

(19) **DANMARK**

(10) **DK/EP 3844355 T3**



(12)

Oversættelse af europæisk patentskrift

Patent- og
Varemærkestyrelsen

-
- (51) Int.Cl.: **E 04 G 21/18 (2006.01)** **B 25 H 7/04 (2006.01)** **B 25 J 5/00 (2006.01)**
E 04 B 1/35 (2006.01) **G 01 C 15/02 (2006.01)**
- (45) Oversættelsen bekendtgjort den: **2023-03-20**
- (80) Dato for Den Europæiske Patentmyndigheds bekendtgørelse om meddelelse af patentet: **2022-12-14**
- (86) Europæisk ansøgning nr.: **19749425.5**
- (86) Europæisk indleveringsdag: **2019-07-12**
- (87) Den europæiske ansøgnings publiceringsdag: **2021-07-07**
- (86) International ansøgning nr.: **IB2019055982**
- (87) Internationalt publikationsnr.: **WO2020044138**
- (30) Prioritet: **2018-08-29 BE 201800094**
- (84) Designerede stater: **AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**
- (73) Patenthaver: **VIAGE SPRL, Rue Merloy 441, 5300 Vezin, Belgien**
- (72) Opfinder: **AGIE DE SELSATEN, Vincent, Rue de Melroy 441, 5300 Vezin, Belgien**
AGIE DE SELSATEN, Olivier, Rue de Melroy 441, 5300 Vezin, Belgien
- (74) Fuldmægtig i Danmark: **Zacco Denmark A/S, Arne Jacobsens Allé 15, 2300 København S, Danmark**
- (54) Benævnelse: **Topografimærkningssystem i faktisk størrelse**
- (56) Fremdragne publikationer:
DE-A1-102010 026 102
JP-A- H0 829 174
JP-A- 2001 289 638
US-A- 5 755 072
US-A1- 2002 005 789
US-A1- 2009 277 031

DESCRIPTION

[0001] The present PCT patent application claims the benefit of the priority of Belgian Patent application N° BE2018/0094 filed on August 29th, 2018.

Summary of the Invention

[0002] The present invention relates to a topography marking system of the robot type bearing a marking system, the said robot being movable on the construction surface for marking topographic information.

State of the Art

[0003] At the time a building construction design is started off, many plans are realised for example to show the locations of distinct different circuits.

[0004] Although computer 3D views could reveal many possible issues and problems, it appears that during the on-site construction phase, one or more particular problems arise.

[0005] One such issue arises for example during casting of the concrete floor slab for supporting the building to be erected, including vertical concrete elements and walls. Any errors related to the concrete slab dimensions can generate a cascade of problems that will only be noticed after starting the concrete slab construction.

[0006] Also, during the construction phase the workers place the horizontal concrete slabs followed by placing the vertical elements (walls, columns, screens, etc.)

[0007] Between these two important steps, a certified topographic surveyor is required on site, for tracing principal reference points on the concrete slabs. This is done with the help of a topography station (Electronic Theodolite), Topography prism, spray colour bombs and a scribe. Thereafter, taking into consideration the marked principal reference points, several "marking" workers mark the construction plan details of the floor to the concrete slab with the help of the plans, measuring tapes and ropes. Once this human marking step is completed, the construction or the placement of the vertical slabs on the concrete floor can start. The above cycle repeats itself for each floor of the building.

[0008] The above explained procedure requires a lot of time, with common marking errors particularly due to the intervention of several marking workers and human reading errors.

[0009] An attempt was made to try marking the installation position on the building slab by a

marking device that received directly architecture information from a computer.

[0010] Such a marking device is for example taught by the document US5755072. This marking device is a marking robot consisting of a real size tracing system for a construction site, where the robot is made of

- Rigid and non deformable large porch-structure that spans the tracing area.
- A colour spray head
- A system for moving the spray head along two perpendicular directions
- An electronic device controlling the position of the porch-robot with respect to reference points.

[0011] The robot of US5755072 comprises :

1. (a) a frame adapted to form a rigid non deformable frame,
2. (b) a marking system comprising a spraying device (5) for spraying a painting composition suitable to be burnt, possibly after partial or complete drying or curing, on said construction surface, so as to paint on said construction surface at least one painted band, and
3. (c) a moving support for the marking system, said moving support being mounted on the frame, and being adapted for ensuring movements of the marking system with respect to the frame, in at least two perpendicular directions.

[0012] Such marking device needs to know beforehand the reference points and does not permit marks with a high degree of precision, nor marks to be impacted by external conditions, like wind or air currents.

[0013] The document JP 2001 289638 discloses a robot with a platform mounted on caterpillars, the device enabling the movement of basic tool to a given position. The document US 2002/005789 discloses a marking device with a liquid spraying head for spraying a liquid onto a given surface, the device position correction being operated during the marking operation.

[0014] To avoid the issues seen due marking operation on a concrete slab, due to lack of precision, document US2009/277031 proposes to print in actual size the plan on many rolls and attach the rolls to the slab. The position and fixation of the rolls is not easy and the rolls are prone to wear and tear, while no more allowing to view marks. In addition, the rolls form a layer that hinders a good grip for the hydraulic binders. This marking issue in real size on site has not yet been solved till now. Hence, the document WO2017 / 093779 proposes to project on the concrete slab the graphic information. The system to use is complex and does not take into account the surface covered by the projector. Such a system is only reliable for flat and

horizontal surfaces, with a vertical projector.

Brief description of the Invention

[0015] The Invention relates to topography marking system (E) for marking in real size at least some construction information on a construction surface, according to claim 1, said system (E) comprising at least:

1. (a) a frame (1) adapted to form a rigid non deformable frame,
2. (b) a displacement system (2) for moving the frame (1) relative to the construction surface,
3. (c) a marking system with at least a topographic prism,
4. (d) a moving support (20) for the marking system, said moving support (20) being mounted on the frame (1) or on an element thereof, and being adapted for ensuring movements of the marking system with respect to the frame, in at least two perpendicular directions (X,Y),

in which said marking system comprises at least:

(c1) a spraying device (5) for spraying a painting composition suitable to be burnt, possibly after partial or complete drying or curing, on said construction surface, so as to paint on said construction surface at least one painted band, and

(c2) an engraving laser (6) for burning the said at least one painted band for marking on the said at least one painted band some construction information.

[0016] This system allows a precise marking, for example of a vertical median plan on a wall, or a vertical plan on an exterior wall, etc.

[0017] Advantageously, the displacement system of the frame comprises at least one electric motor, while means for moving the support comprises also one electrical motor, while the marking system bears at least one electric battery, advantageously of the rechargeable type, for supplying the electric motors of the displacement system or moving means of the frame and support.

[0018] The system of the invention is in this way advantageously of the autonomous robot type.

[0019] According to advantageous particulars of embodiments of the system of the invention, the system of the invention has one or more of the following characteristics, in particular a combination of two or more of said following characteristics:

* the displacement system (2) for moving the frame (1) at least partly on the construction surface comprises at least one electric motor (2A, 2B, 2C), while the moving support (20) comprises at least a displacement means of support (20) provided with at least one electric motor (3A, 3B),

* the topography marking system (E) is provided with at least an electric battery (11), advantageously suitable to be recharged, for supplying energy to the said at least one electric motor of the displacement system (2) and the said at least one electric motor of the moving support (20).

