components, thus of the water and of the additives, takes place. The components are thoroughly mixed for approximately three minutes in the mixer **14**.

[0029] The mixture has the following composition:

[0030] sand (type 0/3, Producer: CWS) 45 to 75 wt %, especially preferred 54.13 wt %,

[0031] sand (type 0.5/2, producer: CWS): 0 to 24 wt %, especially preferred 11.4 wt %,

[0032] quartz sand (type L 55, producer: Quarzwerke): 0 to 30 wt %, especially preferred 5.7 wt %,

[0033] cement (type CEM II 52.5, producer: Holcim): 18 to 25 wt %, especially preferred 20.89 wt %,

[0034] additive (type FK 61, producer: MC Bauchemie): 0.2 to 1.4 wt %, especially preferred 0.47 wt %,

[0035] additive (type BWA 22, producer: MC Bauchemie): 0.2 to 0.8 wt %, especially preferred

[0036] coloring agent (type granite, producer: Lanxess): 0.3 to 1.0 wt %, especially preferred 0.5 wt %.

[0037] The pot life of the green concrete mixture is approximately 20 minutes. After this time its processing property is impaired, which can have a negative effect on the product quality. The pot life is thus the time between mixing a multi-component substance and the end of its processibility, thus the time interval in which the substance can still be "removed from the pot" and processed. The end of the pot life is most frequently indicated by a marked viscosity rise, which prevents further processing. It is therefore recommended to produce each time only a small green concrete quantity of approximately 50 to 100 kg, which can be quickly used up. The produced green concrete is transferred from the mixer **14** to an extraction belt **15** and from it is supplied to a core shooter **16**. The core shooter **16** is described in greater detail in FIGS. **2** to **5**. In the core shooter **16** can be seen an upright core box **17**. This core box **17** is comprised of a first box part **19**, the so-called upper core box **19**, and a second box part **18**, the so-called lower core box **18**. The details of a core box will be described later in FIGS. **9** to **14**.

[0038] Injecting the green concrete into the core box **17** takes place through a compressed air percussion. Through the entering air stream the green concrete is herein converted into a two-phase mixture of compressed air and concrete particles. The concrete particles are entrained by the air stream via an injection opening, not visible here, into the core box **17**, where they are strongly compacted due to their high kinetic energy. The high compaction leads to a porosity or bulk density of the accessory tiles of approximately 16% to 18% (measured according to DIN 52102), which lends high freeze-thaw cycling resistance to the accessory tiles. For the injection of the green concrete the compressed air should have a pressure of at least $4 \cdot 10^5$ Pa. Optimal results are achieved at pressures of approximately $6 \cdot 10^5$ Pa to $10 \cdot 10^5$ Pa. This pressure should at least be maintained for one second, however no longer than five seconds. The pressure is preferably maintained for one to three seconds.

[0039] Using a hydraulic lifting cylinder the filled core box **17** is lowered after the injection process into the core shooter **16**. Since the green concrete has a lesser compaction in the region of the injection opening of the core box **17**, the green concrete located in the injection channel must be re-pressed by means of a re-pressing unit. This re-pressing unit will be described in the context of FIGS. **4** and **5**. The filled core box **17** is removed from the core shooter **16** by a robot unit **20** and transferred into a handling station **22** through a first rotational movement in the direction of arrow **21**. In the handling station **22** several procedure steps are performed, which will be described in the following.

[0040] The handling station **22** includes a first receiving device **23**, into which the robot unit **20** places the filled core box **17**. After the placement, the robot unit **20** releases pneumatically the upper core box **19** and the lower core box **18**. Such released core box comprised of a first lower core box **24** and a first upper core box **25** can be seen in FIG. **1**. The first lower core box **24** is herein depicted with an injected accessory tile **26** in the first receiving device **23**. The first upper core box **25** is raised by the robot unit **20** and moved into a second receiving device **27**. Here, the first upper core box **25** has been lowered onto a second lower core box, not visible in FIG. **1**, into which box a mold carrier has already been placed by personnel **28**. The robot unit **20** latches the first upper core box **25** with the second lower core box, whereby a second core box **29** is formed, which can be transferred to the core shooter **16** by the robot unit **20** performing a second rotational movement in the direction of arrow **30**.

[0041] Before the accessory tile **26** can be removed from the first lower core box **24** located in the first receiving device **23**, the burrs at the head- and foot-end margin of the accessory tile **26** are cut off the accessory tile **26** using cutting devices. These cutting devices will be described in detail in FIG. **6**. After the cutting process, the accessory tile **26** located on a mold carrier is manually removed from the first lower core box **24** and deposed on a conveyor means **31** which transfers the accessory tile **26** to a color coating installation **32** for the purpose of wet coating.

