(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 134 061 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
07.04.2004 Bulletin 2004/15

(51) Int Cl.[7]: **B28B 11/12**, B28B 17/00

(21) Application number: **00204076.4**

(22) Date of filing: **17.11.2000**

(54) **Apparatus and method for providing recesses in a surface of a concrete element**

Vorrichtung und Verfahren zum Erzeugen von Ausnehmungen in der Oberfläche eines Betongegenstandes

Dispositif et procédé pour créer des évidements à la surface d'un élément en béton

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **18.11.1999 NL 1013606**

(43) Date of publication of application:
19.09.2001 Bulletin 2001/38

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Description

[0001] The invention relates to a method and an apparatus for providing recesses in a surface of a concrete element.

[0002] Such method is, for instance, used for providing slots in hollow-core slabs formed from concrete which have not yet hardened, as known from applicant's non-prepublished Dutch patent application 1013136. Such hollow-core slabs are used for forming a floor field in a house, wherein electricity, discharge or water lines can be accommodated in the slots provided during the manufacturing process. In this method, it is advantageous that the provision of an additional layer on the floor surface in which the lines are usually fitted, is avoided. The fitting of lines in such layer is time-consuming and causes the level of the floor surface on a story to vary, which is disadvantageous in the case of reconstructions and reuse of the floor.

[0003] A problem involved in providing slots in unhardened concrete during the manufacture is the realization of a slot at the surface of the hollow-core slab without disturbing the areas adjoining the slot, and the realization of a well-defined slot having regular, smooth walls. Disturbing the surrounding areas could cause the strength of the hollow-core slab to decrease unacceptably. Irregular walls of the slot present problems during the laying and passing-through of lines and lead to stress concentrations under a load, which may cause the strength of the hollow-core slab to decrease.

[0004] The object of the invention is to provide a method wherein a slot can be provided in a surface of an unhardened concrete element without disturbing the other areas of the concrete element and wherein a regular, smooth wall surface of the slot is obtained.

[0005] To this end, according to the invention, a method of the above-described type is characterized by the steps of cutting unhardened concrete to be removed, from the surface of an unhardened concrete element by means of a cutting tool, in a tooling direction substantially parallel to the surface of the concrete element, discharging the unhardened concrete cut from the concrete element, and cutting with a cutting tool provided with two cutting edges located in front of the cutting tool, each cutter being connected to a sidewall which extends rearwards in a tooling direction.

[0006] Also, according to the invention, an apparatus of the above-mentioned type is characterized in that the cutting tool comprises two spaced-apart cutting edges, located at the front of the cutting tool, each cutter being connected to a sidewall which, in a tooling direction, extends rearwards.

[0007] By cutting a slot in the concrete surface to be tooled and discharging the cut-out pieces of concrete, a well-defined slot with regular walls is obtained without disturbing the unhardened concrete surrounding the slot. As a result, after hardening of the concrete, a concrete element is obtained.

[0008] The invention is also embodied in a tooling apparatus having a cutting apparatus according to the invention, and displacing means connected to the cutting apparatus for displacing the cutting apparatus relative to a concrete element to be tooled.

[0009] French patent specification 1,416,393 discloses an apparatus for tooling a cellular concrete poured into a mold, comprising a shaft having blades whereby concrete is scraped off and displaced to a mixer. From the mixer, the concrete scrapings are discharged.

[0010] The invention will be further specified on the basis of a detailed description of an exemplary embodiment of the invention, with reference to the drawing. In this drawing:

Fig. 1 is a side elevation of a tooling apparatus according to the invention,
Fig. 2 is a front view of the tooling apparatus of Fig. 1, with the posterior parts left out,
Fig. 3 is a side elevation, partly in section, of a portion of the tooling apparatus of Fig. 1,
Fig. 4 is a side elevation, partly in section, of a cutting apparatus according to the invention,
Fig. 5 is a top plan view of the cutting apparatus of Fig. 4,
Fig. 6 shows a control system according to the invention, and

[0011] Figs. 1, 2 and 3 show a tooling apparatus 1 according to the invention. The tooling apparatus 1 comprises a frame 10 supported by wheels 20 driven by a drive mechanism 21. By means of the wheels, the drive mechanism 21 can move the apparatus 1 in the direction indicated by X. Disposed on the frame 1 is a tank 22, mobile over the frame by means of wheels and comprising extraction means 27 for extracting cement. Also disposed on the frame is a water tank 23. having a water pump, not shown, for pumping water from the tank 23. Located behind the tanks 22 and 23 is a second tank 24 likewise arranged for extracting cement.

[0012] At the front of the tooling apparatus 1, there are arranged two columns 30 interconnected by means of a cross girder 31. On the cross girder 31, a cutting apparatus 80 is mounted. The cutting apparatus 80 is provided with an elongated frame part 81 connected, by means of supports 82, to four guide wheels 83. The guide wheels 83 are arranged for rotation relative to the supports 82 and engage the cross girder 31. The wheels 83 are connected to a drive mechanism 88 (Fig. 3) capable of displacing the cutting apparatus 80 via the guide wheels 83 along the cross girder 31 in a direction indicated by the arrow Y. The cross girder 31 is further connected to a drive mechanism 32 arranged for displacing the cross girder 31, and accordingly the cutting apparatus 80, in a direction indicated by the arrow Z.

[0013] Mounted on the frame part 81 is an electromotor 84 comprising a driven shaft with a number of pulleys 85. By means of a number of endless belts 86, the pul-

leys 85 are connected to pulleys 87. The pulleys 87 are rotatable relative to the frame part 81 and are connected to a cutter head 140 so as to be restrained from rotation. The cutter head 140 is bearing-mounted for rotation relative to the frame part 81, so that via the belt drive mechanism 85, 86 and the pulley 87, the motor 84 can rotate the cutter head 140.

[0014] Figs. 4 and 5 show a lowermost portion of the cutting apparatus 80 in more detail. A substantially rectangular top plate 100 is provided with two opposite openings 121 and 122 wherein connecting means, not shown, engage, which connecting means project upwards and are connected to the frame part 81. Adjacent one end thereof, the top plate 100 is provided with a discharge opening 101 and at its opposite end, it is provided with an opening 102 extending to the edge of the top plate 100. Mounted below the top plate 100 is a sidewall 110, consisting of a plate bent so as to be U-shaped. As a result, the sidewall 110 has a rounding 111 and two ends 112 and 113. The rounding 111 of the sidewall 110 is located adjacent the discharge opening 101, and the two ends 112, 113 are located adjacent the opposite edge of the top plate 100. The ends 112, 113 are provided with respective cutting edges.