* The topography marking system comprises an electronic command system (12) to command a series of different marking functions and advantageously moving functions, said electronic command system (12) being associated with a wireless communication means for receiving information at least relating to the position of the system or part thereof on the said construction surface (S).

* the spraying device (5) comprises a spraying head adapted to spray on the construction surface a painted band of width less than 5cm, advantageously comprised between 0.5 and 2cm, while the engraving laser (6) comprises of a head to grave on the painted band, at least points and/or lines with thickness of less than 1mm.

* the electronic command system (12) is programmed to prevent the functioning of the engraving laser (6) and the spraying device (5) during the displacement of the frame (1) on the construction surface (S), and to prevent the functioning of the engraving laser (6) during the functioning of the spraying device (5).

* the topography marking system (E) comprises a series of security means sending signals to the electronic command system (12) at least to stop or prevent the functioning of the engraving laser (6), and advantageously also to stop or prevent the functioning of the spraying device (5), the said security means being advantageously selected from the group comprising :

- A distance detector (100) between, on one hand, the topography marking system (E) or a part of thereof, especially the engraving laser (6), and, on the other hand, the construction surface S;
- One or more cameras or sensors (101) for detecting the presence of at least an object on a zone of the construction surface to be marked;
- A smoke detector (103) ;
- An inclination detector (104) of the frame (1) with respect to the horizontal plan;
- An Inclination or tilt detector (105) of the engraving laser (6) with respect to the vertical axis;
- A motion detector (106) of the frame;
- An infrared detector (107);
- A detector (108) for detecting the presence or movement of an object, person or animal at least within a distance of less than 2m from the frame (1);
- A fault detector (109) for determining at least one fault in the electric circuit and /or in the

electronic circuit (12) and /or in one of the motors (2A, 2B, 2C, 3A, 3B);

- A current leakage detector (110) with advantageously a series of electric fuse protectors.
- A wind detector (111); and
- A protection cover opening detector 112, advantageously determining the possible pivoting of the protection cover from a safe cover protecting position, and
- any combinations thereof.

* the moving support (20) of the marking system (5,6) is mounted mobile in relation to the frame (1) in at least two perpendicular directions between them (X, Y) in the manner to cover a substantially rectangular marking zone, with its sides of at least 0.2m, advantageously at least 1.5m, said substantially rectangular marking zone covering a potential marking surface of minimum 0.4m^2 , advantageously at least 1m^2 .

* the moving support (20) of the marking system comprises at least one positioning camera (101).

* the displacement system (2) for moving the frame (1) comprises at least a series of wheels or rollers, at least three of which being each driven by an electric motor.

* the moving support (20) of the marking system is mounted mobile in translation to a first direction (X) on a rail (3), which is mounted mobile in translation with respect to the frame (1) in a second direction (Y) perpendicular to the first direction (X).

* the moving support (20) of the marking system comprises a carriage mounted mobile on a rail (3) defining a vertical plane (V1) (Symmetric plan of the rail) when the frame (1) is substantially horizontal, the said carriage in relation to this vertical plan (V1) defined by the rail, having, on one side, the engraving laser (6) with the overhanging topographic prism (7), and in that the spaying head of the spaying device (5) is placed under the rail (3), and deported with respect to the engraving laser (6).

* the engraving laser (6) comprises of a guiding laser beam tube (60) for guiding the laser beam generated by the engraving laser (6) towards the construction surface (S).

* the moving support (20) is equipped with at least two distance laser detectors (102) that allow to scan a horizontal area for detecting possible existing obstacles on or around a marking zone of the construction surface.

* the frame (1) is provided or associated along one of its edges, with a structure provided with at least a paint reservoir (200) for the painting composition suitable to be burnt, as well as advantageously one or more batteries (11) to supply electric power to the electric motors, so as to deport the centre of gravity of the whole topography marking system to said one of its edges, the latter being advantageously associated to a first wheel or caterpillar driven to move by at least a first electric motor (2A), and to a second wheel or caterpillar driven to move by at least a second electric motor (2B), the first wheel or caterpillar being distant from the second wheel or caterpillar.

* the frame (1) is protected by a protecting hood or cover (113).

* the topography marking system comprises a displacement rail (3) for the support (20), the said displacement rail (3) being attached to a rotation system (300) enabling at least the support to move around at least part of the frame (1).

* One of the two or more combinations of these characteristics or particularly de total of all above characteristics.

[0020] The invention relates also to a process for marking in real size at least some construction information on a construction surface, according to claim 15, in which one or more topography marking systems of the invention as disclosed here above is/are used for spraying a painting composition suitable to be burnt on said construction surface, so as to paint on said construction surface at least one painted band, and for burning thereafter the said at least one painted band for marking on the said at least one painted band some construction information.

[0021] The particularities and details of this invention will be clear and explicit in the detailed description that follows, and has a reference to the designs in annex.

Brief Description of the Designs

[0022]

Figure 1 is a perspective view of the first embodiment of a system according to the invention;

Figure 2 is a detailed perspective view of a detail of the embodiment of Figure 1;

Figure 3 is a perspective view of another embodiment of the system according to the invention;

Figure 4 is a detailed perspective view of a marking support system of the embodiment of Figure 3;

Figure 5 is a perspective view of another embodiment of the system of the invention; and

Figure 6 and 6A are schematic diagrams representing the functioning of the device according to Figure 3.

Description of Embodiments According to the Invention

[0023] The topographic printer or marking system of Figure 1 is a real size topographic printer for a building (Figure 1) that comprises a rigid and non-deformable braced frame (1) made of light alloys, an autonomous movable system (2) (wheels or rollers or caterpillars) allowing the movement of the marking system over the entire surface to treat or to mark, an internal displacement device (3) enabling a movement in two directions (X and Y) for the printer head (4), a printer head (4) composed of a sprayer (5) for a narrow paint or liquid band that can be burnt, and an engraving laser (6). On the printer head (4) a prism support and topography prism (7) are placed.

[0024] In the front side of the frame is a box (8) that contains the electronic cards, battery, communication system and spraying paint stock reserve.

[0025] At the rear of the frame (1) two motorised hovercraft turbines (9) help to raise the rear of the frame. They are in rotational movement when the device advances. Once the device is in place over the to-be printed area, they stop and the frame is posed on its legs (10).

[0026] The printing head (Figure 2) is composed of a sprayer for narrow paint or liquid band that can be burnt and an engraving laser (6). On the Printing head, a prism support and a topographic prism (7) are mounted. A Servo motor (11) permits to trigger or halt the spraying system giving way to the laser engraving system. It operates by rotation on the pivot (12).

[0027] The system is guided by the topographic total station. To do so, once substantially correctly positioned, the device will displace the printer head to the four extreme corners of the rectangular printable area. The software will compare the readings measured by the topographic total station and the coordinates X, Y measured from the displaced printer head. The software calculates the change from the coordinates using the Helmert Transformation Method. Then it sends a G-code file (Tracing file) to the printer.

