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(54) **Decoration system for powder-on-powder technology**

(57) A decoration system for powder-on-powder technology comprising a handling device 1 of bars or extruded profiles 4, comprising a frame 10 with which the bars are coupled mutually parallel and rotatably with respect to the frame, so as to be made to rotate about a principal axis thereof aligned with an overhead travelling crane 6, which conveys, transverse to the feed direction of the frame 10 imparted by the handling device, a dec-

oration device 51 comprising a perforated roll 52 adapted to rotate about a principal axis thereof while it advances conveyed by the overhead travelling crane 2 and adapted to coat said bars or extruded profiles 4 with powder paints, generally heat-setting, said profiles and said powders being electrostatically charged with opposite polarities so that the powders remain adhering to the bars even when they rotate about said principal axis thereof.

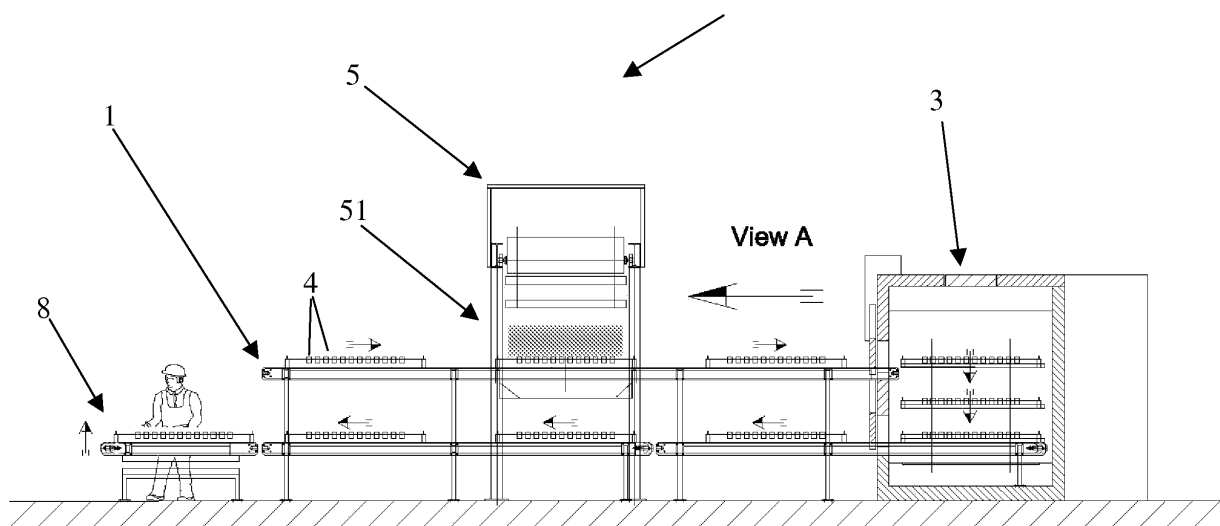


Fig. 1

Description

Field of the invention

[0001] The present invention relates to a decoration system for powder-on-powder technology.

State of the art

[0002] There are already known devices to give structural elements and other items the effect of decoration, among which the most widespread effect is decoration imitating the natural grain of wood.

[0003] The most well-known application relates to decoration of aluminium bars for window frames, although this procedure is not limited thereto. In prior art, the profiles are firstly painted with base coat of a first powder applied electrostatically, followed by partial curing of the powder to promote the absorption of a second coat in which the coloured powder, generally different from the first, is applied so as to imitate the grain of the wood or other effects.

[0004] In a method proposed by prior art, the second coat of powder is applied manually; another method proposed by prior art uses an engraved rotating belt which conveys the powder and drops it onto the face to be decorated. In this case, the device comprising the rotating belt is stationary, while the workpieces to be decorated are moved under the rotating belt.

[0005] In all cases proposed by prior art, the main problem lies in the fact that once a surface of an item has been covered with powder, if this surface is inclined or overturned, the powder detaches and falls to the ground. Therefore, when wishing to decorate a number N of faces of the item, it is necessary to perform at least N-1 intermediate curing cycles, albeit partial, of the powder applied, in order to make it adhere to the face of the item to which it has been applied. This determines long processing times, considerable energy costs, but above all a low level of process automation.