[0015] The top plate 100 and the sidewall 110 bound a tooling space, a front side of which is provided with an entrance 130 bounded by the cutting edges 112 and 113. The thus formed tray 135 has two parallel sidewalls; the invention is not limited hereto, and if so desired, the sidewalls can also be designed so as to converge from the opening.

[0016] Preferably, the tray 135 is rotatably connected to the frame part 81, so that the tray can rotate relative to the cross girder 31. Preferably, for this purpose, the tray 135 comprises rotation means. The effect thus achieved is that the tray can follow changes in direction more effectively.

[0017] Located above the top plate 100 is a cutter head 140, provided with three cutter blades 141, 142, 143 which project into the tooling space via the opening 102. By means of a drive mechanism, the cutter head 140 can rotate in the direction indicated by the arrows B, thereby displacing the cutter heads 141-143, rotating in the direction B. Preferably, the cutter blades 141-143 are fitted on the cutter head 140 so as to be changeable.

[0018] Located concentrically in the cutter head 140 is a water supply 150, comprising two water supply pipes 151 and 152, each terminating in a spray nozzle 153 located in the space between the cutter blades 141-143. The supply pipe 152 opens into three outlets 154 located at the same level and positioned at an angle relative to each other. The supply pipe 151 opens into two outlets 155 and 156 located above the outlets 154. The spray nozzle 153 is rotatable relative to the top plate 100. The pipes 151 and 152 are connected to the pipe 26, which pipe is connected to the water tank 23.

[0019] In a structural variant according to the invention not shown, the sidewall 110 is provided with a bottom plate along its side remote from the top plate 100. The edge of the bottom plate located adjacent the ends of the sidewall is provided with a cutting edge. If so desired, the connecting means projecting upwards from the bottom plate 100 can be left out. In this case, the bottom is connected to the bottom side of the spray nozzle, so that the tray is rotatably connected to the cutting apparatus.

[0020] Via the opening 101, a discharge pipe 160 is introduced into the tooling space, of which discharge pipe a suction opening 161 is located adjacent the cutter blades 141-143.

[0021] The tooling apparatus 1 further comprises a control system 200 shown in Fig. 6, connected to the drive mechanisms 21, 32 and 88, and to the water supply means 22, the discharge means 27 and the electromotor 84. The control system 200 is arranged for controlling the tooling apparatus 1.

[0022] An application of the invention will hereinafter be specified on the basis of a practical example. Reference is made to Fig. 2. In a suitable and known manner, a hollow-core slab 60 is formed on a path 50. In this example, the hollow-core slab 60 is provided with a number of channels 61 extending lengthwise of the hollow-core slab, and with prestressed reinforcement 62 oriented lengthwise of the hollow-core slab 60. The hollow-core slab 60 is formed from so-called dry-poured cement, i.e. cement having a relatively low water content. By means of a vibrating operation, the cement of the hollow-core slab 60 has already been compacted, but has not yet hardened. This condition is also referred to as "green" concrete. In this condition, the consistency of the hollow-core slab 60 is such that the hollow-core slab 60 does have self-supporting capacity, but is not capable of supporting greater loads. In course of time, the cement hardens into concrete, whereupon the hollow-core slab 60 has obtained the strength needed for use. For a detailed description of the geometry of the hollow-core slab 60, reference is made to applicant's non-prepublished Dutch patent application 1013136.

[0023] The path 50 on which the hollow-core slab 60 lies is provided with raised longitudinal edges 51 on which the wheels 20 of the apparatus 1 are placed. The control system 200 is arranged for moving the cutting apparatus 80 in the directions X, Y and Z by operating the drive mechanisms 21, 32, 88, and accordingly moving the cutting apparatus 80 along a predetermined path relative to the hollow-core slab 60. Thus, a tooling direction is defined along which the cutting apparatus 80 is guided, which direction is indicated in the drawing by an arrow A (Fig. 5).

[0024] By means of the drive mechanism 32, the cutting apparatus 80 is moved to such a height that the opening 130 relative to the hollow-core slab 60 is located at the level of the recess to be formed in the hollow-core slab 60.

[0025] During the displacement of the cutting apparatus 80, the cutting edges 112 and 113 cut into the un-

hardened concrete of the hollow-core slab 60, thus defining the shape of the walls of the recess to be formed. The lower side of the cutter blades defines the bottom of the recess. Through the displacement in the tooling direction A, the cut, unhardened concrete ends up downstream in the tooling area of the cutter blades 141-143 rotated by the control system 200. Through the rotation of the cutter blades 141-143, the unhardened concrete is reduced and ground into small cement particles through the cutting operation of the cutter blades. By adding mechanical energy to the unhardened concrete, the cement becomes slightly fluid again.

[0026] When the unhardened cement is being ground into small particles, water is fed by the control system 200 and via the pipes 26, 151 and 152, from the tank 23 and via the outlets 154-155 to the area surrounded by the cutter blades 141-143. Through rotation of the cutter blades 141-143, the water thus supplied is formed, with the ground cement particles, into a liquid mass of cement, cement particles and water.

[0027] The liquid mass formed is pumped downstream, via the extraction means 27, through the extraction opening 161 and the pipes 160 and 25, to the concrete tank 23. Thus, the unhardened concrete cut from the concrete surface of the hollow-core slab is discharged and the intended recess in the concrete surface is formed through displacement of the cutting apparatus 80 along the predetermined path.

[0028] Because the tray 135 is mounted for rotation relative to the frame part 80, the opening 130 of the tray can rotate during changes of direction in order to follow the path.

[0029] Since the opening 130 provided with cutting edges 112, 113 cuts the shape of the slot to be formed in the top portion of the hollow-core slab, it is achieved that the removal of the concrete, and accordingly the formation of the slot, can take place in a fast and accurate manner, to obtain a smooth and regular wall of the slot.

[0030] Although in this example, cutting edges are used for cutting the slot in the unhardened concrete, the invention is not limited hereto; the invention also provides other apparatus for cutting a slot in the unhardened concrete, such as, for instance, a wire frame, a water cutting apparatus, and multiple cutting blades.

[0031] Because the walls, located behind the cutting edges, of respectively the sidewall and the bottom slide along the slot formed, a smooth finishing of the slot is realized.

[0032] Since the tooling space where the grinding of the unhardened concrete and the mixing of the water take place, is closed off from the other parts of the hollow-core slab by the walls, the risk of slot-adjoining parts being disturbed is reduced considerably.