[0028] The invented topography printer (called hereafter «Robot Topo») is intended to help and improve tracing steps of a topographic surveyor and the <<Tracing>> workers by printing the complete plan on a slab to a real scale 1/1. It allows a direct link of the computerised plan or model of the BIM (Building Information Model) to its layout on the casted slab. To do so the drawing software breaks down the tracing zone in rectangular areas with a size corresponding to the printing size of the printer. The printer traces marks within a rectangular zone. Then it moves automatically to the next.

[0029] The whole topography station measures and calculates in real time the 3D position of the robot's prism. A computer receives the position and guides the robot in an autonomous way on the site. The high precision laser tracer helps print the construction plan given by computer aided design software (CAO) directly to a scale of 1/1 onto the freshly laid concrete slab.

[0030] A remote operator commands the « Robot Topo » either from the working site or from its office. This office can be situated anywhere. The « Robot Topo » can work 24hours on

24hours, 7days on 7, with reloading phases (short or in continuous with a marking step) for material (Paint) and Energy (Electricity).

[0031] The remote operator loads the actual current plan on the computer (in DWG, DNG format from computer-aided design software (CAD)) or from a file format IFC from the BIM server (Building Information Model) for the floor being built. Adjustment to the quotation, texts, customized notations, parameters is done to extract the plan for the 1/1 scale.

[0032] Once the floor concrete slab of that level is placed by the on-site technical workers, the system of the invention « Robot Topo » is put on a support placed on the freshly cast concrete slab (Parking).

[0033] The « Robot Topo » is not put to use till the concrete has set to allow smooth displacement without any blocking risk (concrete sufficiently hardened for enabling movement of the wheels or caterpillars of the system of the invention on the cast concrete).

[0034] When the remote operator sends a command signal to the « Robot Topo » for positioning itself to one of the site ends to start the marking/tracing operation with the help of the precision laser, the system of the invention is stand still and the topography station gives the position to the remote operator.

[0035] The tracing/marking software extracts the relevant file containing all information of the rectangular zone located under the mobile part of the « Robot Topo ». The software generates then an instruction file, for example in the GCODE format (G-code), which is transmitted to the marking system.

[0036] The « Robot Topo » makes a first move by depositing a colour jet and a second move with the laser tracer/marker. The text, metric information, lines, points; symbols are all traced/marked to the highest precision on the fresh slab (not fully hardened).

[0037] Once this trace/marking is effectively done, the « Robot Topo » moves to the next position. The cycle therefore repeats till the complete surface is treated.

[0038] The topographic printer controlling software can also do part of remote operator's job thus allowing him to carry out remote work at the same time on other construction sites. The remote operator benefits a complete training and can work from a remote office, whereby the operator can be a physically challenged person, enabling then his better integration in a working sector considered as physically requiring.

[0039] If the printing device is externally supported, it can be used to print on vertical elements and also under horizontal elements (example ceilings). In such a case an operator must manually place the printer device, maintain its place and move it from one zone to another.

[0040] In case of use of the topographic printer outside, the prism can be replaced by a series

of integrated signal receptors GNSS RTK that calculates in real time the printer head position.

[0041] The printer of the invention as shown in Figure 3 comprises a system (E) for real size topography printing on the surface of a construction site, said system (E) having at least (a) a non deformable mobile frame (1), (b) a displacement system (2) for moving the frame with respect to the site considered, (c) a marking system with a topographic prism, (d) a support (20) for the movable marking system with respect to the frame in at least two perpendicular directions (X, Y), in which this marking system (6) comprises of at least a spraying device (5) for spraying a liquid or paint band able to be burnt, and a engraving laser (6) for submitting a portion of the sprayed band (on the site surface) by the spraying device (5) to a burning step.

[0042] The displacement system 2 of the frame 1 comprises of at least an electric motor, while the means for moving the support 20 also has at least one electric motor (2A, 2B for example for the front end wheels). The system has at least one electric battery (11), advantageously of the rechargeable type, to supply the above mentioned electric motors 2A, 2B of the displacement system 2 of the frame 1 and of the support 20, the latter being moved by a motor 3A for moving the rail 3 in the direction Y and by a motor 3B for moving the support 20 along the rail 3 in the direction X.

[0043] The system E comprises an electronic command system 12 (electrically supplied by battery 11) to command different functions of the electronic system (12) that is associated with wireless communication means (for facilitating its working as an autonomous robot), to receive information at least with respect to the position of the system (E) on the construction site considered.

[0044] The spraying device 5 comprises a spraying head adapted for spraying on the construction site surface a paint band with width less than 5cm, advantageously comprised between 0.5cm and 2cm, while the engraving laser has a engraving head to mark on the band, points or lines with a thickness size of less than 3mm, advantageously from 0.1mm to 0.8mm.

[0045] The electronic command system 12 is programmed to prevent the engraving laser 6 and the spraying device 5 to function during displacement of the non-deformable mobile frame 1 (so during the driving of the motor 2A and 2B) and to prevent the graving/markings by the engraving laser 6 during the functioning of the spraying device 5, whereby ensuring assure a certain time period between the spraying step and the laser engraving/markings, so as to ensure some drying/curing of the paint or resin prior its burning by the laser.

[0046] It has been observed that the laser marking step after some drying of the sprayed paint or resin band ensures an increased and fast adhesive zone for at least a portion of the sprayed paint band. This is useful when the concrete slab is submitted to bad weather conditions.

[0047] The displacement system at the rear end of the frame 1 has one wheel 21 pivoting around a vertical axis V, so its orientation being controlled by the motor 2C. This enables a

better control of the direction of the movement of the frame from a marked zone towards an adjacent zone to be marked.

[0048] At the front end of the frame 1 two wheels form the displacement system 2, said wheels pivoting also around vertical axes V. These two wheels are motorised, i.e. meaning that they are each associated to motors 2A and 2B respectively. The orientation of each wheel is controlled by motor 2C. Each wheel may have a different orientation compared to the other.

[0049] The system E comprises a series of security means that sends electronic command signals for preventing or stopping the functioning of engraving laser (6) and advantageously also of the spraying device, when a security means detects a potential or real danger. The security means are advantageously selected from the group consisting of:

- A distance detector 100 between on one hand, the system or a part of this system (for example the support 20), particularly the engraving laser (6), and on the other hand, the surface of site S covered by the frame of the system;
- One or more cameras 101 (mounted on the support 20 near the spraying head 5 and the laser 6) to detect the presence of at least an object (for preventing cable damage) or pre-marked areas on the site surface covered by the frame of the system E;
- A smoke detector 103 (for detecting a fire the risk, the support 20 may be equipped with a mini extinguisher system to stop the start of fire).
- An inclination detector 104 of the frame (1) with respect to the horizontal plan;
- An Inclination or tilt detector 105 of the engraving laser 6 with respect to the vertical axis;
- A motion detector 106 of the frame;
- An infrared detector 107, for example to detect source of heat or reflecting element dangerous for reflecting laser ray.
- A presence or movement detector 108 (of an object, person or animal) at a distance of less than 2m from the frame 1;
- A fault detector 109 in the electric circuit and /or in the electronic circuit 12 and /or in one of the motors 2A, 2B, 2C, 3A, 3B;
- A current leakage detector 110; including a series of electric fuse protectors.
- A wind detector 111; and
- A opening detector 112 of a cover/hood 113 (drawn as dashed lines) , the latter pivoting around the axe 114. The cover/hood 113 is advantageously transparent or translucent, but preferably manufactured in a material adapted for blocking the passage of laser ray at the emitted frequency ray by the engraving laser 6. Preferably, the cover is made in an organic material (transparent or translucent) in which one or more organic absorbing colour material are dissolved and /or in a mineral material doped with one or more metal alloys or composite materials.