[0042] To ensure high molding accuracy the lower core boxes and the upper core boxes are cleaned after every third injection process. As a rule, the length of an injection process is 45 seconds. The cleaning is completed using a compressed air jet or water vapor jet. Further, a parting agent is applied to avoid adhesions of the accessory tile in the core box. As parting agent can be utilized, for example, a bio-oil, with the application quantity being preferably approximately 1 g. This application can be carried out manually or by machine.

[0043] In the color coating installation **32** is already an accessory tile **33**, which had been transported by the conveyor means **31** into a spray chamber **34** and been positioned beneath a movable nozzle arrangement. Since the accessory tile, seen in top view, only overlaps the mold carrier partially, the non-covered regions of the mold carrier are masked with the aid of a template in order for the mold carrier not to be contaminated with the coloring agent (FIGS. **7** and **8**). As soon as the template has been positioned, the movable nozzle arrangements travels over the entire profile of the accessory tile, wherein the polymer dispersion coloring agent is applied. The quantity of coloring agent is herein at least 15 g per accessory tile. Since the compacted green concrete of the accessory tile is still moist, an especially good cross-linkage between the polymer dispersion coloring agent and the surface of the accessory tile is obtained whereby a durable coating is generated. After termination of the coating process, the accessory tile **33** is again removed from the spray chamber **34** by the conveyor means **31** in order for it to be manually transferred into a drying chamber trolley **35**.

[0044] As soon as the drying chamber trolley **35** is completed loaded with accessory tiles, it is driven into a drying chamber **36** where the accessory tiles are cured over a dwelling time of 6 to 10 hours and at a temperature between 45° to 60° C. To attain complete hydration, to the drying chamber **36** water vapor is supplied at regular intervals during the curing process, which is indicated by an arrow **37**. The relative air humidity is thereby kept in a range of 65 to 90%. At the end of the dwelling time the accessory tiles have a sufficiently high solidity permitting the detachment of the accessory tiles from the mold carrier.

[0045] Since the thus produced accessory tiles comprise monolithically only one material, they have the same surface quality everywhere. The cured accessory tile is now preferably manually detached from the mold carrier, the so-called pallet. This detachment of the accessory tile from the mold carrier is referred to as stripping. After they have been stripped from the mold carrier, the accessory tiles can be transferred to further work stations, not depicted in FIG. **1**, such as for example to a packing station.

[0046] FIG. **2** shows the core shooter **16** comprising a main component **40** as well as a lifting cylinder **41**. Both, the main component **40** as well as the lifting cylinder **41** are disposed on a pedestal **54**. The main component **40** is comprised of a machine stand **42**, a center part **43** as well as a cylinder **44**. Above the cylinder **44** is located a connection element **45** serving as a dosing element, which connects the cylinder **44** with a funnel **46**. The connection element **45** is herein connected with the cylinder **44** via a ring **47** and with the funnel **46**, via a flange **48**.

[0047] Further can be seen in FIG. **2** that the connection element **45** includes a switching element **49**. At the lower section of the cylinder **44** is disposed a shooting unit **50**. This shooting unit **50** is comprised of a shooting head **51** as well as a shooting plate **52**. The machine stand **42** is disposed in a base **53**, which is fixedly connected with the pedestal **54**. On the machine stand **42** is disposed a clamping device **55** to hold a core box **56**. This clamping device **55** is substantially comprised of two opposing arms connected with their one end to the machine stand **42** and include at their other end a holding jaw located on an articulation. In FIG. **2** only one arm **58** can be seen, which at its one end is connected to the machine stand **42** and includes at the other end a holding jaw **59** disposed on an articulation **57**. The core box **56** is herein held between the holding jaws of the clamping device **55**. Both holding jaws are movably disposed on the arms via the articulations.

[0048] Core box **56** is disposed on a support plate **60** of lifting cylinder **41**. This support plate **60** is located on a cylinder **61** which is anchored in a base **62**. The lifting cylinder **41** can be moved by means of an hydraulic force in the direction of arrows **63** and **64**. Therewith it becomes feasible to move the core box **56** on the support plate **60** either in the direction toward the shooting unit **50** or to move the core box **56** away from this unit. The center part **43** as well as the machine stand **42** are each connected across conduits **65** to **67**, for example pipes, with a pump device **69** driven by a motor **68**. On the pumping device **67** can be seen two manometers **70**, **71**. By means of the pump device **69** it is possible to supply compressed air to the core shooter **16** via the conduits **65** to **67** or to extract this [air] again from the core shooter **16**. As can be seen in FIG. **2** conduit **65** is connected with the center part **43** across a cap **72**. The conduits **65** to **67** include intake and discharge valves, which, however, are not depicted here.