[0006] To remedy this problem, prior art proposes the irradiation of a surface covered with powder paint with UV radiation, in order to liquefy the powder to make it adhere to the surface to which it is applied before turning the item over to decorate another face.

[0007] This solution, although based on UV radiation, substantially has the same problems mentioned above, i.e. long processing times, considerable energy costs, but above all a low level of process automation.

[0008] Therefore, the main problem in powder-on-powder decoration processes lies in the fact that it is impossible to decorate the different faces of an item without having to perform intermediate curing steps.

[0009] Another secondary problem, which also influences processing times, regards handling of the items, which must not interfere with decoration of all the faces of an item and which must take account of a curing step that takes place at very high temperatures.

[0010] Therefore, a secondary problem is that it is difficult to insert the final curing step of the decorated workpieces into an automated line, so much so that, to date, in the prior art an operator is used to handle the workpieces to be decorated.

SUMMARY OF THE INVENTION

[0011] The object of the present invention is to provide a decoration device for powder-on-powder technology which allows the aforesaid problems to be solved.

[0012] The subject matter of the present invention is a decoration device for powder-on-powder technology which, in conformity with claim 1, comprises:

- a perforated roll adapted to rotate around its own axis of rotation and to move horizontally and parallel to said axis in order to coat a surface of an item to be decorated with powder paints;
- an electrical generator adapted to electrostatically charge said item to be decorated so that the powders adhere to said surface.

Another object of the present invention is a handling device for profiles for a decoration system for powder-on-powder technology adapted to solve the aforesaid problem of handling items to be decorated on several faces without interfering with the decoration.

The subject-matter of the present invention is also a handling device for profiles for a decoration system for powder-on-powder technology which, in conformity with claim 4, comprises

- a rectangular shaped frame comprising coupling means adapted to keep at least one workpiece to be decorated in the horizontal position and perpendicular with respect to a frame feed direction, and so that said workpiece to be decorated is rotatably associated with the frame with respect to a longitudinal axis thereof and means for locking said rotation;
- at least one pair of mutually parallel tracks, sliding on each of which and longitudinally thereto is a drive chain, adapted to drive a frame which is placed on the tracks;
- actuation means, integral at one point with respect to said pair of tracks, and comprising means for releasing rotation of the workpiece to be decorated about the longitudinal axis thereof and rotation actuation means, adapted to promote a portion of rotation of the workpiece to be decorated about the longitudinal axis thereof.

[0013] Another object of the present invention is to provide a decoration system for powder-on-powder technology comprising said decoration device and said profile handling device, adapted to solve the problem of limiting human intervention to a minimum.

[0014] Therefore, the subject-matter of the present invention is also a decoration system in conformity with

claim 10.

[0015] Said system can be used both in the decoration of bars and of extruded profiles, but also of sheets and workpieces in general.

[0016] The dependent claims describe preferred embodiments of the invention, forming an integral part of the present description.

Brief description of the figures

[0017] Further features and advantages of the invention will be more apparent in the light of the detailed description of preferred, but not exclusive, embodiments, shown by way of non-limiting example with the aid of the accompanying drawings, wherein:

Fig. 1 represents a longitudinal view of the decoration system;

Fig. 2 schematically shows a part of the system in Fig. 1;

Fig. 3 shows the operating diagram of the part shown in Fig. 2;

Fig. 4 shows a front view A of the longitudinal view of Fig. 1;

Figs. 5a, 5b, 5c, 5d, 5e and 5f show a portion of another part of the system in Fig. 1 with highlighted an operating sequence of this portion;

Fig. 6 shows a detail of the part in Fig. 5;

Figs. 7a and 7b show a further detail of the portion of the part in Fig. 5;

Fig. 8 shows the assembly of the part of Fig. 5;

Fig. 9 shows a view B of the detail of Fig. 6;

Fig. 10 shows a schematized view of the part of Fig. 5.