[0033] Although in this example, a cutter is used for grinding the cut concrete, the invention is not limited hereto; the invention also provides other apparatus for grinding concrete, such as, for instance, rotating cutter blades, a rotating propeller or screw. In particular, the invention provides an embodiment wherein, by means of supplying a mixture of water and air downstream of the cutting apparatus, the cement to be removed is broken open and the mixture thus formed is extracted.

[0034] Although in this example, the cut concrete is ground before being discharged, the invention is not limited hereto; the invention also provides that the cut concrete is discharged without grinding, such as, for instance, through extraction or a discharge belt.

[0035] The invention is in no way limited to the use with prestressed hollow-core slabs, mentioned by way of example. The invention may also be used for providing recesses in other concrete parts manufactured from dry-poured cement, such as, for instance, wall and facade elements.

Claims

1. A method for providing recesses in a surface of a concrete element (60), comprising

   cutting unhardened concrete to be removed, from the surface of an unhardened concrete element (60) by means of a cutting tool, in a tooling direction (A) substantially parallel to the surface of the concrete element, and discharging the unhardened concrete cut from the concrete element (60), **characterized by** cutting with a cutting tool provided with two spaced-apart cutting edges (112,113) located at the front relative to the tooling direction (A) of the cutting tool, each cutting edge being connected to a respective sidewall which extends rearwards relative to the tooling direction (A).

2. A method according to claim 1, **characterized by** grinding the unhardened concrete cut from the concrete element (60).

3. A method according to claim 1 or 2, **characterized by**

   supplying water adjacent to at least one cutting edge (112,113), and
   mixing the unhardened concrete cut from the concrete element with water.

4. A method according to any one of the preceding claims, **characterized by** extracting the unhardened concrete cut from the concrete element (60).

5. A method according to any one of the preceding claims, **characterized by** cutting the unhardened concrete to be removedwith a cutting apparatus.

6. A method according to claim 5, **characterized by**

grinding the unhardened concrete cut from the concrete element (60) with a grinding apparatus (140-143) which, in the tooling direction (A), is located behind the cutting tool.

7. A method according to claim 5 or 6, **characterized by** discharging the unhardened concrete cut from the concrete element (60) by means of a discharge apparatus (25,27,160,161) which, in the tooling direction (A), is located behind the cutting tool.

8. A method according to any one of the preceding claims, **characterized by** milling the unhardened concrete to be removed.

9. A method according to any one of claims 3-8, **characterized by** supplying water to the unhardened concrete to be removed during the grinding of the unhardened concrete to be removed.

10. A cutting apparatus (80) for providing recesses in a surface of an unhardened concrete element (60), having

a cutting tool for cutting from the concrete element unhardened concrete to be removed, in a tooling direction (A) parallel to the concrete surface, and
a discharge member (25,27,160,161) for discharging the unhardened concrete cut from the concrete element, **characterized in that** the cutting tool comprises two spaced-apart cutting edges (112,113), located at the front of the cutting tool relative to the tooling direction (A), each cutter being connected to a respective sidewall (110) which, relative to the tooling direction (A), extends rearwards.

11. A cutting apparatus (80) according to claim 10, **characterized in that** the wall (110) at least partially defines a tooling area.

12. A cutting apparatus (80) according to claim 10 or 11, **characterized in that** the sidewalls (110) are connected to a bottom comprising a foremost cutting edge.

13. A cutting apparatus (80) according to any one of claims 10-12, **characterized in that** a grinding member (140-143) is located in the tooling area.

14. A cutting apparatus (80) according to any one of claims 10-13, **characterized by** a grinding member (140-143), located behind the cutting tool in a tooling direction (A), arranged for grinding unhardened concrete cut from the concrete element.

15. A cutting apparatus (80) according to any one of claims 10-14, **characterized by** a mixing member, located behind the cutting tool in a tooling direction, comprising a water supply (150), arranged for mixing unhardened concrete cut from the concrete element, with water.

16. A cutting apparatus (80) according to any one of claims 10-15, **characterized by** an extraction member (27), located behind the cutting tool in a tooling direction (A), for extracting unhardened concrete cut from the concrete element.

17. A cutting apparatus (80) according to claims 10-16, **characterized in that** the cutting tool comprises a milling cutter.

18. A cutting apparatus (80) according to claim 17, **characterized in that** the grinding member (140143) is formed by the milling cutter.

19. A cutting apparatus (80) according to any one of claims 10-18, **characterized in that** the cutting tool comprises a water cutting member.

20. A tooling apparatus (1) for providing recesses in a surface of an unhardened concrete element, **characterized by** a cutting apparatus (80) according to one of claims 10-19, and displacing means (30-32, 81-83) connected to the cutting apparatus for displacing the cutting apparatus relative to a concrete element (60) to be tooled.

21. A tooling apparatus according to claim 20, **characterized by** an extraction apparatus (27) connected to the cutting apparatus (80).

22. A tooling apparatus according to claim 20 or 21, **characterized by** a control system (200) connected to the displacing means(30-32, 81-83), arranged for controlling the cutting apparatus (80) along a defined path.

Patentansprüche

1. Verfahren zum Herstellen von Ausnehmungen in einer Oberfläche eines Betonelements (60) mit den Schritten:

Schneiden von zu entfernendem unabgebundenen Beton aus der Oberfläche eines unabgebundenen Betonelements (60) mit einem Schneidwerkzeug in einer Werkzeugrichtung (A), die im Wesentlichen parallel zu der Oberfläche des Betonelements ist, und
Abführen des aus dem Betonelement (60) geschnittenen unabgebundenen Betons, **gekennzeichnet durch** Schneiden mit einem

Schneidwerkzeug, das mit zwei mit Abstand angeordneten Schneiden (112, 113) versehen ist, die an der Vorderseite in Bezug zur Werkzeugrichtung (A) des Schneidwerkzeugs angeordnet sind, wobei jede Schneide mit einer jeweiligen Seitenwand verbunden ist, die in Bezug zur Werkzeugrichtung (A) nach hinten verläuft.

2. Verfahren nach Anspruch 1, **gekennzeichnet durch** Zerkleinern des aus dem Betonelement (60) geschnittenen unabgebundenen Betons.

3. Verfahren nach Anspruch 1 oder 2, **gekennzeichnet durch** Zuführen von Wasser neben mindestens einer Schneide (112, 113) und Mischen des aus dem Betonelement geschnittenen unabgebundenen Betons mit Wasser.