[0049] FIG. **3** depicts a front view of the core shooter **16** shown in FIG. **2**, with view in direction B. Seen can again be the main part **40** as well as the lifting cylinder **41** disposed on pedestal **54**. The main part **40** is comprised of the machine stand **42**, the center part **43** and the cylinder **44**. Seen can be further the funnel **46** which is connected via the flange **48** with the connection element **45**. This connection element **45** includes the switching element **49** which can be, for example, a wheel or a lever. In FIG. **3** the switching element **49** is formed as a wheel. At the lower end of cylinder **44** is disposed the shooting unit **50**, which is comprised of a lower part **75**, a central part **76** and an upper part **77**. The shooting head **51** is connected via the upper part **77** with the cylinder **44**. At the lower part **75** is located the shooting plate **52**. This shooting plate **52** is connected with the shooting head **51** via connection elements which are not depicted here. The shooting head **51** is also affixed on cylinder **44** via connection elements. These connection elements are also not visible in FIG. **3**. The core box **56** comprising an upper core box **78** and a lower core box **79**, is held by the clamping device **55**. This clamping device **55** includes holding jaws **59**, **80**, which are movably disposed on arms **58**, **82** via articulations **57**, **81**.

[0050] Furthermore can be seen in FIG. **3** a re-pressing unit **83** which includes an extension [beam] **86** disposed laterally on machine stand **42**, on which extension is disposed a pneumatic cylinder **87**. The pneumatic cylinder **87** comprises a piston rod **89** movable in the direction of arrows **84**, **85**, in the free end of which a rotatable press-on roller **90** is inserted. The piston rod **89** with the press-on roller **90** disposed thereon is moved for the re-pressing in the direction of arrow **84**, e.g. in the direction of core box **56**. The press-on roller **90** is subsequently rolled out on the front side of core box **56** whereby the green concrete in the region of the injection opening is compacted. However, the injection opening is not visible in FIG. **3**.

[0051] FIG. **4** depicts once again in detail the re-pressing unit **83** described in FIG. **3**. Seen can be the extension **86** on which is disposed the pneumatic cylinder **87** by means of mountings **88**, **91**. On the pneumatic cylinder **87** is disposed the piston rod **89** which at its free end has a gap into which the press-on roller **90** is inserted. The press-on roller **90** disposed in the gap of piston rod **89** is fastened rotatably by means of a connection element **97**. This connection element **97** can be, for example, a pin. The gap is not visible in FIG. **4**. As depicted in FIG. **4**, the press-on roller **90** can be implemented in the form of a cylinder as a brush.

[0052] FIG. **5** shows an exploded representation of the shooting unit **50**. The shooting unit **50** includes a receiver **119** for an inset **120** as well as two-plate-shaped elements **121**, **122**. The receiver **119** and the inset **120** form the shooting head **51** and the two plate-shaped elements **121**, **122** form the shooting plate **52**. The receiver **119** includes an annular first flange **123**, which by means of fastening elements is attached on cylinder **44** of the core shooter **16** (cf. FIG. **3**). Beneath the annular first flange **123** is disposed the cone-shaped central part **76**. Adjoining this central part **76** is a frame-shaped flange **128** into which several connection elements **129** to **134** are inserted.

[0053] In FIG. **5** can also be seen the inset **120** which can be introduced with its upper section **145** disposed on a plate-like part **144** into an opening **146** of the receiver **119**. The inset **120** includes two interconnectable parts **147**, **148**. These parts **147**, **148** are connected with one another by means of connection elements **149** to **152**. In the lower plate-shaped part **144** are located several openings **153** to **156**. The inset **120** is preferably comprised of hard metal.

[0054] The plate-shaped element **121** includes an opening **157** in its center. This opening **157** is encompassed by a border strip **162** provided with openings **158** to **161**. This border strip **162** of opening **157** is encompassed by a frame **163** which is also provided with several openings **164** to **167**. Compared to frame **163**, the border strip **162** is thinner, such that this border strip **162** forms a support-plate surface for the plate-shaped part **144** of inset **120**, whereas the frame **163** forms a support surface for receiver **119**. The inset **120** rests subsequently on the border strip **162** such that the openings **153** to **156** are located precisely above openings **158** to **161**.

[0055] The plate-shaped element **122** has in its central plateau **135** an opening **136** through which concrete from the core shooter **16** can reach a core box. This opening **136** is consequently the opening of the shooting unit **50**. The element **122** comprises a margin section **137** with several connection elements **138** to **143** which can engage into the openings **158** to **161** of the plate-shaped element **121** and the superjacent openings **153** to **156** of inset **120**, whereby the elements **121**, **122** and inset **120** are firmly connected with one another.

