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(54) FACILITY AND METHOD FOR CONSTRUCTION OF PREFABRICATED BRICK FACADES

(57) Facility and method for the construction of pre-fabricated brick facades. The invention deals with a method and a facility of flexible manufacturing that by means of automated stations allows the prefabrication of interior

divisions and exterior enclosures with an unprecedented level of finish. The method and facility configure and support all aspects that guarantee agile and controlled manufacturing with the application of BIM technology.

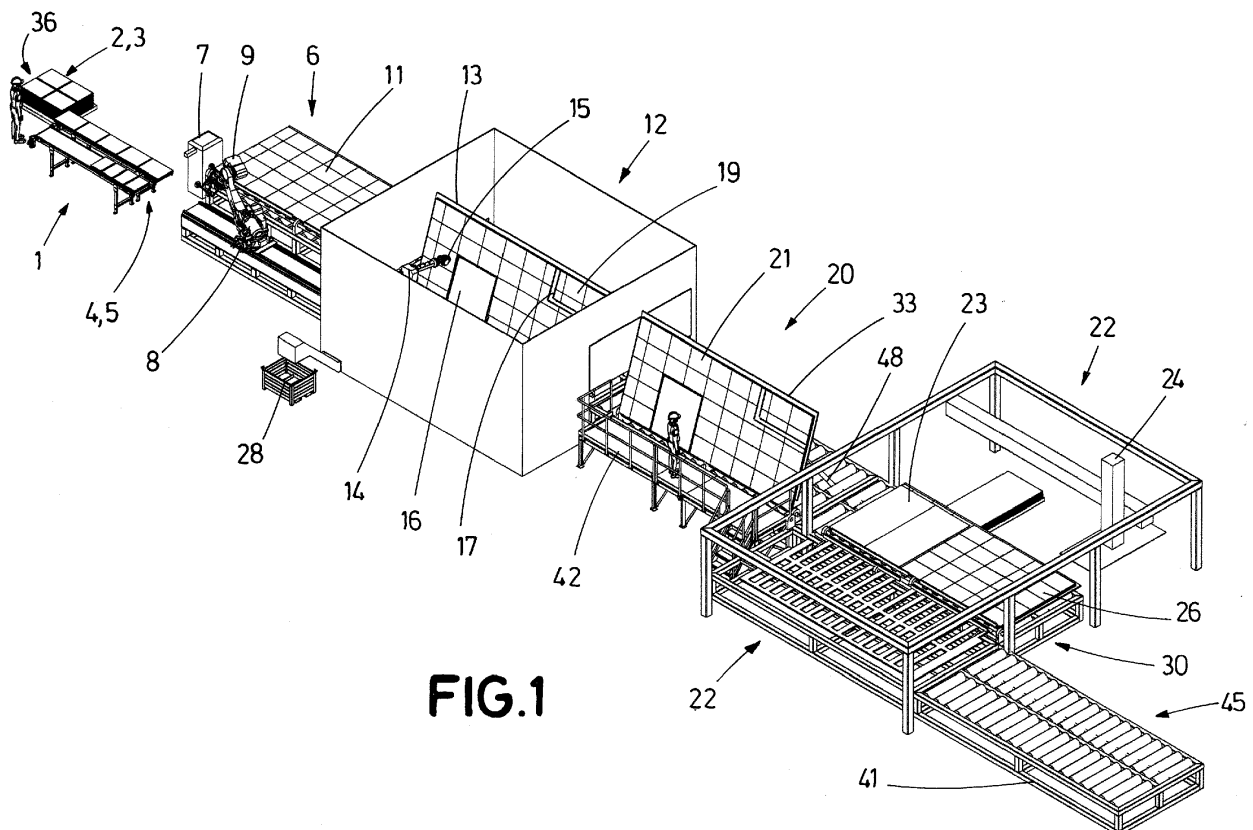


FIG.1

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Description

OBJECT OF THE INVENTION

[0001] The object of the invention is a facility and a method for the construction of prefabricated brick facades.

[0002] In particular, the invention is about a method and a facility of flexible manufacturing that allow the prefabrication of interior divisions and exterior enclosures, by automated stations, with an unprecedented level of finish. The method and the facility configure and support all the aspects that guarantee agile and controlled fabrication with the application of BIM technology.