[0018] The same reference numbers and letters in the figures identify the same element or components.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

[0019] A decoration system according to the present invention comprises the following macro elements: a handling device 1 of at least one rectangular shaped frame 10, adapted to carry bars or workpieces 4, at least one decoration station 5, comprising a decoration device 51, adapted to distribute powder paints onto the bars 4 and an oven 3 for curing the powders.

[0020] The decoration station 5 comprises an overhead travelling crane 6 adapted to move said decoration device 51 over the bars 4.

[0021] Said decoration device 51, as shown in Figs. 2 and 3, comprises a perforated roll 52 adapted to rotate about its own axis of rotation and to move parallel to the surface of an item to be decorated. Said perforated roll 52 comprises therein, so as to move integrally with the roll, but without rotating with it:

- a powder dispenser 53,
- a hopper 54 adapted to distribute the powder paints poured by the dispenser into the hopper onto the inner surface of the roll,
- a first suction device 58 adapted to suck up the excess powder which has not been applied by the roll; said first suction device is shaped so as to follow the inner surface of the roll and is positioned so as to follow the hopper 54 in the direction of rotation of the roll indicated by the curved arrow in Fig. 2,
- an air blower device 59, adapted to blow air through the perforated roll 52, from the inside towards the outside of the perforated roll.

[0022] The decoration device 51, outside the perforated roll 51, comprises a second suction device 60 adapted to suck the powder that is pushed out of said blower device 59 through the holes of the perforated roller 52.

[0023] According to the variant represented in the figure, said blower device 59 and said second suction device 60 are positioned in a top part of the perforated roll, i.e. as far as possible from the application point of the powder paint from the hopper 54.

[0024] Said decoration device further comprises an electrostatic generator 55 adapted to electrostatically charge the bars 4 so that the powders adhere to the surface to be decorated.

[0025] Advantageously, said electrical generator 55 comprises a pair of terminals 56 and 57 electrically connected, directly or otherwise, one to an electrostatic bar 56a, the other to the workpiece to be decorated, so that the powder adhering to the surface of the workpiece 4 to be decorated, allows the workpiece to be rotated without the powder falling to the ground.

[0026] Said electrostatic bar, also called electrostatic charging bar, in a variant thereof, comprises therein a plurality of needle emitters adapted to promote single-polarity ion emission.

[0027] Said electrostatic bar, of the same length as the perforated roll, follows the roll during its translating movement at a small distance from the surfaces on which the roll has applied the powder paints, so as to make said powders adhere to said surfaces.

[0028] If the decoration device is adapted to apply powders in both directions of movement, for two-way application, then a second electrostatic charging bar 56a can be located at the opposite side with respect to the perforated roll so as to follow the movement of the perforated roll. In this case, only the bar that follows is electrostatically charged by said generator 55. Preferably, said bar is at a distance of between 50 and 500 mm from said bar, although the preferred distance is 150 mm.

[0029] For a perforated roll and therefore for an electrostatic bar of around 1400 mm in length, according to a preferred variant of the invention, said electrical generator has a rated power of 36kV DC, but it is advisable to adjust its power in relation to the extension of a surface to be coated with powders.

[0030] According to another aspect of the invention, following numerous and costly tests, it has been found that said perforated roll must be made of metallic and not synthetic material, owing to the different behaviours that the two materials have to rubbing caused by the passage of powder paint through the relative holes. In particular, it has been noted that rolls made of synthetic material become electrostatically charged, worsening the quality of the decoration.

[0031] Preferably, when said workpieces 4 are bars or in any case elongated elements, they are positioned so that their major dimension is substantially aligned with the direction of movement imparted by the overhead travelling crane 6 to the decoration device 51.

[0032] It is also preferable, as shown in Figs. 1 and 4, for said direction of movement imparted by the overhead travelling crane 6 to the decoration device 51 to be transverse to a feed direction imparted by the handling device 1 to the workpiece 4 to be decorated.

[0033] Therefore, the perforated roll coats a workpiece to be decorated with powder paint, rotating about itself and simultaneously moving forward according to the direction of movement imparted by the overhead travelling crane.