[0056] The shooting unit **50** is formed by placing the receiver **119** onto the plate-shaped element **121** and introducing the connection elements **129** to **134** into openings **164** to **167** of frame **163**. The shooting unit **50** can consequently be simply removed from cylinder **44** of the core shooter **16** and be disassembled. Maintenance of the shooting unit **50** is therefore simple.

[0057] FIG. **6** shows a detail of the receiving device **23** according to FIG. **1** of handling station **22** when viewed in direction A. In this receiving device **23** is located the lower core box **24** with the accessory tile **26** disposed thereon on a support surface **170**. The accessory tile **26** shown in FIG. **6** is a venting tile. Due to the parting line between upper and lower core box the accessory tile **26** has burrs. At least the burrs on the head- and foot-end edge **185**, **186** of the accessory tile **26** must be removed from the accessory tile **26**.

[0058] For this purpose two cutting devices **171**, **172** are disposed laterally of the receiving device **23**, each of which cutting devices includes a cutting tool **184** and **196**, respectively. The cutting tools **184**, **196** are of different structure such that the cutting tool **184** working the head-end edge **185** carries out a simple straight cut and the cutting tool **196** working the foot-end edge **186** during the straight cut performs additionally a compaction of the cut edge.

[0059] The cutting device **171** has movable tracks **175** which can be moved via a lifting device **176** in the direction of arrows **173**, **174**. On the tracks **175** is visible a carriage **177** disposed on wheels, which can be moved in the direction of arrows **178**, **179**. The carriage **177** has, for example as in FIG. **6**, four wheels, wherein two wheels are in each case opposite one another, such that in FIG. **6** only the wheels **180**, **181** can be seen. The carriage **177** is connected to a driving mechanism **182**, by means of which the carriage **177** can be moved on the tracks **175** in the direction of arrows **178**, **179**.

[0060] At the end of carriage **177** is disposed a removable insert **183** for the exchangeable cutting tool **184**. With this cutting tool **184** the burr on the head-end edge **185** of accessory tile **26** is removed. For this purpose through movement of the carriage **177** in the direction of arrow **179** the cutting tool **184** is disposed precisely above the site at which the burr adhering on the accessory tile **26** must be cut off. Subsequently the tracks **175** with the carriage **177** disposed thereon are lowered in the direction of arrow **174**. The cutting tool **184** penetrates therein the end of the green concrete and cuts this from the accessory tile **26** proper. By moving the carriage **177**

in the direction of arrow **178** the green concrete cut off the accessory tile **26** is removed from the lower core box **24**.

[0061] The cutting device **172** has a similar constructional setup as the cutting device **171**. In the case of cutting device **172** a carriage **189** movable in the direction of arrow **187**, **188** is disposed on tracks **190**. The carriage **189** includes wheels of which only wheels **191**, **192** can be seen since the other two wheels which can not be seen, are oppositely located. The carriage **189** is connected with a driving mechanism **193** by means of which the carriage **189** can be moved in the direction of arrows **187** and **188**.

[0062] On the end of carriage **189** facing the receiving device **23** (FIG. **1**) is disposed a lifting device **194** on which by means of an insert **195** the removable cutting tool **196** is fastened. By means of this lifting device **194** the cutting tool **196** can be moved in the direction of arrows **197**, **198**.

[0063] By moving the carriage **189** in the direction of arrow **188** the cut-off green concrete is removed from the accessory tile **26** and pushed from the lower core box **24**. Both cutting devices **171**, **172** preferably operate synchronously. Once the green concrete is removed from the lower core box **24**, the two cutting devices **171**, **172** move back into the initial position as shown in FIG. **6**.

[0064] Although in FIG. **6** only two variants of cutting devices are shown, other variants are also feasible. It is herein only important that the cutting tools **184**, **196** of the particular cutting device **171**, **172** can be moved in a horizontal direction, e.g. in the direction of arrows **178**, **179** and **187**, **188**, respectively, and in a vertical direction, e.g. in the direction of arrows **173**, **174** and **197**, **198**, respectively.

[0065] Thereby that during the cutting process the cutting tools **184**, **196** are also pressed against the accessory tile **26**, before they remove the cut-off green concrete from the lower core box **24**, the cutting devices **171**, **172** also serve for re-pressing the accessory tile.