4. Verfahren nach einem der vorhergehenden Ansprüche, **gekennzeichnet durch** Herausholen des aus dem Betonelement (60) geschnittenen unabgebundenen Betons.

5. Verfahren nach einem der vorhergehenden Ansprüche, **gekennzeichnet durch** Schneiden des zu entfernenden unabgebundenen Betons mit einer Schneidvorrichtung.

6. Verfahren nach Anspruch 5, **gekennzeichnet durch** Zerkleinern des aus dem Betonelement (60) geschnittenen unabgebundenen Betons mit einer Zerkleinerungsvorrichtung (140 - 143), die in der Werkzeugrichtung (A) nach dem Schneidwerkzeug angeordnet ist.

7. Verfahren nach Anspruch 5 oder 6, **gekennzeichnet durch** Abführen des aus dem Betonelement (60) geschnittenen unabgebundenen Betons mit einer Abführvorrichtung (25, 27, 1,60, 161), die in der Werkzeugrichtung (A) nach dem Schneidwerkzeug angeordnet ist.

8. Verfahren nach einem der vorhergehenden Ansprüche, **gekennzeichnet durch** Fräsen des zu entfernenden unabgebundenen Betons.

9. Verfahren nach einem der Ansprüche 3 - 8, **gekennzeichnet durch** Zuführen von Wasser zu dem zu entfernenden unabgebundenen Beton während des Zerkleinerns des zu entfernenden unabgebundenen Betons.

10. Schneidvorrichtung (80) zum Herstellen von Ausnehmungen in einer Oberfläche eines unabgebundenen Betonelements (60) mit

einem Schneidwerkzeug zum Schneiden von zu entfernendem unabgebundenen Beton aus dem Betonelement in einer Werkzeugrichtung (A), die parallel zu der Beton-Oberfläche ist, und

einem Abführteil (25, 27, 160, 161) zum Abführen des aus dem Betonelement geschnittenen unabgebundenen Betons, **dadurch gekennzeichnet, dass** das Schneidwerkzeug zwei mit Abstand angeordnete Schneiden (112, 113) aufweist, die an der Vorderseite des Schneidwerkzeugs in Bezug zur Werkzeugrichtung (A) angeordnet sind, wobei jede Schneide mit einer jeweiligen Seitenwand (110) verbunden ist, die in Bezug zur Werkzeugrichtung (A) nach hinten verläuft.

11. Schneidvorrichtung (80) nach Anspruch 10, **dadurch gekennzeichnet, dass** die Wand (110) zumindest teilweise einen Werkzeugbereich definiert.

12. Schneidvorrichtung (80) nach Anspruch 10 oder 11, **dadurch gekennzeichnet, dass** die Seitenwände (110) mit einem Boden verbunden sind, der eine vorderste Schneide aufweist.

13. Schneidvorrichtung (80) nach einem der Ansprüche 10 - 12, **dadurch gekennzeichnet, dass** ein Zerkleinerungsteil (140 - 143) in dem Werkzeugbereich angeordnet ist.

14. Schneidvorrichtung (80) nach einem der Ansprüche 10 - 13, **gekennzeichnet durch** ein nach dem Schneidwerkzeug in einer Werkzeugrichtung (A) angeordnetes Zerkleinerungsteil (140 - 143), das zum Zerkleinern von aus dem Betonelement geschnittenen unabgebundenen Beton vorgesehen ist.

15. Schneidvorrichtung (80) nach einem der Ansprüche 10 - 14, **gekennzeichnet durch** ein nach dem Schneldwerkzeug In einer Werkzeugrichtung (A) angeordnetes Mischteil mit einer Wasserzufuhr (150), das zum Mischen von aus dem Betonelement geschnittenen unabgebundenen Beton mit Wasser vorgesehen ist.

16. Schneidvorrichtung (80) nach einem der Ansprüche 10 - 15, **gekennzeichnet durch** ein nach dem Schneidwerkzeug in einer Werkzeugrichtung (A) angeordnetes Extraktionsteil (27) zum Herausholen von aus dem Betonelement geschnittenen unabgebundenen Beton.

17. Schneidvorrichtung (80) nach den Ansprüchen 10 - 16, **dadurch gekennzeichnet, dass** das Schneidwerkzeug einen Fräser aufweist.

18. Schneidvorrichtung (80) nach Anspruch 17, **dadurch gekennzeichnet, dass** das Zerkleinerungsteil (140 - 143) von dem Fräser gebildet wird.

19. Schneidvorrichtung (80) nach einem der Ansprüche 10 - 18, **dadurch gekennzeichnet, dass** das Schneidwerkzeug ein Wasserschneidteil aufweist.

20. Werkzeugvorrichtung (1) zum Herstellen von Ausnehmungen in einer Oberfläche eines unabgebundenen Betonelements (60), **gekennzeichnet durch** eine Schneidvorrichtung (80) nach einem der Ansprüche 10 - 19 und **durch** mit der Schneidvorrichtung verbundene Verlagerungsmittel (30 - 32, 81 - 83) zum Verlagern der Schneidvorrichtung In Bezug zu einem maschinell zu bearbeitenden Betonelement (60).

21. Werkzeugvorrichtung nach Anspruch 20, **gekennzeichnet durch** eine Extraktionsvorrichtung (27), die mit der Schneidvorrichtung (80) verbunden ist.

22. Werkzeugvorrichtung nach Anspruch 20 oder 21, **gekennzeichnet durch** ein mit den Verlagerungsmitteln (30 - 32, 81 - 83) verbundenes Steuersystem (200), das zum Steuern der Schneidvorrichtung (80) entlang einem definierten Pfad vorgesehen ist.

Revendications

1. Procédé pour créer des évidements à la surface d'un élément en béton (60), consistant à
couper du béton non solide qui doit être enlevé, à la surface d'un élément en béton non solide (60) au moyen d'un outil de découpage, dans une direction de découpage (A) substantiellement parallèle à la surface de l'élément en béton, et décharger le béton non solide coupé dans l'élément en béton (60), **caractérisé par** un découpage au moyen d'un outil de découpage comportant deux bords découpés (112,113) espacés l'un par rapport à l'autre et situés à l'avant de l'outil de découpage relativement à la direction de découpage (A), chaque bord découpé étant connecté à une paroi de côté respectif qui s'étend vers l'arrière relativement à une direction de découpage (A).

2. Procédé selon la revendication 1, **caractérisé par** le meulage du béton non solide coupé dans l'élément en béton (60).

3. Procédé selon la revendication 1 ou 2, **caractérisé par** l'addition d'eau adjacente à au moins un bord découpé (112,113) et par le mélange du béton non solide coupé dans l'élément en béton avec de l'eau.