BACKGROUND OF THE INVENTION

[0003] Nowadays the construction industry has begun to develop methods and systems for the construction of prefabricated facades using BIM technology, which brings multiple advantages by allowing an initial design that integrates all the components of a facade.

[0004] In the prior art solutions, it is known a method and apparatus where the bricks are transported by a conveyor belt to a base where a robotic arm picks them up one by one and places them on a frame arranged vertically or horizontally. The bricks are automatically positioned according to the data in the CAD model. The robot applies adhesive to the bricks and joins them together. The system takes into account the position and dimensions of the windows and doors so that no bricks are placed in these areas. When the wall is finished it is transported to the construction site and installed in its position. It is also known a conveyor belt that applies adhesive to the brick and lifts it up to a long robotic arm, which places it according to the plan of the house that has been loaded into memory.

[0005] However, none of the processes mentioned allows the construction of prefabricated facades completely finished in the factory. It does not take into account the cavities of the grooves for conduits neither the installation of laminated boards.

DESCRIPTION OF THE INVENTION

[0006] The present invention discloses a method and a facility for the construction of prefabricated brick facades.

[0007] The method comprises the steps of conveying bricks successively to a first adhesive applicator station, applying an adhesive element to the lateral surfaces of the bricks and forming a brick wall, conveying the brick wall to a cutting station, cutting the brick wall to a first shape required for cavities for windows and doors, cutting the brick wall to a second shape required for grooves for conduits and forming a prefinished brick wall, conveying the prefinished brick wall to an embedding station, embedding internal ducts of electrical installations, plumbing

and similar into the grooves and embedding frames into the cavities, forming a finished brick wall comprising two faces, conveying the finished brick wall to an assembling station, conveying a laminated board to the assembling station, applying adhesive to the faces of the finished brick wall and assembling the laminated board respectively on each side of the finished brick wall and form a prefabricated brick façade.

[0008] In this way it is possible to manufacture a prefabricated brick facade in such a way that the manufacturing times are reduced considerably and design versatility is increased. The prefabricated brick facade is also optimally finished thanks to the laminated boards.

[0009] The method may further comprise the step of transferring the bricks from a brick storehouse and depositing them into the first conveyor. In this way a very high quantity of bricks can be stored in the warehouse and transported depending on the needs.

[0010] As the internal ducts of electrical, plumbing and similar installations are inserted into the grooves and the frames into the window and door cavities, it is not necessary to insert the ducts later on during the final construction of the building, with the time and effort savings that this implies. Moreover, as this stage is carried out before assembling the laminated panels it is easier to insert the ducts in their correct position.

[0011] The method may comprise the step of removing the waste of bricks after cutting the brick wall removing the brick waste of bricks generated after cutting the brick wall so the brick waste does not interfere with operations.

[0012] The method may comprise the step of packing the prefabricated brick façade by means of a packer device ensuring that the prefabricated brick facade is not damaged during the transport.

[0013] Preferably, the method can include the stage of exporting a BIM file, converting it to CAD and converting it to CAM so that all stages of an initial design can be adapted and the configuration of each element is known from the beginning. In this way, the exact design of the finished product, the exact position of the bricks, the quantity needed for each finished brick wall and the position of the necessary cuts are known before starting with the manufacturing.

[0014] The present invention also discloses a facility for the construction of prefabricated brick facades comprising a brick reception station comprising a first conveyor which receives bricks, an adhesive application station comprising an adhesive dispenser configured to deposit adhesive on these bricks and a first robot comprising a handling gripper which receives the bricks from the first conveyor and transports them to the adhesive dispenser where there the bricks receive adhesive, and places them in a predetermined position onto a first support forming a brick wall, a cutting station comprising a second support which receives the brick wall from the adhesive application station and a brick cutting robot equipped with a cutting head which cuts the brick wall into a first shape required for window and door openings

and a second shape required for grooves, forming a pre-finished brick wall and where brick waste is generated.

[0015] The facility comprises, an embedding station comprising a third support which receives the prefinished brick wall and where internal conduits for electrical, plumbing and similar installations are embedded in the grooves and frames into the openings of the windows and doors, forming a finished brick wall equipped with two faces.