[0066] FIG. **7** shows the color coating installation **32**, in which the accessory tile **33**, here a venting tile, is to be coated with a polymer dispersion coloring agent. A spray chamber **34** open toward the top can be seen, next to which a robot unit **200** is disposed comprising a nozzle arrangement **231**. The nozzle arrangement **231** can be moved by means of the robot unit **200** within the spray chamber **34**. The robot unit **200** is driven by a computing unit, not depicted in FIG. **7**, in which the contours of the various accessory tiles are stored. In this manner the nozzle arrangement **231** can be guided following the contour of the accessory tile **26**, such that an optimal coloring agent application takes place. Since this robot unit is a commercially available model (Model Fanuc S12 by KC Robotics, Fairfiled, Ohio, USA), a detailed description of this robot unit **200** is here omitted. With respect to robot units, reference is also made to A. Redford and E. Lo, "Montageroboter", VCH-Verlag, 1992.

[0067] The accessory tile **33** located on a mold carrier **232** has been transferred into the spray chamber **34** via the conveyor means **31**. The rear wall **233** can be seen as well as the two side walls **234**, **235** and the bottom **236** of the spray chamber **34**. The conveyor means **31** is comprised of a T-shaped carriage **237** disposed on wheels, wherein in FIG. **7** only wheels **238**, **239** can be seen. These wheels **238**, **239** are disposed on tracks **240**, **241** such that the carriage **237** can be driven into the spray chamber **34** and out of it again. At the site at which the tracks **240**, **241** do not extend further, a stop bar **260** is provided. This stop bar **260** can be implemented as a block. A hood **242** with a through-hole **243** serves the carriage **237** as a guidance element. On the carriage **237** is located a support plate **244** on which is located the mold carrier **232** with the accessory tile **33** disposed thereon.

[0068] Further can be seen walls **245**, **246** extending parallel to both sides of the hood **237**. At each of the upper front ends of these walls are disposed bearings for an articulation rod **249**, **250**. Of the bearings only bearings **247**, **248** can be seen in FIG. **7**. On the articulation rods **249**, **250** are each disposed two coverings **251**, **252**, which, together, form a template **253**. This template **253** serves for masking the area of the mold carrier **232** on which the accessory tile does not rest. The accessory tile **33**, however, is not masked by the template **253**. The coverings **251**, **252** are connected with the particular articulation rod **249** and **250**, respectively, via webs **254**, **255**. Via a drive, not depicted here, the articulation rods **249**, **250** with the coverings **251**, **252** disposed thereon can be moved in the direction of arrows **256**, **257** and **258**, **259**, respectively. The movement takes herein place synchronously, e.g. the covering **251** is moved in the direction of arrow **257** when the covering **252** is moved in the direction of arrow **259**, or the covering **251** is moved in the direction of arrow **256** when the covering **252** is moved in the direction of arrow **258**.

[0069] If the accessory tile **33** is now to be coated with polymer dispersion coloring agent, the covering **251** is moved in the direction of arrow **256** and the covering **252** in the direction of arrow **258**. As soon as the template **253** masks the region of the mold carrier **232** not covered by the accessory tile, the robot unit **200** can carry out the coloring agent application by means of the nozzle arrangement **231**.

[0070] The state in which the template **253** masks the region of the mold carrier **232** not covered by the accessory tile **33**, is also shown in FIG. **7**. It is denoted by the reference number **253'**, and the coverings disposed on the webs **254'**, **255'** are denoted by the reference numbers **251'** and **252'**, respectively.

[0071] FIG. **8** depicts a top view onto the spray chamber **34**, shown in FIG. **7**, of the coloring agent coating installation **32**. The walls **233** to **235** of spray chamber **34** and the robot unit **200** with the nozzle arrangement **231** are not shown in FIG. **8** for the sake of clarity. However, the state can be seen in which the template **253'** nearly completely masks the region of the mold carrier **232** which is not covered by the accessory tile **33**. This region of the mold carrier **232**, however, is preferably completely masked by the template **253'**.

[0072] Also seen is the conveyor means **31** with hood **242** with the through-hole **243**. The tracks **240**, **241** disposed beneath the hood **242** are also visible. At the end of this track line formed by the tracks **240**, **241** is disposed stop bar **260**. Walls **245** and **246**, which at least partially overlap the hood **242**, include bearings **248**, **261** and **247**, **262**, respectively, in which are disposed the articulation rods **249** and **250**, respectively.

[0073] FIG. **9** is a section C-C through the core box **56** disposed in FIG. **3** on the shooting unit **50**. However, of the shooting unit **50** only the plate-shaped element **122** with opening **136** is visible (cf. FIG. **5**). The remainder of the shooting unit **50** is not depicted for the sake of clarity.