4. Procédé selon l'une quelconque des revendications précédentes, **caractérisé par** l'extraction du béton non solide coupé dans l'élément en béton (60).

5. Procédé selon l'une quelconque des revendications précédentes, **caractérisé par** le découpage du béton non solide qui doit être enlevé au moyen d'un dispositif de découpage.

6. Procédé selon la revendication 5, **caractérisé par** le meulage du béton non solide coupé dans l'élément en béton (60) au moyen d'un dispositif de meulage (140-143) qui est situé derrière l'outil des découpages, dans la direction de découpage (A).

7. Procédé selon la revendication 5 ou 6, **caractérisé par** la décharge du béton non solide coupé dans l'élément en béton (60) au moyen d'un dispositif de décharge (25,27,160,161) qui est situé derrière l'outil de découpage, dans la direction des découpages (A).

8. Procédé selon l'une quelconque des revendications précédentes, **caractérisé par** le meulage du béton non solide qui doit être enlevé.

9. Procédé selon l'une quelconque des revendications 3 à 8 **caractérisé par** l'addition d'eau au béton non solide qui doit être enlevé pendant la phase de meulage du béton non solide qui être enlevé.

10. Dispositif de découpage (80) pour créer des évidements à la surface d'un élément en béton non solide (60), ayant
un outil de découpage pour couper dans l'élément en béton le béton non solide qui doit être enlevé, dans une direction de découpage (A) parallèle à la surface du béton, et
un élément de décharge (25,27,160,161) pour décharger le béton non solide coupé dans l'élément en béton, **caractérisé en ce que** l'outil de découpage comprend deux bords découpés séparés l'un de l'autre (112,113) situé à l'avant de l'outil de découpage relativement à une direction de découpage (A), chaque bord découpé étant connecté à une paroi respective (110) qui s'étend vers l'arrière dans une direction de découpage (A).

11. Dispositif de découpage (80) selon la revendication 10, **caractérisé en ce que** la paroi (110) défini au moins partiellement une zone de découpage.

12. Dispositif de découpage (80) selon la revendication 10 ou 11, **caractérisé en ce que** les parois (110) sont connectées à un fond qui comprend un premier bord découpé.

13. Dispositif de découpage (80) selon l'une quelconque des revendications 10 à 12, **caractérisé en ce que** un élément de meulage (140-143) est situé dans la zone de découpage.

14. Dispositif de découpage (80) selon l'une quelcon-

que des revendications 10-13, **caractérisé par** un élément de meulage (140-143), situé derrière l'outil de découpage dans une direction de découpage (A), conçu pour meuler le béton non solide coupé dans l'élément en béton.

15. Dispositif de découpage (80) selon l'une quelconque des revendications 10 à 14, **caractérisé par** un élément de mélange, situé derrière l'outil de découpage dans une direction de découpage, qui comprend un dispositif d'addition d'eau (150), conçu pour mélanger le béton non solide coupé dans l'élément en béton avec de l'eau.

16. Dispositif de découpage (80) selon l'une quelconque des revendications 10 à 15, **caractérisé par** un élément d'extraction (27), situé derrière l'outil de découpage dans une direction de découpage (A), pour extraire le béton non solide coupé dans l'élément en béton.

17. Dispositif de découpage (80) selon les revendications 10 à 16, **caractérisé en ce que** l'outil de découpage comprend une fraise.

18. Dispositif de découpage (80) selon la revendication 17, **caractérisé en ce que** l'élément de meulage (140-143) est formé par la fraise.

19. Dispositif de découpage (80) selon l'une quelconque des revendications 10 à 18, **caractérisé en ce que** l'outil de découpage comprend un élément de découpage d'eau.

20. Dispositif de découpage (1) pour créer les évidements à la surface d'un élément en béton non solide, **caractérisé par** un dispositif de découpage (80) selon l'une des revendications 10 à 19, et un moyen de déplacement (30-32,81,82) connecté au dispositif de découpage pour déplacer le dispositif de découpage relativement à un élément en béton (60) qui doit être découpé.

21. Dispositif de découpage selon la revendication 20, **caractérisé par** un dispositif d'extraction (27) connecté au dispositif de découpage (80).

22. Dispositif de découpage selon la revendication 20 ou 21, **caractérisé par** un système de commande (200) connecté au moyen de déplacement (30-32,81,83), conçu pour commander le dispositif de découpage (80) le long d'un chemin défini.