[0016] The facility comprises, an assembly station which receives two laminated boards and the finished brick wall, which comprises a handler that moves the laminated boards and places them respectively on each face of the finished brick wall, forming a prefabricated brick facade in which the finished laminated boards and the finished brick wall are joined by means of an adhesive.

[0017] Thanks to the configuration of all the elements of the facility, the steps described above can be easily carried out. The facility is intended to be integrated into a building so that operations are carried out in a secure environment. Preferably the devices and machinery used are standard and can be configured for each operation.

[0018] The facility may also have a second conveyor that connects the adhesive application station, the cutting station, the embedding station and the assembly station and is equipped with rollers that allow the movement of the walls between stations.

[0019] Preferably, the cutting station can comprise a safety enclosure with safety doors allowing passage to an authorized operator and a vacuum cabin that sucks in the dust generated by the cutting operations.

[0020] After this work is done, an operator enters to push the wall debris towards the debris extractor comprised in the cutting station and the window and door cuts will be removed in the next operation. The installation can also include a third conveyor to remove brick waste from the cutting station.

[0021] In the embedding station the embedding stage can be done manually, where the operators put the cables and pipes in the previously made grooves. The third support can be raised by means of hydraulic actuators so that the operators can work more comfortably. It also has a safety system to prevent the wall from falling and is equipped with shelves to store the materials mentioned above. Alternatively, the embedding station can include a third robot which autonomously inserts the ducts and frames into the sales shafts and gaps automatically. Thus, the installation of the ducts is carried out fully automatically with the consequent time savings and a high degree of precision. Preferably, the embedding station is fenced in to preserve the safety of the operators.

[0022] The facility may comprise a fourth conveyor parallel to the second conveyor extending from the assembly station and the assembly station comprises a turning device configured to receive the finished brick wall with one board of the second conveyor and turn it 180° over the fourth conveyor. Thanks to this configuration, the prefin-

ished wall is raised and turned over the other side, which does not have the laminated board, so the second board can be placed.

[0023] Preferably, the bricks may consist of whole bricks and bricks cut in half and the first conveyor comprises a first conveyor which receives whole bricks and a second conveyor which receives bricks cut in half.

[0024] The supports may be reclinable and are preferably connected by the second conveyor so that the walls being generated can be easily transferred from one support to the next thanks to the rollers. Roller tables with hydraulic lift for transporting partitions.

[0025] Advantageously, the robots and the manipulator are configured to work by means of a CAD-CAM system, to which a design has been previously converted into BIM format, so that the operations performed by them are based on a first design made in BIM format.

[0026] The installation also includes a control module configured to carry out any of the stages of the previously described method.

[0027] Alternatively, the brick reception station can additionally include a destacking device equipped with a vertically and horizontally movable clamp to transfer the bricks from a brick store and deposit them on the first conveyor. In this way, the bricks are automatically transferred to the first conveyor.

[0028] The installation can also include a packing station that receives the prefabricated brickwork façade, which includes a packing device to pack the prefabricated brickwork façade and form a packed façade. The installation may also comprise a control module configured to carry out any of the stages of the method described above.

DESCRIPTION OF THE DRAWINGS

[0029] To complement the description being made and in order to aid towards a better understanding of the characteristics of the invention, in accordance with a preferred example of practical embodiment thereof, a set of drawings is attached as an integral part of said description wherein, with illustrative and non-limiting character, the following has been represented:

Figure 1.- Shows a perspective view of an installation for the construction of prefabricated brick facades.

Figure 2.- Shows a perspective view of a first detail of an installation for the construction of prefabricated brick facades.

Figure 3.- Shows a perspective view of a second detail of an installation for the construction of prefabricated brick facades.

PREFERRED EMBODIMENT OF THE INVENTION

[0030] Figure 1 shows an installation for the construction of prefabricated brick facades, according to the present invention, where the installation comprises a

brick reception station (1) equipped with a first conveyor (4,5) which receives some bricks (2,3) and these are transported to an adhesive application station (6) comprising an adhesive dispenser (7), where a first robot (8) is in charge of placing the bricks (2,3) with an adhesive in a predetermined position on a first support (10) and forming a brick wall (11).