[0074] The upper core box **78** of core box **56** has on the side facing away from the lower core box **79** several bracings **270** to **272**. Further can be seen a side wall **273** which is in connection with the bracings **270** to **272**. The lower core box **79** also includes several bracings **274** to **276**, which are in connection with a side wall **277**. The lower core box **79** has furthermore a prominence **278** as well as a notching **279**. On the prominence **278** of the lower core box **79** rests a mold carrier **280**. The mold carrier **280** includes two webs **281**, **282**, wherein the one web **281** encompasses the prominence **278** of the lower core box **78** and the other web **282** engages into the notching **279**. The mold carrier **280** is thereby fixedly disposed on the lower core box **79**. Between the mold carrier **280** and an indentation **283** of the upper core box **78** an injection channel **284** can be seen, which has its greatest extent in the region of web **281** of mold carrier **280** and opening **136** of shooting plate **52**. This extent is denoted as terminating edge **285**. FIG. **9** shows further a milling-out **286** through which air can escape when concrete is injected into the injection channel **284**. Therewith the compacted concrete can accumulate in the injection channel **284** as well as in the terminating edge **285**. Since the concrete accumulated on the terminating edge **285** and on the milling-out **286** forms a burr on the accessory tile, such is cut off, as described in FIG. **6**, by means of the cutting devices **171**, **172**.

[0075] In the proximity of the milling-out **286**, furthermore, a screen nozzle **287** is disposed as a part of the lower core box **78**. This screen nozzle **287** includes several openings **288** to **291**, through which the air can escape from the core box **56** when concrete is injected into it.

[0076] While the screen nozzle **287** in FIG. **9** has several openings **288** to **291**, however, it is feasible for this [nozzle] to have only a single opening. However, such a variant is not shown.

[0077] The at least one opening of the screen nozzle **287** must herein have such diameter that air, however not concrete, can leave the core box **56**. It is understood that the screen nozzle **287** can also be disposed on the lower core box **79** or that the screen nozzle is formed by the lower core box **79** as well as also by the upper core box **78**.

[0078] The screen nozzles can be disposed on the end of the injection channel or laterally on the injection channel. Since the screen nozzles lead to exhaust markings on the accessory tile, they are so disposed in the core box that, with respect to the accessory tile, they are disposed in regions where they are later no longer visible once they are installed. Milling-out can be employed in addition to the screen nozzles. The cross section of a milling-out is less than the diameter of the concrete particles such that these cannot escape from the core box. However, such millings-out are not depicted in FIG. **9**.

[0079] FIG. **10** shows an exploded representation of the core box **56** shown in FIG. **9**, however, rotated by **90** degrees in the clockwise direction. The plate-shaped element **122** is not depicted in FIG. **10**. The upper core box **78**, the lower core box **79** as well as the mold carrier **280** with a prominence **292** can again be seen. On the prominence **292** are disposed screen nozzles, of which in FIG. **10** two screen nozzles **293**, **294** are visible. The screen nozzles **293**, **294** serve as openings from which air between the lower core box **79** and the mold carrier **280** can escape when concrete is injected into the core box **56**. Since the screen nozzles **293**, **294** have only a small screen diameter, it is nearly impossible for the concrete to come between the lower core box **79** and the mold carrier **280**. Through these screen nozzles **293**, **294** disposed on the mold carrier **280** the air beneath an accessory tile **295** can escape.

[0080] The accessory tile **295** shown in FIG. **10** is an arris starting tile. Clearly visible is that this accessory tile **295** has a form which corresponds to that of the prominence **292** of mold carrier **280**. Furthermore, side walls **273**, **296** to **298** are visible. These side walls **273**, **296** to **298** are connected with one another across an arrangement **299** comprised of several bracings **300** to **304**. Although another arrangement **299** is also conceivable, it must always be structured such that it can withstand high pressures and high temperatures that are generated when concrete is introduced through the core shooting into the injection channel **284** of core box **56**. However, the injection channel **284** is not visible in FIG. **10**.

[0081] The lower core box **79** includes a lower part **305** on which an upper part **306** is disposed. On this upper part **306** is disposed the prominence **278**, which includes the notching **279**. This prominence **278** is so formed that on it the mold carrier **280** can be seated with accurate fit. The lower part **305** of the lower core box **79** further includes several openings **307** to **311**, into which connection elements of the upper core box **78** can be introduced, wherein only the connection elements **312** to **314** of the upper core box **78** are evident. Furthermore is evident the milling-out **286** in the lower part **305**. Through this milling-out **286** air can escape from the core box **56** via the screen nozzle **287** when green concrete is injected. The screen nozzle can also be disposed on walls **297** or **273**. It is also feasible to provide several screen nozzles.

[0082] FIG. **11** depicts a further view of the core box **56** shown in FIG. **10**, and, in particular, in a view obliquely from below. Evident are again the upper core box **78**, the lower core box **79** and the mold carrier **280**, which form the core box **56**. The lower core box **79** of the core box **56** includes an arrangement **315** whose structure resembles that of the arrangement **299** of the upper core box **78**.