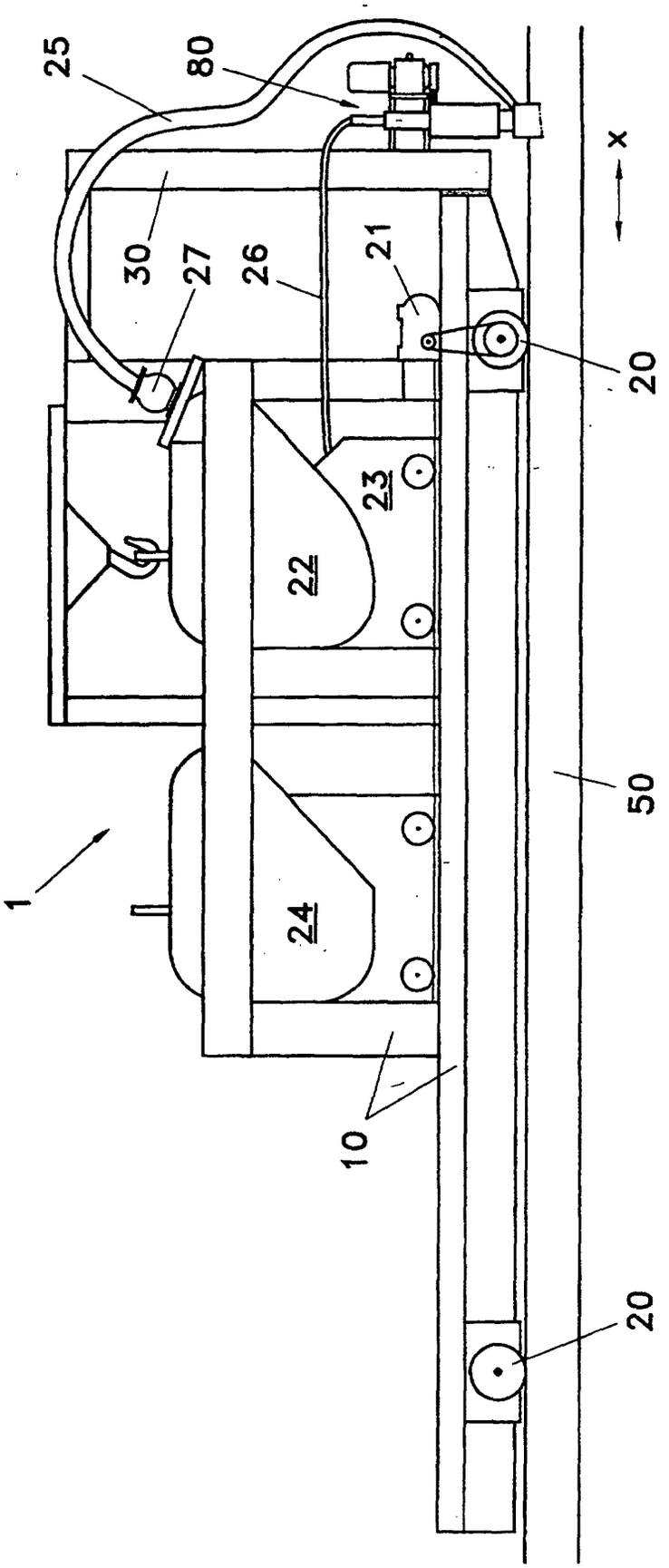


FIG. 1

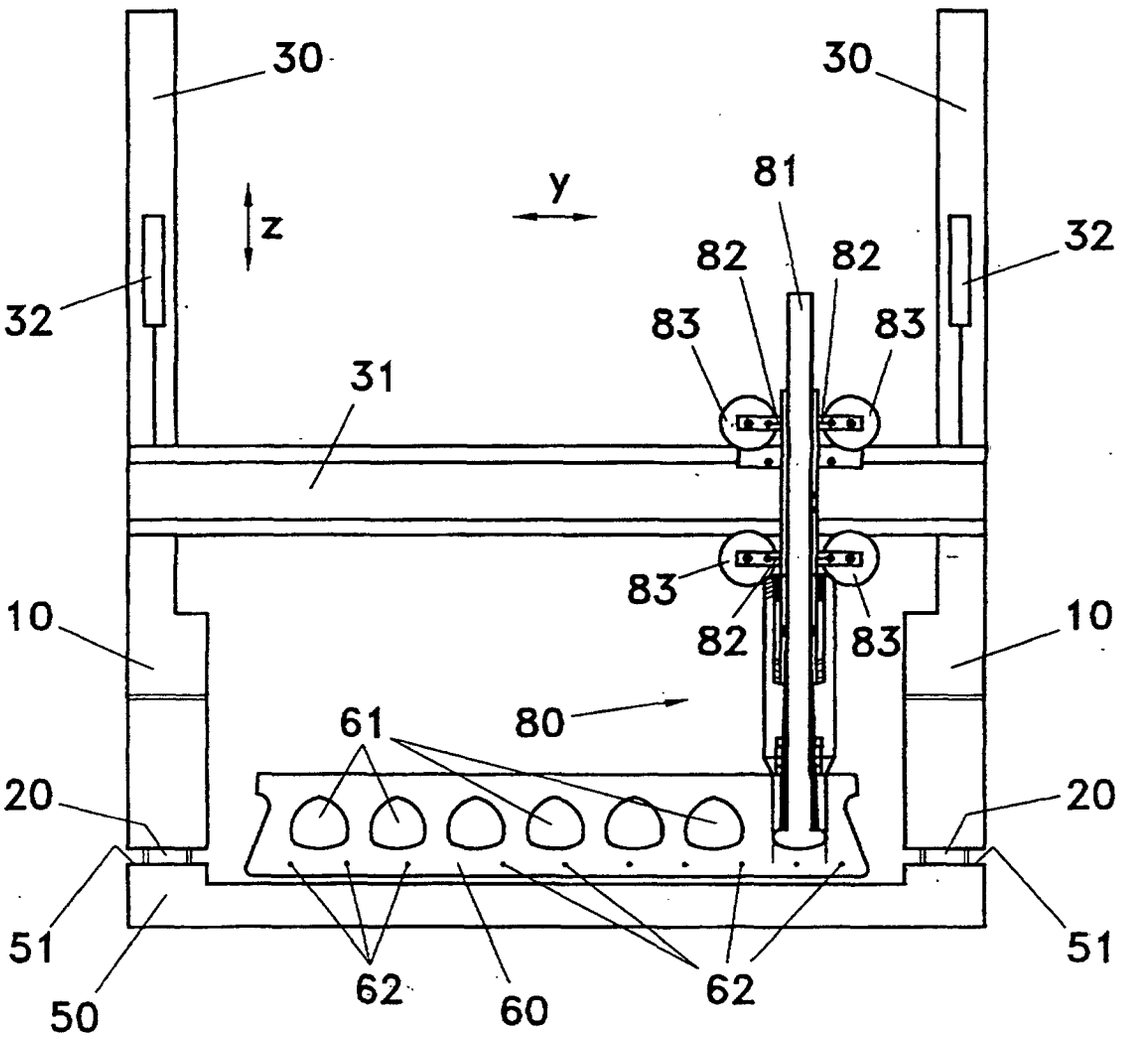

30
30
y
z
81
82
82
32
32
83
83
31
83
82
83
10
10
80
61
20
20
51
51
50
62
60
62

FIG. 2