[0031] Adjacent to the brick reception station (1), the installation includes a cutting station (12) equipped with a second support (13) that receives the brick wall (11) from the adhesive application station (6) and where the cutting station (12) includes a brick cutting robot (14) equipped with a cutting head (15) that cuts the brick wall (11) into a first shape required for window and door cavities (16) and a second shape required for grooves (17). As a consequence of these operations, brick waste (28) is generated.

[0032] Thus, a prefabricated brick wall (19) is generated with its cavities (16) and grooves (17) which is transported to an embedding station (20). The embedding station comprises a third support (33) which receives the prefabricated brick wall (19) where internal conduits for electrical, plumbing and similar installations are manually embedded into the grooves (17) and frames in the cavities (16) of the windows and doors, forming a finished brick wall (21) with two faces (27,49).

[0033] Finally, the installation comprises an assembly station (22) which receives two laminated boards (23,25), and the finished brick wall (21), which comprises a handler (24) that moves the laminated boards (23,25) and places them respectively on each face (27,49) of the finished brick wall (21). The figure shows only a first face (27) to which a first laminated board (23) has been attached.

[0034] The installation includes a second conveyor (30) that links the adhesive application station (6), the cutting station (12), the embedding station (20) and the assembly station (22) and is equipped with rollers (31) that allow the movement of the walls (11,19,21) between these stations when the rollers (31) are activated. Preferably the second conveyor (30) is a raised platform where the supports (10,13,33) rest.

[0035] Figure 2 shows a first detailed view of the installation for the construction of prefabricated brick facades, according to the present invention, where it is shown that preferably an operator unloads the bricks (2,3) from a brick storehouse (36) in the first conveyor (4,5).

[0036] It can be seen that the bricks (2,3) consist of whole bricks (2) and bricks cut in half (3) and the first conveyor (4,5) comprises a first conveyor second c(4) that receives whole bricks (2) and a second conveyor (5) that receives bricks cut in half (3) and moves them to a waiting position, thanks to a photocell that retains them, not shown in the figures, until they are picked up by the brick cutting robot (14).

[0037] The adhesive dispenser (7) is configured to deposit adhesive on these bricks (4,5) and the first robot

(8) is equipped with a handling gripper (9) that receives the bricks (2,3) from the first conveyor (4,5) and transports them to the adhesive dispenser (7) where they receive adhesive. Additionally, the first robot (8) includes a machine vision system to locate and position the bricks (2,3).

[0038] Specifically, the first robot (8) places a first face of a brick (2,3) under the adhesive dispenser (7) where it receives adhesive on one face and if necessary, the robot manipulates and turns the brick so that the brick (2,3) receives adhesive on more than one face. The adhesive dispenser (7) dispenses adhesive only when it detects the presence of bricks (2,3).

[0039] Preferably the first support (10) and the second support (13) are reclinable. Specifically, the first support (10) is in a horizontal position and on it rests the brick wall (11) and the second support (13) is inclined to facilitate the manoeuvring of the brick cutting robot (14).

[0040] After finishing the work in the adhesive application station (6), the first support (10) is placed back in a horizontal position and by means of the rollers (31) of the second conveyor (30), the brick wall (11) passes to the cutting station (12).

[0041] It is also appreciated that the installation includes a third conveyor (32) to eliminate brick waste (28) generated in the cutting station (12), where the waste is deposited in a waste store (37).

[0042] Preferably the robots (9,15), are supported on a track (38) equipped with two rails (39) on which the robots (9,15) slide thanks to their base and describe a linear movement that allows them to perform the maneuvers correctly. The first robot (8) includes an artificial vision device that helps the precise positioning of the bricks (2,3).

[0043] Figure 3 shows a second detailed view of the installation for the construction of prefabricated brick facades, where the embedding station (20) includes a safety fence (42) so that the operator can work safely.

[0044] The embedding station includes a third support (33) which supports the finished wall (21) and has the possibility to lift it thanks to a hydraulic arm (48) joined to the support, present in all the supports (10,13,33), so that the operator can work on the prefabricated wall more easily to put the cables, conduits and pipes in the grooves. Preferably the embedding station (20) includes shelves to store materials such as cables and pipes and a safety retention system to hold the finished brick wall (21).