[0083] Here side walls **316** to **319** are also connected with one another via bracings **320** to **322**. As the arrangement **299**, this arrangement **315** also serves for purpose for the core box **56** to withstand the temperatures and pressures generated when concrete is injected. Via the two webs **281**, **282** the mold carrier **280** is placed onto the prominence **278** with accurate fit. However, prominence **278** is not visible in FIG. **11**. Two screen nozzles **323**, **324** are further visible. Seen can be further the connection elements **312** to **314**, **325**, **326** which serve for firmly connecting the upper core box **78** with the lower core box **79**. Furthermore depicted is the accessory tile **295** which is formed when concrete is introduced into the injection channel **284** of the core box **56**.

[0084] FIG. **12** depicts an exploded representation of a variant of the core box **56** shown in FIG. **10**. This core box **330** is comprised of a lower core box **331**, an upper core box **332** and a mold carrier **333**. The accessory tile **334** produced with this core box **330** is a hip cap. Like the lower core box **79** of core box **56**, this lower core box **331** of core box **330** also includes an arrangement **335** located between side walls **336** to **339** of lower core box **331**. This arrangement **335** also serves in order for the core box **330** to withstand the high pressures as well as the high temperatures. The upper core box **332** includes connection pieces **340** to **344**, by means of which the upper core box **332** can be firmly connected with the lower core box **331**. The mold carrier **333** includes webs in the lower region, wherein only webs **345** and **346** are evident. Visible is further an upper part **347** of mold carrier **333** and an indentation **348** of the upper core box **332**. The upper part **347** can herein be disposed in the indentation **348**. The upper part **347** in this case is so spaced apart from the indentation **348** that here also an injection channel is formed such that, when injecting concrete into the core box **330**, an accessory tile **334** is formed whose shape and size results precisely from the distance between the upper part **347** and the indentation **348**.

[0085] In FIG. **12** there is moreover a screen nozzle **349** with openings **350** to **353** disposed on the upper core box **332**. Openings **350** to **353** are of such a diameter that air, not however concrete, can escape from the core box **330**. Although openings **350** to **353** in FIG. **12** are formed as slots, they can also have a different shape. It is, for example, conceivable for the screen nozzle **349** to have round openings. However, it is also conceivable that the diameter of the opening is so large that concrete can also leave through the opening. In this case it is necessary to dispose, for example, a net or grid in the opening such that concrete cannot leave the core box **330**.

[0086] As already stated in the first embodiment example, it is feasible to dispose the screen nozzle **349** on the lower core box **331** or on the upper core box **332** as well as also on the lower core box **331**.

[0087] FIG. **13** depicts a further view of core box **330** according to FIG. **12**. The core box **330** has here been rotated so that the view is not directed in the direction of the underside of the upper core box **332**. The core box **332** includes several walls **355** to **358** between which is located an arrangement **354**. This arrangement **354** is also comprised of several interconnected bracings **359** to **363**, which connect the walls **355** to **358** with one another. Arrangement **354** also serves for the core box **330** to withstand high temperatures and high pressure to which it is exposed during the injection of the concrete. Like the upper core box **78**, this upper core box **332** also includes several connection elements with which the upper core box **332** can be connected with the lower core box **331**. However, in FIG. **13** only connection elements **340** to **342** are visible. The lower core box **331** includes several connection sites **364** to **369** for the introduction of the connection elements **340** to **342** of the upper core box **332**. Also visible is a milling-out **370** in the lower core box **331**. The lower core box **331** includes, furthermore, a prominence **371** in which several notchings **372** to **375** are introduced. Into theses notchings **372** to **375** the webs of mold carrier **333** can be introduced such that the mold carrier **333** is firmly disposed on the lower core box **331**.

[0088] In FIG. **13** can further be seen that the mold carrier **333** - as does also the mold carrier **280**—includes screen nozzles **376** to **378**. These screen nozzles **376** to **378** also serve for the purpose of the air being able to escape, which is between the mold carrier **333** and the prominence **371** of the lower core box **331** when concrete is injected into the core box **330**.

[0089] FIG. **14** depicts an exploded representation of a further variant of the core box **56** shown in FIG. **10**. This core box **400** is again comprised of a lower core box **401** and an upper core box **402** as well as a mold carrier **403**. Further, an accessory tile **404** is depicted. The accessory tile **404** produced with this core box **400** is a venting tile.

[0090] The lower core box **401** also includes an arrangement **405** with several bracings **406** to **409** located between walls **410** to **413**.