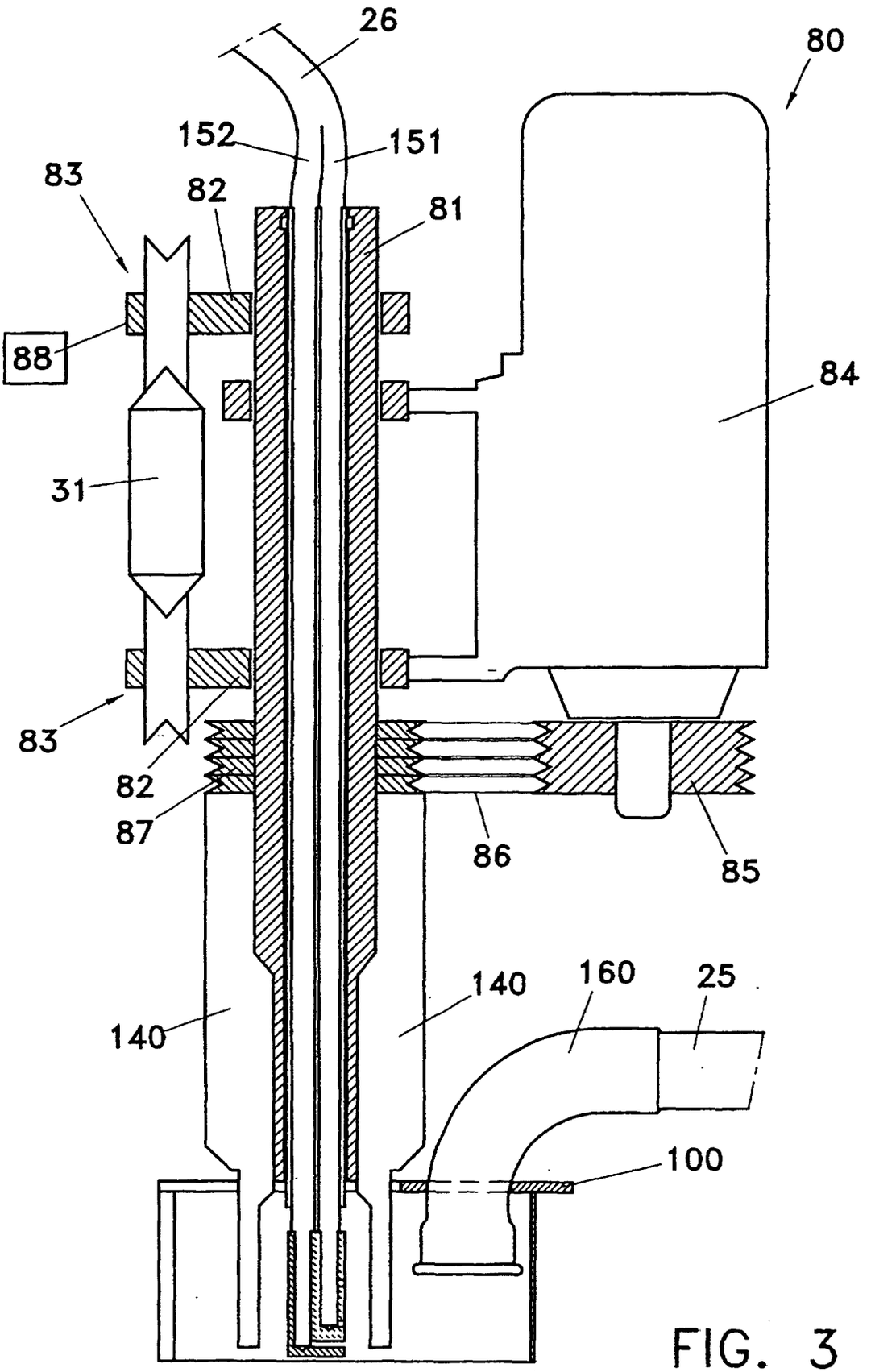


FIG. 3

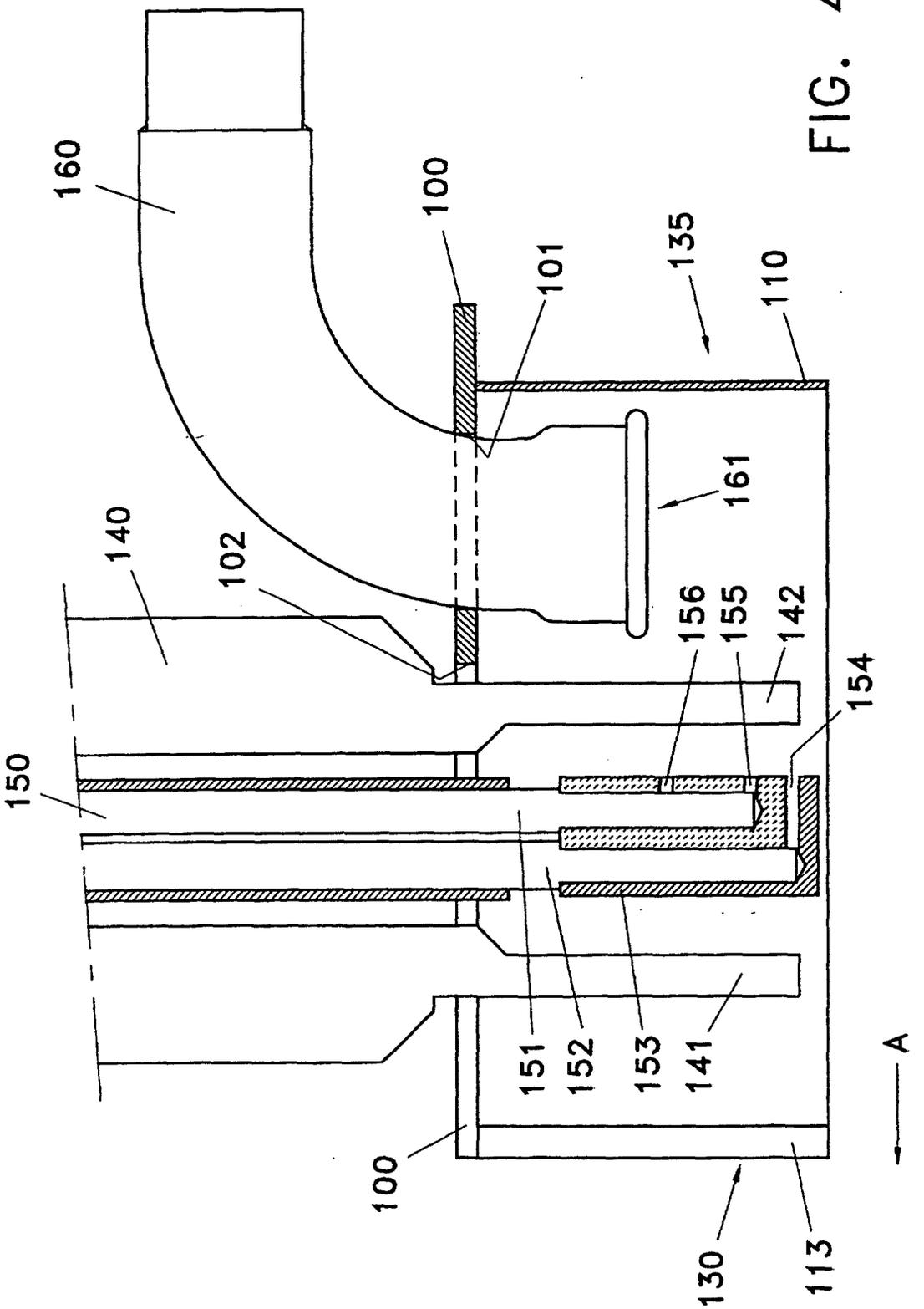

160
100
101
135
110
161
140
102
156
155
142
154
150
151
152
153
141
A
100
130
113