[0045] This forms a pre-fabricated brick facade (29) in which the laminated boards (23,25) and the finished brick wall (21) are joined by means of an adhesive. It can be seen that the installation comprises a fourth conveyor (35) parallel to the second conveyor (30) which extends from the assembly station (22). The assembly station (22) comprises a turning device (34) configured to receive the finished brick with the first laminated board (23) wall of the second conveyor (30) and turn it 180° over the fourth conveyor (35).

[0046] Specifically, the assembly station (22) comprises a fourth support (43) which receives the finished brick wall (21), and when the turning device (34) is activated it turns to the fourth support (43) and transfers the prefinished facade (26) together with the first laminated board (23) to a fifth support (44) which is placed on the fourth conveyor (35) and has been previously tilted to receive the prefinished facade (26). Thus, once the first laminated board (23) has been attached to the first face (27), a second laminated board (25) is attached to the second face (49) forming a prefabricated brick façade (29).

[0047] The installation includes a final inspection station (45) equipped with a sixth support (41) where the final inspection of the prefabricated brick façade (29) is carried out. The sixth support (41), which can be a hydraulically tiltable table, is placed in a predetermined position to be carried by a bridge crane.

Claims

1. Method for the construction of prefabricated brick facades, **characterized by** comprising the steps of:

- conveying bricks (2,3) successively to a first adhesive applicator station (6);
- applying an adhesive element to the lateral surfaces of the bricks (2) and forming a brick wall (11);
- conveying the brick wall (11) to a cutting station (12);
- cutting the brick wall (11) to a first shape required for cavities (16) for windows and doors;
- cutting the brick wall (11) to a second shape required for grooves (17) for conduits and forming a prefinished brick wall (19);
- conveying the prefinished brick wall (19) to an embedding station (20);
- embedding internal ducts of electrical installations, plumbing and similar into the grooves (17) and embedding frames into the cavities (16), forming a finished brick wall (21) comprising two faces (27,49);
- conveying the finished brick wall (21) to an assembling station (22);
- conveying a laminated board (23,25) to the assembling station (22)
- applying adhesive to the faces (27,49) of the finished brick wall (21);
- assembling the laminated board (23,25) respectively on each face (27, 49) of the finished brick wall (21) and form a prefabricated brick façade (29);

2. The method of claim 1, further comprising the step of transferring the bricks (2,3) from a brick storehouse (36) and depositing them into the first convey-

or (4,5).

3. The method of claim 1, further comprising the step of removing a brick waste (28) of bricks generated after cutting the brick wall (11).

4. A facility for the construction of prefabricated brick facades, **characterized by** comprising:

- a brick reception station (1) comprising a first conveyor (4,5) which receives bricks (2,3);
- an adhesive application station (6) comprising an adhesive dispenser (7) configured to deposit adhesive on these bricks (4,5) and a first robot (8) comprising with a handling gripper (9) which receives the bricks (2,3) from the first conveyor (4,5) and transports them to the adhesive dispenser (7) where there the bricks (2,3) receive adhesive, and places them in a predetermined position onto a first support (10) forming a brick wall (11);
- a cutting station (12) comprising a second support (13) which receives the brick wall (11) from the adhesive application station (6) and a brick cutting robot (14) equipped with a cutting head (15) which cuts the brick wall (11) into a first shape required for window and door cavities (16) and a second shape required for grooves (17), forming a prefinished brick wall (19) and where brick waste (28) is generated;
- a embedding station (20) comprising a third support (33) which receives the prefinished brick wall (19) and where internal conduits for electrical, plumbing and similar installations are embedded in the grooves (17) and frames into the cavities (16) of the windows and doors, forming a finished brick wall (21) equipped with two faces (27,49);
- an assembly station (22) which receives two laminated boards (23,25), and the finished brick wall (21), which comprises a handler (24) that moves the laminated boards (23,25) and places them respectively on each face (27,49) of the finished brick wall (21), forming a prefabricated brick facade (29) in which the finished laminated boards (23,25) and the finished brick wall (21) are joined by means of an adhesive.

5. The facility according to claim 4, which comprises a second conveyor (30) that links the adhesive application station (6), the cutting station (12), the embedding station (20) and the assembly station (22) and is equipped with rollers (31) that allow the movement of the walls (11,19,21).