[0050] The frame 1 is advantageously mounted on positioning means (like lift cylinders) to ensure that the frame 1 is stable in the desired plan (for example horizontal plan, or a plan parallel to the plan of the concrete slab).

[0051] The marking support system (20) is mounted to be mobile on the frame at least in two perpendicular directions (X, Y) in the manner to cover a marking zone, at least rectangular with one or more sides of at least 0.2m, advantageously at least 1.5m, the marking zone covering a surface of at least 0.4m², advantageously at least 1m², preferably comprised between 1 and 2m².

[0052] The marking support (20) comprises of a positioning camera that can be the camera 101, said camera being then also able to detect angles or crosses formed by lines previously marked by the laser, during a scanning step of the support 20 in the two directions X, Y.

[0053] The displacement system of the frame 1 comprises at least a series of wheels or caterpillars each one driven by an electric motor. The wheels for example are situated on the same side as the platform Ibis intended to support the paint reservoir 200 and the pump 201 to feed (via one or more tubes or pipes) the paint to be sprayed to the spraying head 5. The platform Ibis can accommodate several paint reservoirs to make bands with different colours.

[0054] The marking device support 20 is mounted to be mobile in translation along a first direction X on a rail, the latter being mounted to be mobile in translation with respect to the frame along a second direction Y perpendicular to the first direction X.

[0055] The marking device support 20 comprises a carriage mounted mobile on the rail 3 that defines a vertical plan VI (symmetric plan of the rail) when the frame 1 is substantially horizontal, the carriage 20 having in relation to this vertical plan defined by the rail, on one side the engraving laser 6 with the overhanging topographic prism 7. Under the rail 3, and deported with respect to the laser 6, sits the spraying head 5.

[0056] To operate the engraving laser on a previously painted band, it is necessary to displace the rail 3 and/or the support 20 to bring the laser head just over the paint band. The offset values with respect to axes X and Y are approximately known during the conception of the system. The exact offset values between the prism position, the engraving laser and the spraying head are precisely recalculated during the calibration process. This calibration step is done by printing a same pattern in a same zone, after turning the frame 1 by about 180 degrees around the vertical axis. The topographic station helps in correct repositioning of the tracing pattern, the calibration is done by measuring the error as per X and Y. The correction to be made corresponds to half the distance in X and Y separating the patterns traced on the same position.

[0057] The engraving laser 6 comprises a guiding laser beam tube 60 towards the site surface S. This tube is advantageously made of a material absorbing laser ray in case of reflection on the surface to trace.

[0058] The support 20 is equipped with two distance laser detectors 102 (at least one detector) that enable to scan a horizontal area for existing obstacles around the tracing zone.

This distance reading is recalculated in the general coordinate system by using the prism position.

[0059] The frame 1 carries or is associated along one of its edges to a structure (platform Ibis) associated to at least one liquid or paint reservoir (200) (liquid or paint suitable to be burnt), and advantageously at least the battery or batteries (11) for supplying electric current to the electric motors and the pump (201), so as to deport the centre of gravity of the system towards the said edge, which is advantageously associated to a first wheel or caterpillar driven in movement by a first electric motor and a second wheel or caterpillar driven in movement by a second electric motor, the first wheel or caterpillar being distant from the second wheel or caterpillar.

[0060] This invention relates also to the use of a system according to the invention for topographic printing in real size on a surface of a building construction site, in which successive portions (S1,S2,S3, etc.) of the surface are each first printed with one or more paint bands or marking bands, followed with laser marking on one or more of said paint bands or marking bands. To simplify the frame position during its displacement for each portion of the surface, it is advantageous to trace/mark at least two laser reference marks (R1, R2, etc.) per tracing portion. The frame is then moved in such a manner so that the frame in which are moving the support 20 and the positioning camera 101 covers the preceding reference marks. This invention is also capable of repositioning itself onto a previous tracing comprising of minimum intersecting lines, even if said lines were not traced for the purpose of further repositioning. This means that the positioning camera is capable to recognise a previously marked zone for its precise repositioning. This case is useful when it is necessary to complete/correct a prior trace or marking. Indeed, the BIM is continuously amended with the project and the marking have to be amended or completed.

[0061] The topographic printer as per the invention shown in figure 5 is a system (E) of a real size topographic printer on a site surface, where the system (E) comprises at least (a) an non deformable movable frame (1), (b) a displacement system (2) of the frame relative to the respective site, (c) a marking system with a topographic prism , (d) a support (20) for a marking system movable relative to the frame at least in two perpendicular directions (X,Y), in which the marking system comprises at least a spraying device (5) of a band of a paint or liquid suitable to be burnt and an engraving laser (6) for submitting a portion of the sprayed band (on the site by the spraying device) to a burning step.

[0062] A displacement rail (3) for support (20) fixed to a rotation system (300) has the advantage to allow the support to move all around the non-deformable frame, enabling to trace or mark in difficult or less-accessible zones and in the four sides of the frame.

REFERENCES CITED IN THE DESCRIPTION

Cited references

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- [BE20160094 \[0001\]](#)
- [US5755072A \[0010\] \[0011\]](#)
- [JP2001289638A \[0013\]](#)
- [US2002005789A \[0013\]](#)
- [US2009277031A \[0014\]](#)
- [WO2017093779A \[0014\]](#)

Patentkrav

1. Topografimærkningssystem (E) til mærkning i faktisk størrelse af mindst nogle konstruktionsoplysninger på en konstruktionsoverflade, hvor systemet (E) mindst omfatter:

- (a) en ramme (1), der er tilpasset til at danne en bøjningsstiv, ikke-deformerbar ramme,
- (b) et mærkningssystem,
- (c) en bevægelig støtte (20) til mærkningssystemet, hvor den bevægelige støtte (20) monteres på rammen (1) eller på et element deraf, og bliver tilpasset til at sikre bevægelse af mærkningssystemet i forhold til rammen i mindst to vinkelrette retninger (X, Y),

hvor mærkningssystemet omfatter mindst:

- (d) en sprøjteanordning (5) til sprøjtning af en laksammensætning, der er egnet til at blive brændt, muligvis efter delvis eller komplet tørring eller hærkning, på konstruktionsfladen for at male mindst ét malet bånd på konstruktionsfladen,

kendetegnet ved, at systemet desuden omfatter:

- (d) et forskydningssystem (2) til at bevæge rammen (1) i forhold til konstruktionsfladen, og

- (e) en graveringslaser (6) til brænding af det mindst ene malede bånd til mærkning af det mindst ene malede bånd med nogle konstruktionsoplysninger;

og ved, at (f) mærkningssystemet omfatter mindst én topografisk prisme.