[0091] The mold carrier **403** includes on its underside several webs **414** to **417**, which can engage into the notchings of a prominence disposed on the lower core box **401**. However, in FIG. **14** the prominence as well as the notchings are not visible. Also not visible is a screen nozzle which is disposed on the lower core box **401**. The upper core box **402** includes an indentation **418** in which the mold carrier **403** is at least partially disposed when the core box **400** is assembled. Between the indentation **418** and the mold carrier **403** is provided an injection channel into which the concrete is injected such that the accessory tile **404** is formed.

[0092] The upper core box **402** includes moreover several connection elements **419** to **423** as well as openings **424**, **425**, via which the upper core box **402** can be firmly connected with the lower core box **401**. The upper core box **402** includes an arrangement with several bracings similar to the arrangement **405** of the lower core box **401**, which arrangement, however, is not visible in FIG. **14**.

[0093] It is understood that the arrangements **299**, **315**, **335**, **354** and **405** shown in FIGS. **10** to **14** can also have a different shape. It is also feasible to omit such an arrangement if a core box is provided which is comprised of such a material or has such a shape that it permits withstanding the high pressure and temperatures generated during the injection.

[0094] The depicted notchings on the prominences of the lower boxes can also be implemented differently.

[0095] Based on FIGS. **10** to **14** it can therewith be shown that through variation of the core boxes, e.g. in particular of the shape of the prominences **278**, **371**, the mold carrier **280**, **333**, **403** disposed thereon as well of the indentations of the upper core boxes **78**, **332**, **402**, accessory tiles of the most diverse shape can be produced. Even the production of roof decoration is feasible.

1. Method for producing roofing tiles by means of a core shooter device and a core box including a mold carrier, characterized by the following steps:

a) at least two components, of which the one component is water and the other component is cement, are placed into a mixer and mixed to form green concrete;

b) the green concrete is filled, by means of compressed air, through an injection opening of the core box into the core box;

c) the venting of the core box takes place via at least one screen nozzle disposed on the mold carrier;

d) the roofing tile formed in the core box is removed from the core box and transferred to a cutting device where projecting portions of the roofing tile are cut off.

2. Method as claimed in claim **1**, characterized in that the roofing tile is an accessory tile.

3. Method as claimed in claim **1**, characterized in that sand, water, cement, pigments and additives are dosed and supplied to the mixer.

4. Method as claimed in claim **3**, characterized in that to the mixer are supplied 45 to 75 wt % sand (type 0/3), 0 to 24 wt % sand (type 0.5/2), 0 to 30 wt % quartz sand (type L 55), 18 to 25 wt % cement (type CEM II 52.5), 0.2 to 1.4 wt % additive (type FK 61), 0.2 to 0.8 wt % additive (type BWA 22) and 0.3 to 1.0 wt % coloring agent (type granite).

5. Method as claimed in claim **4**, characterized in that to the mixer are supplied 54.13 wt % sand (type 0/3), 11.4 wt % sand (type 0.5/2), 5.7 wt % quartz sand (type L 55), 20.89 wt % cement (type CEM II 52.5), 0.47 wt % additive (type FK 61), 0.38 wt % additive (type BWA 22) and 0.5 wt % coloring agent (type granite).

6. Method as claimed in one of claims **3** to **5**, characterized in that to the mixer are first supplied the solids and then, at the onset of the mixing process, the liquid components.

7. Method as claimed in claim **1**, characterized in that the pressure of the compressed air is at least $4 \cdot 10^5$ Pa, preferably $6 \cdot 10^5$ Pa to $10 \cdot 10^5$ Pa.

8. Method as claimed in claim 1, characterized in that the compressed air acts for 1 to 5 seconds onto the core box.

9. Method as claimed in claim **1**, characterized in that before providing the core box a parting agent is applied onto the lower core box and onto the upper core box as well as onto the mold carrier.

10. Method as claimed in claim **1**, characterized in that during the venting the air escapes via at least one screen nozzle disposed on the core box.

11. Method as claimed in claim **1**, characterized in that the roofing tile is re-pressed during the cutting process.

12. Method as claimed in claim **1**, characterized in that the roofing tile is provided with an outer coating after the cutting process.

13. Method as claimed in claim **12**, characterized in that the roofing tile is provided with a coloring agent coating.

14. Method as claimed in one of claim **12** and claim **13**, characterized in that after the coating the roofing tile is cured in a drying chamber at a temperature of at least 40° C. and an air humidity of at least 65%.

15. Method as claimed in claim **14**, characterized in that the roofing tile dwells for 6 to 10 hours in the drying chamber.

16. Device for producing roofing tiles, wherein the device includes a core shooter device as well as a core box comprising a mold carrier, characterized by the following distinguishing features:

a) a mixer is provided for the production of green concrete, wherein the green concrete comprises at least the components water and cement;

b) the core box comprises an injection opening;

c) a cutting device is provided which cuts off projecting portions of the roofing tile.

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