6. The facility according to claim 4, further comprising a fourth conveyor (35) parallel to the second conveyor (30) extending from the assembly station (22)

and the assembly station (22) comprises a turning device (34) configured to receive the default wall of the second conveyor (30) and turn it 180° over the fourth conveyor (35).

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7. The facility according to claim 4, wherein that the bricks (2,3) consist of whole bricks (2) and bricks cut in half (3) and the first conveyor (2,3) comprises a first conveyor (4) which receives whole bricks (2) and a second conveyor (5) which receives bricks cut in half (3). 10
8. The facility according to claim 4, further comprising a third conveyor (32) to remove brick waste (28) from the cutting station (12). 15
9. The facility according to claim 4, in which the supports (10,13,33) are reclinable. 20

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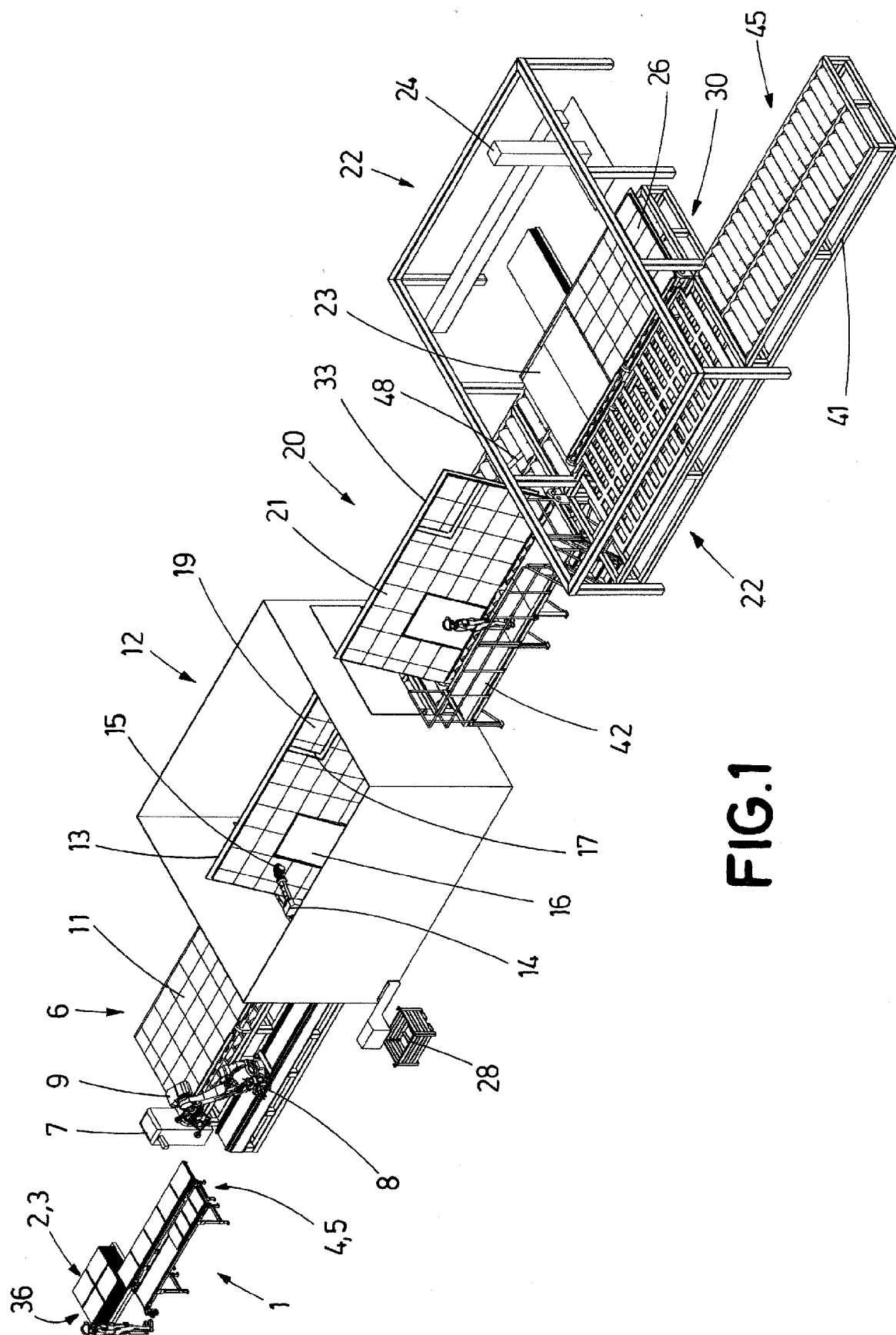