2. Topografimærkningssystemet ifølge krav 1, kendetegnet ved, at:

- forskydningssystemet (2) til bevægelse af rammen (1) mindst delvist på konstruktionsfladen omfatter mindst én elektrisk motor (2A, 2B, 2C), mens bevægelsesstøtten (20) omfatter mindst et forskydningsstøttemiddel (20), der er udstyret med mindst én elektrisk motor (3A, 3B), og

– topografimærkningssystemet (E) er tilvejebragt med mindst et elektrisk batteri (11), der er egnet til med fordel at blive genopladet, til forsyning af energi til den mindst ene elektriske motor i forskydningssystemet (2) og den mindst ene elektriske motor til den bevægelige støtte (20).

3. Topografimærkningssystemet ifølge krav 1 eller 2, kendetegnet ved, at det omfatter et elektronisk styringssystem (12) til styring af en række forskellige mærkningsfunktioner og fortrinsvis bevægelsesfunktioner, hvor det elektroniske styringssystem (12) er associeret med et trådløst kommunikationsmiddel til modtagelse af oplysninger mindst angående positionen af systemet eller del deraf på konstruktionsfladen (S), hvorved det elektroniske styringssystem (12) fortrinsvis er programmeret til at forhindre funktionen af graveringslaseren (6) og sprøjteanordningen (5) under forskydning af rammen (1) på konstruktionsfladen (S) og til at forhindre funktionen af graveringslaseren (6) under funktionen af sprøjteanordningen (5).

4. Topografimærkningssystemet ifølge ethvert af de forudgående krav, kendetegnet ved, at sprøjteanordningen (5) omfatter et sprøjtehoved, der er tilpasset til på konstruktionsfladen at sprøjte et malet bånd med en bredde på mindre end 5 cm, fortrinsvis i området mellem 0,5 og 2 cm, mens graveringslaseren (6) omfatter et hoved til graving på det malede bånd af mindst punkter og/eller linjer med en tykkelse på mindre end 1 mm.

5. Topografimærkningssystemet ifølge krav 3, kendetegnet ved, at topografimærkningssystemet (E) omfatter en række sikkerhedsmidler, der sender signaler til det elektroniske styringssystem (12) mindst for at stoppe eller forhindre funktionen af graveringslaseren (6), og fortrinsvis også for at stoppe eller forhindre funktionen af sprøjteanordningen (5), hvor sikkerhedsmidlerne fortrinsvis bliver valgt fra den gruppe, der omfatter:

- En afstandsdetektor (100) mellem, på den ene side, topografimærkningssystemet (E) eller en del deraf, specielt graveringslaseren (6), og, på den anden side, konstruktionsfladen S;
- Ét eller flere kameraer eller sensorer (101) til detektion af tilstedeværelsen af mindst et objekt på en zone af konstruktionsfladen, der skal mærkes;
- En røgdetektor (103);
- En hældningsdetektor (104) på rammen (1) i forhold til det vandrette plan;
- En hældnings- eller krængedetektor (105) på graveringslaseren (6) i forhold til den vertikale akse;
- En bevægelsesdetektor (106) på rammen;
- En infrarøddetektor (107);
- En detektor (108) til detektion af tilstedeværelsen eller bevægelsen af et objekt, en person, et dyr mindst inden for en afstand på mindre end 2 m fra rammen (1);
- En fejldetektor (109) til bestemmelse af mindst én fejl i det elektriske kredsløb og/eller i det elektroniske kredsløb (12) og/eller i én af motorene (2A, 2B, 2C, 3A, 3B);
- En strømlæagedetektor (110) fortrinsvis med en række elektriske sikringsbeskyttere.
- En vinddetektor (111); og
- En beskyttelsesdækselåbningsdetektor (112), der fortrinsvis bestemmer den mulige drejning af beskyttelsesdækslet fra en sikker dækselbeskyttelsesposition, og
- kombinationer heraf.

6. Topografimærkningssystemet ifølge ethvert af de foregående krav, kendetegnet ved, at den bevægelige støtte (20) på mærkningssystemet (5, 6) er monteret mobilt i forhold til rammen (1) i mindst to vinkelrette retninger mellem dem (X, Y) på en måde, der dækker en hovedsageligt rektangulær mærkningszone med dens sider på mindst 0,2 m, fortrinsvis mindst 1,5 m, den hovedsageligt rektangulære mærkningszone dækker en potentiel mærkningsflade på mindst 0,4 m², fortrinsvis mindst 1 m².

7. Topografimærkningssystemet ifølge ethvert af de foregående krav, kendetegnet ved, at den bevægelige støtte (20) på mærkningssystemet omfatter mindst ét positioneringskamera (101).
8. Topografimærkningssystemet ifølge ethvert af de forudgående krav, kendetegnet ved, at forskydningssystemet (2) til bevægelse af rammen (1) omfatter mindst en række hjul eller ruller, hvoraf mindst tre drives af en elektrisk motor.
9. Topografimærkningssystemet ifølge ethvert af de foregående krav, kendetegnet ved, at den bevægelige støtte (20) på mærkningssystemet er monteret mobilt flytbart i forhold til en første retning (X) på en skinne (3), der er monteret mobilt flytbart i forhold til rammen (1) i en anden retning (Y) vinkelret på den første retning (X).
10. Topografimærkningssystemet ifølge ethvert af de foregående krav, kendetegnet ved, at den bevægelige støtte (20) i mærkningssystemet omfatter en vogn, der er monteret mobilt på en forskydningsskinne (3), der definerer et symmetrisk vertikalt plan (V1) af skinnen, når rammen (1) er hovedsageligt vandret, vognen, i forhold til dette symmetriske vertikale plan (V1), der er defineret af forskydningsskinnen, på én side, har graveringslaseren (6) med den overhængende topografiske prisme (7), og ved, at sprøjte hovedet på sprøjteanordningen (5) er placeret under forskydningsskinnen (3) og er forflyttet i forhold til graveringslaseren (6), hvorved forskydningsskinnen (3) fortrinsvis er fastgjort på et rotationssystem (300), der muliggør, at mindst støtten kan bevæges omkring mindst en del af rammen (1).
11. Topografimærkningssystemet ifølge ethvert af de forudgående krav, kendetegnet ved, at graveringslaseren (6) omfatter et styrelaserstrålerør (60) til styring af den laserstråle, der frembringes af graveringslaseren (6), mod konstruktionsfladen (S).
12. Topografimærkningssystemet ifølge ethvert af de forudgående krav, kendetegnet ved, at den bevægelige støtte (20) er udstyret med mindst to afstandslaserdetektorer

(102), der gør det muligt at scanne et vandret område for at detektere mulige eksisterende forhindringer på eller omkring en mærkningszone på konstruktionsfladen.

13. Topografimærkningssystemet ifølge krav 2, samt fortrinsvis ifølge ethvert af kravene 3 til 12, kendetegnet ved, at rammen (1) er tilvejebragt eller associeret langs én af dets kanter, med en struktur, der er tilvejebragt med mindst en malingbeholder (200) til den malingssammensætning, der er egnet til at blive brændt, samt fortrinsvis ét eller flere batterier (11) til tilførsel af elektrisk strøm til de elektriske motorer for at forflytte tyngdepunktet af hele topografimærkningssystemet til én af dets kanter, hvor den sidstnævnte fortrinsvis associeres med et første hjul eller larvebånd, som drives til bevægelse af mindst en første elektrisk motor (2A), og med et andet hjul eller larvebånd, som drives til bevægelse af mindst en anden elektrisk motor (2B), hvor det første hjul eller larvebånd er langt fra det andet hjul eller larvebånd.