FIG. 4

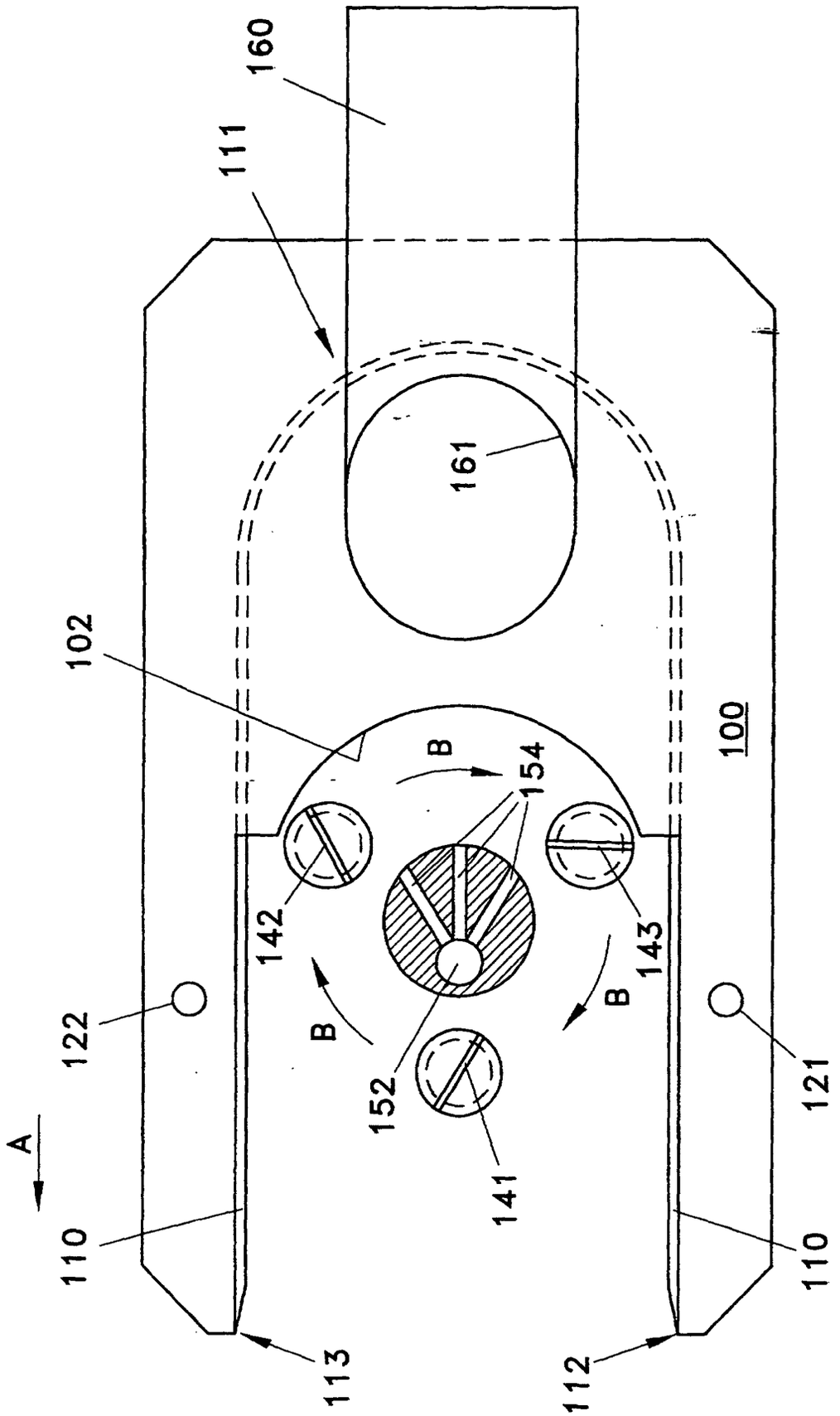

160
111
161
102
100
B
154
142
143
122
121
152
141
A
110
110
113
112

FIG. 5

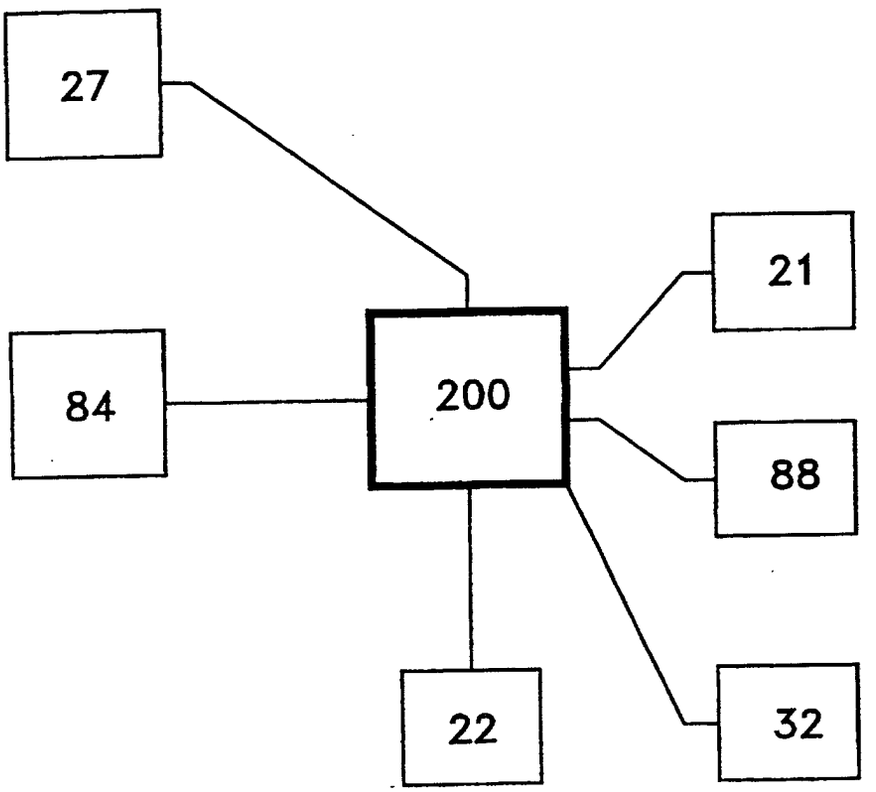


FIG. 6