FIG. 1

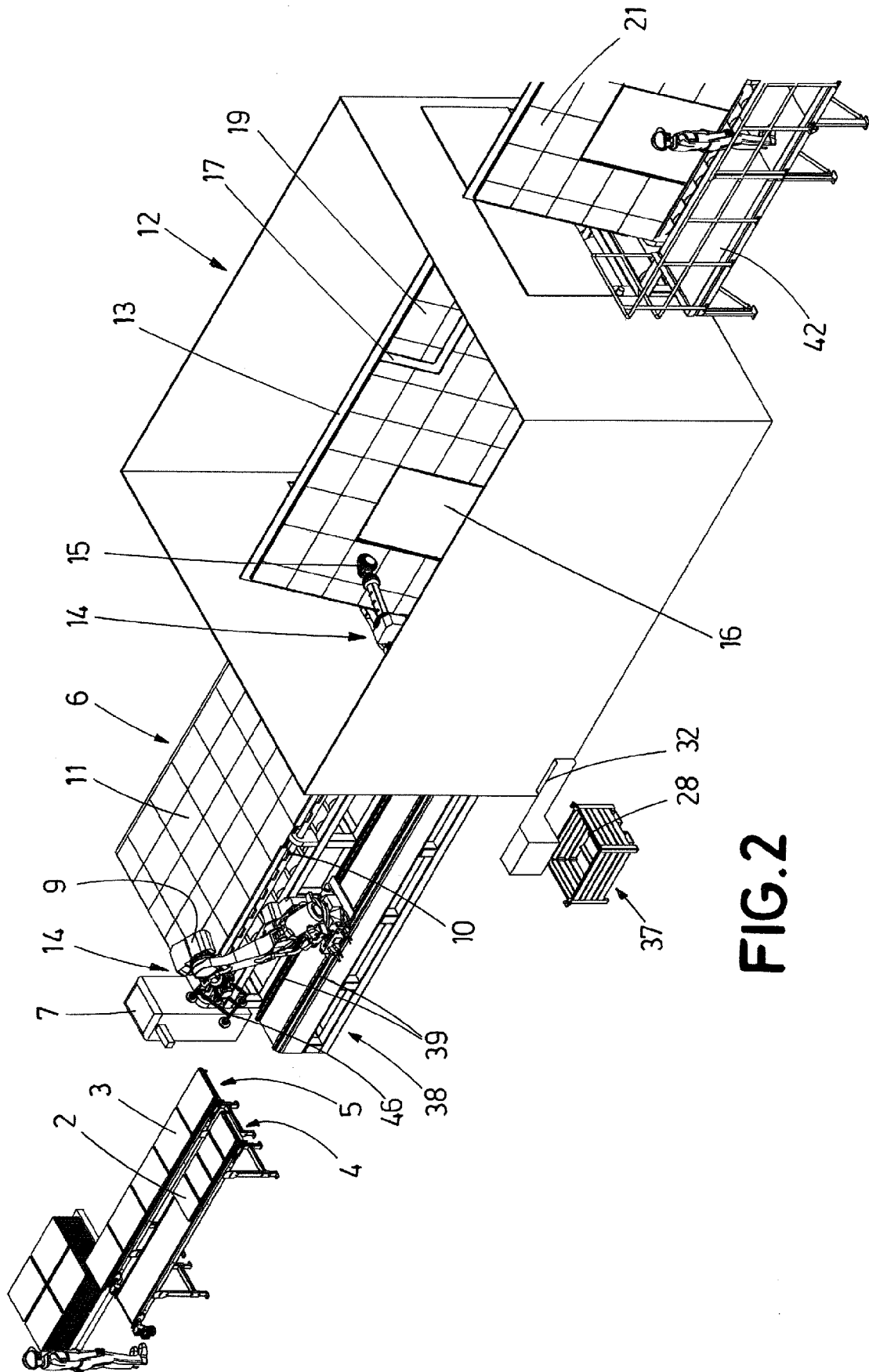


FIG. 2

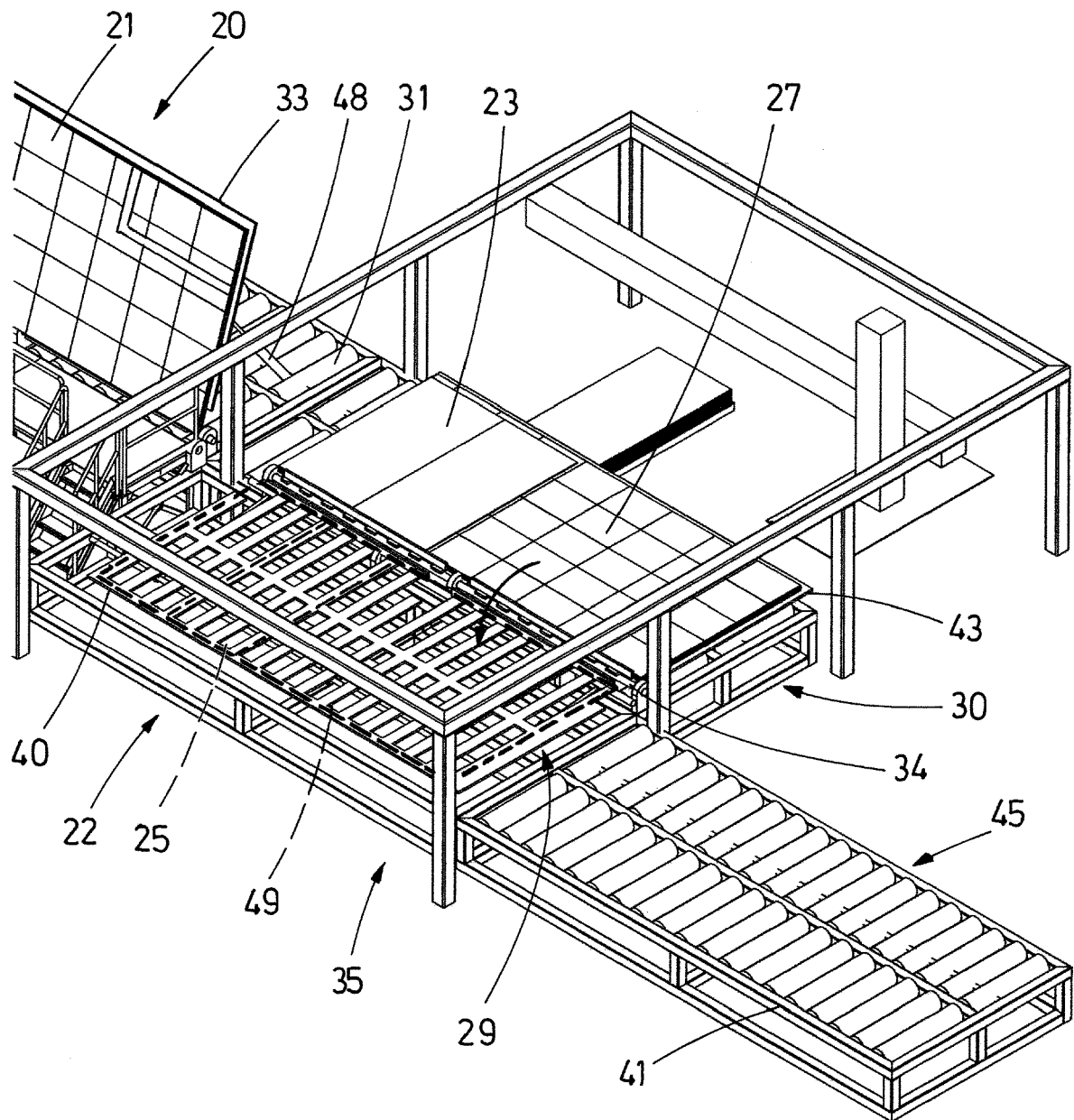


FIG.3



EUROPEAN SEARCH REPORT

 Application Number
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 11 March 2021	Examiner Saretta, Guido
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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