14. Topografimærkningssystemet ifølge ethvert af de foregående krav, kendetegnet ved, at rammen (1) er beskyttet af en beskyttelseshætte eller et beskyttelsesdæksel (113).

15. En fremgangsmåde til mærkning i faktisk størrelse af mindst nogle konstruktionsoplysninger på en konstruktionsflade, hvorpå ét eller flere topografimærkningssystemer ifølge ethvert af de foregående krav anvendes til at sprøjte en malingsammensætning, der er egnet til at blive brændt, på konstruktionsfladen for på konstruktionsfladen at male mindst ét malet bånd og for derefter at brænde det mindst ene malede bånd til mærkning på det mindst ene malede bånd af nogle konstruktionsoplysninger.

DRAWINGS

Figure 1:

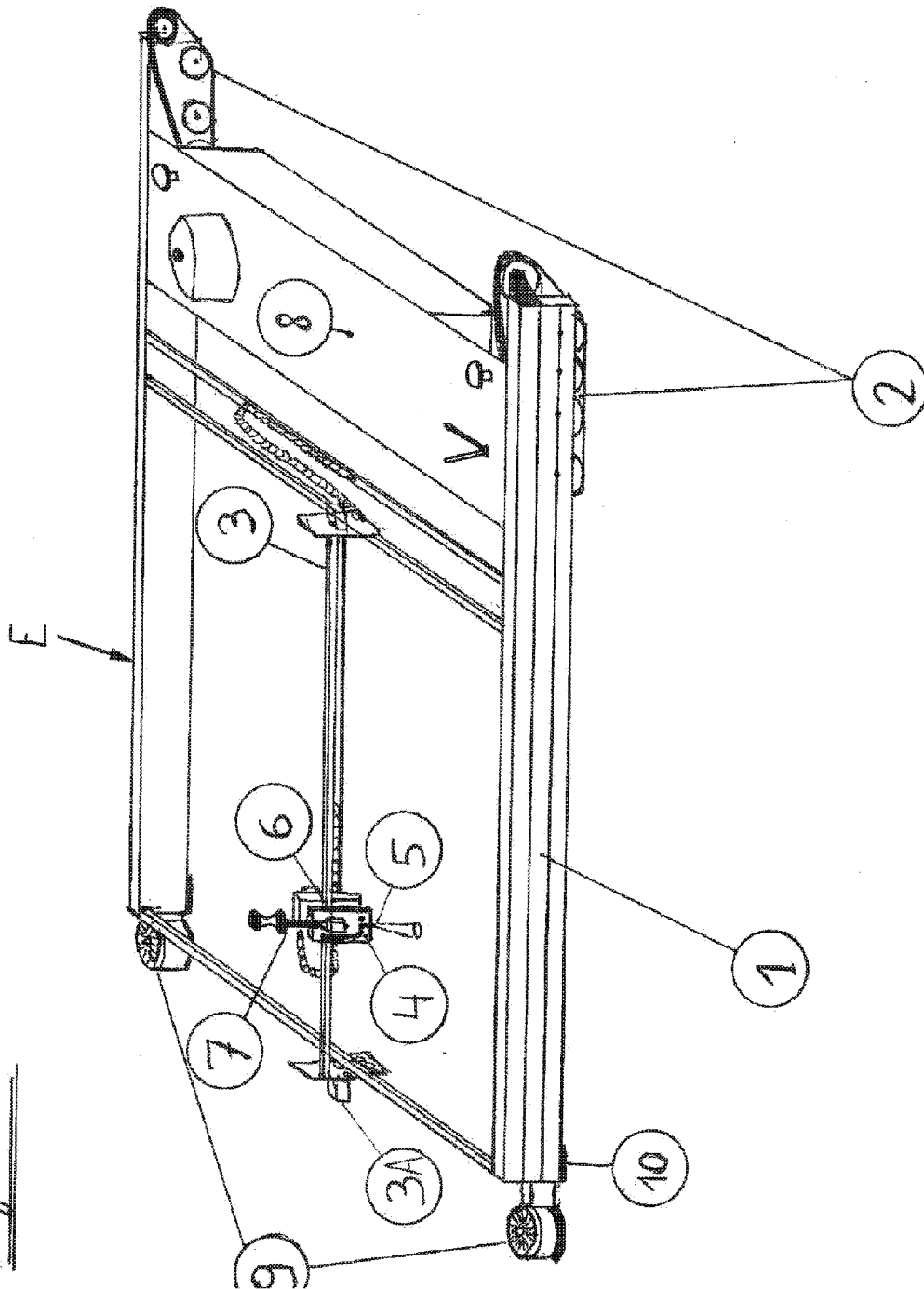
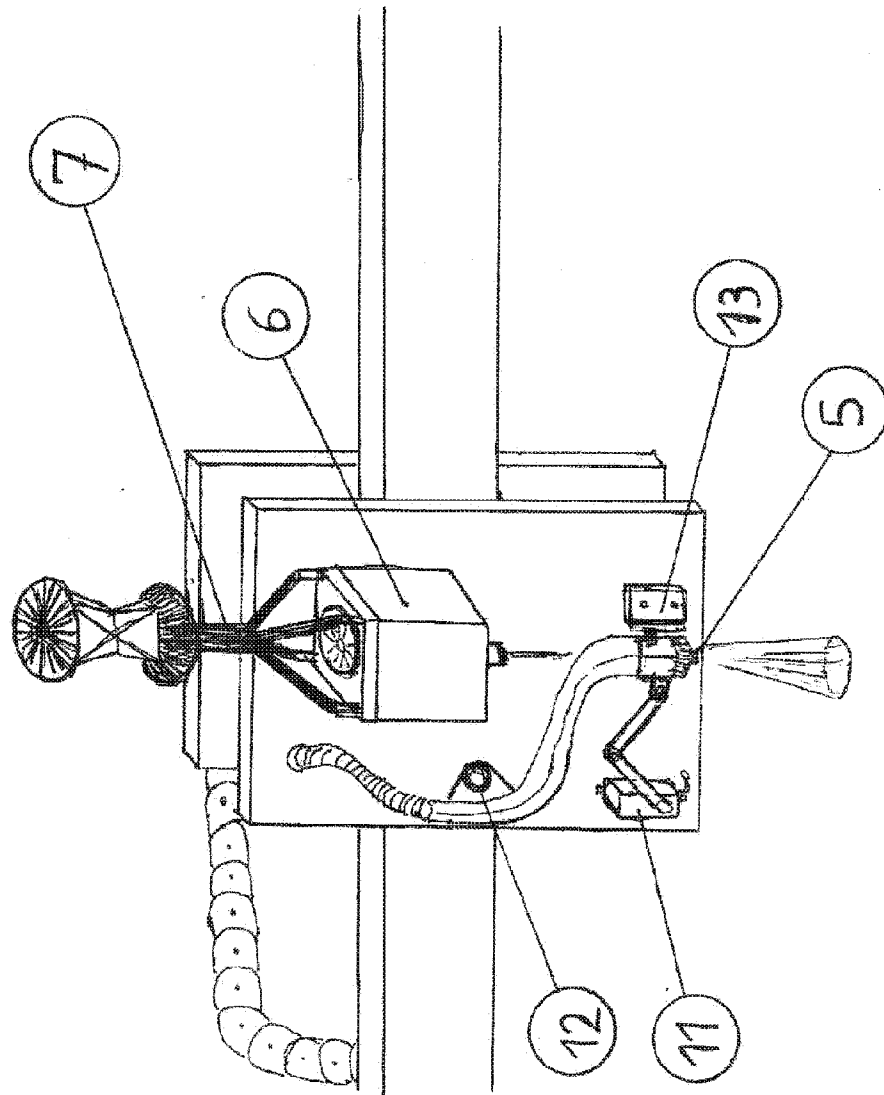


Figure 2 :



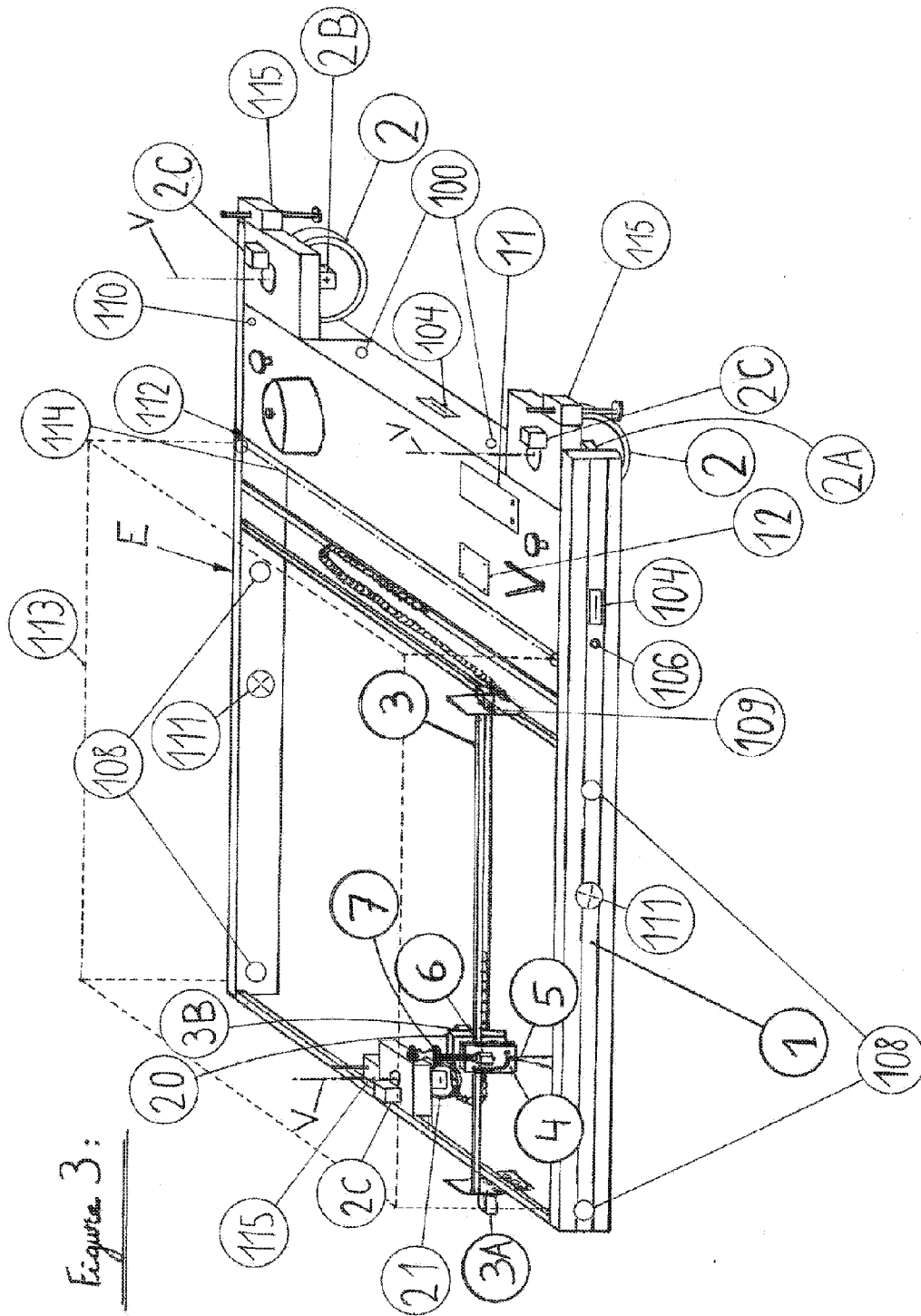


Figure 4:

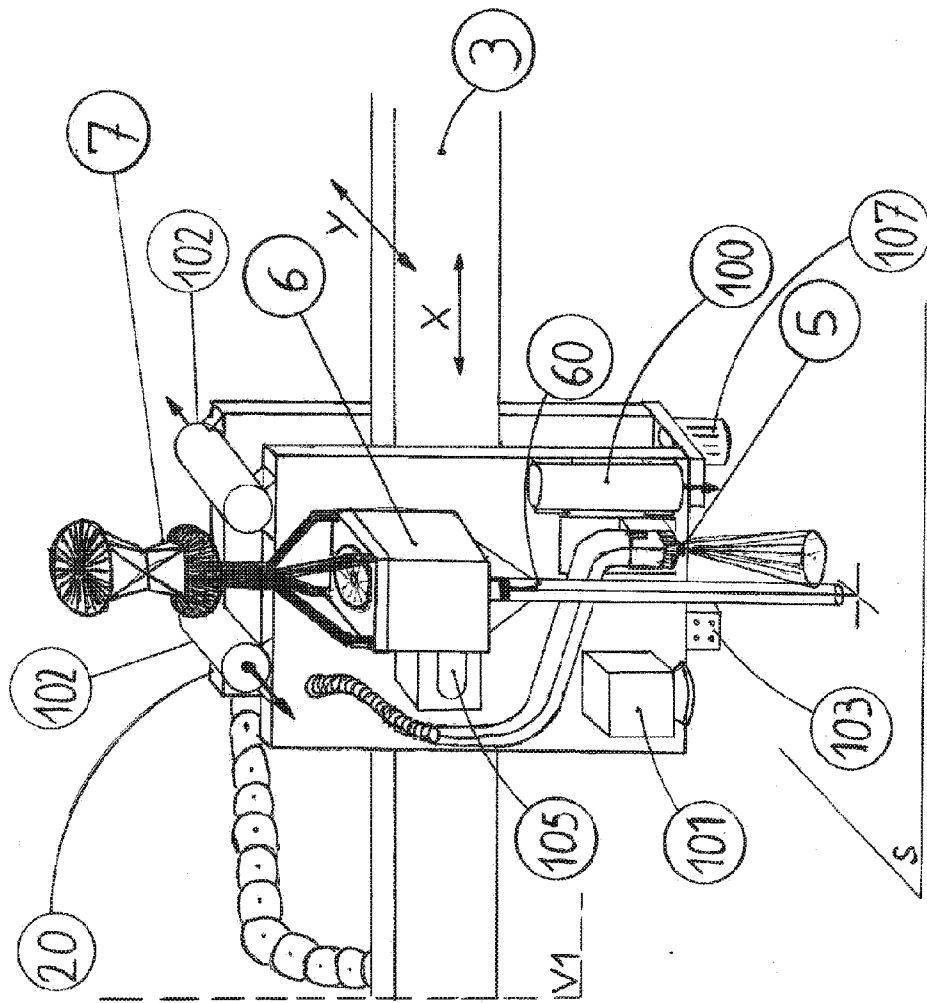


Figure 5:

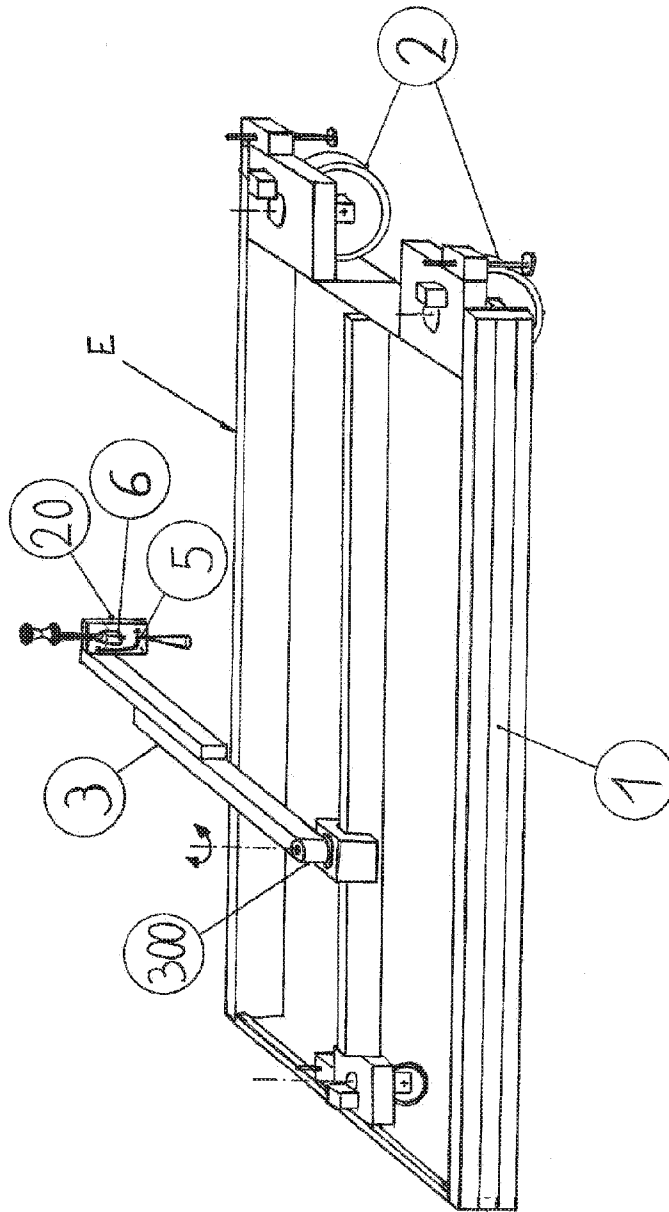


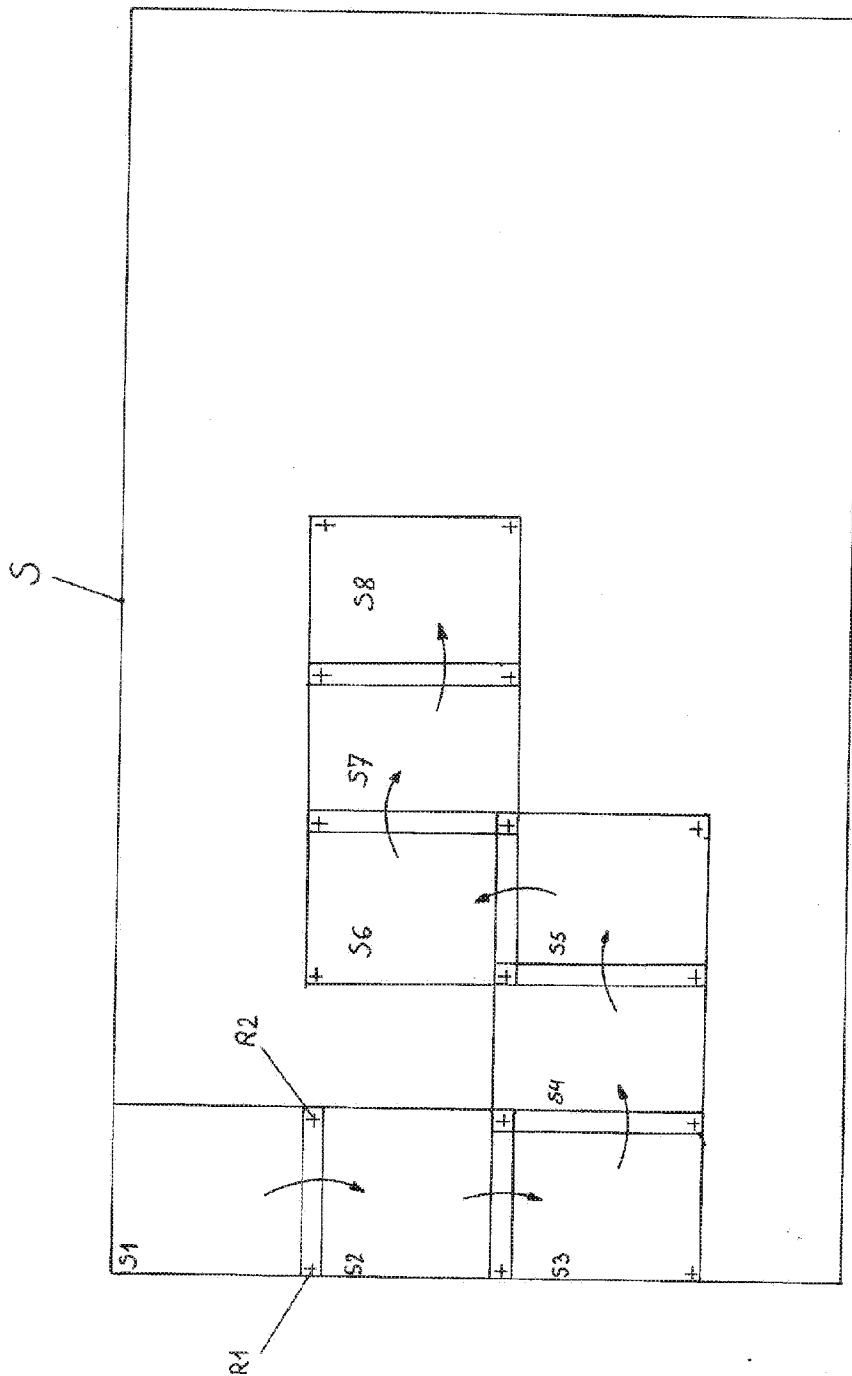
Figure 6

Figure 6A