[0034] During the decoration operation the workpieces remain stationary and, at each passage, the decoration device 51, moving parallel to the workpieces via an overhead travelling crane 6, decorates the entire length of one face of the workpieces.

[0035] Before a second passage of the decoration device, the workpieces are rotated about themselves with respect to the longitudinal axis thereof, until all the faces have been decorated, without performing any intermediate curing of the workpieces.

[0036] A decoration system in conformity with the present finding is adapted to simultaneously handle several workpiece holding frames 10. These are handled in the various steps of the decoration process associated with the system, so that one frame is in the decoration station 5, others inside the curing oven 3, others in the cooling step and other in the workpiece unloading/loading station 8.

[0037] Movement of said bar holding frame 10 starts from said loading/unloading station 8. The loading/unloading step of the bars or workpieces 4 from the frame 10 is the only moment requiring manual human intervention.

[0038] Said movement is performed by means of a pair of mutually parallel tracks 7, sliding on each of which and longitudinally thereto is a drive chain 71, adapted to drive a frame 10 which is placed on the chain 71.

[0039] The bars or workpieces 4 are mounted on a frame 10, see Fig. 10, comprising coupling means A, produced so as to eliminate contact points that interfere with decoration of the workpieces. Figs. 7a and 7b show insertion of a ratchet 14 into a bar 4 of a window frame.

[0040] As the ratchet/bar coupling is of the sliding type, a rotation imparted to the ratchet causes a rotation of the

bar along its longitudinal axis.

[0041] The coupling means A are described below, with the aid of Fig. 9.

[0042] Said coupling means A comprise said interchangeable ratchet 14, preferably made of aluminium, so as to adapt to the various shapes of the extruded profiles that form the bars or workpieces 4. Said ratchet is integral with an end 15a of a shaft 15 which passes through a part of the frame 10 so as to be rotatably associated therewith; said shaft is concentrically integral with a toothed wheel 12.

[0043] Therefore, said coupling means A comprise at least one, but in general a first plurality of shafts 15 each comprising a ratchet 14 and a toothed wheel 12 are mutually parallel side by side, according to the diagram in Fig. 10, being associated with the frame 10 and, at least a second, but in general a second plurality of shafts 15', each comprising at least one ratchet 14', arranged symmetrically with respect to said first plurality so as to be in pairs coaxially, i.e. adapted to keep the bars or workpieces mutually parallel, again according to the diagram in Fig. 10.

[0044] Therefore, a rectangular shaped frame 10 comprising coupling means A adapted to keep at least one workpiece 4 to be decorated in the horizontal position or with a face to be decorated facing upwardly and with a major dimension parallel with respect to a direction of movement of the perforated roll, i.e. perpendicular to the frame feed direction, and so that said workpiece 4 to be decorated is rotatably associated with the frame with respect to a longitudinal axis thereof and relative to said major dimension.

[0045] In order to keep the distance of the toothed wheels 12 constant with respect to the frame 10, specific spacer bushings 11 are provided, wherein the shaft 15 can slide telescopically with respect to the frame 10. Moreover, so that the group A of elements can be adjusted in relation to the length of the profiles or bars 4 to be coupled with the frame 10, said shaft 15 comprises a threaded end 15b, opposite that of the ratchet, onto which a tightening nut 13 is screwed to lock telescopic sliding of the shaft 15 with respect to the frame 10.

[0046] Said coupling means A rotatably associated with the frame 10 are locked by a rack 20, which meshing from above with said first plurality of toothed wheels, acts as locking means adapted to prevent rotation of the bars 4 about their longitudinal axis, during handling of the frame.

[0047] For simplicity, bars are represented, but this could be an item of any shape, coupled to the coupling means A by an axis relative to a greater dimension associated with said dimension.

[0048] At said decoration station 5, said handling system 1 comprises a group B of functional elements adapted to cooperate with said coupling means A comprised by the frame 10.

[0049] Said group B of functional elements comprising a second group B1 of elements to perform a rotation of

the coupling means A, highlighted by a dashed box in Fig. 5B, comprising a support bar 22 and a second rack 21, horizontally overlapping and parallel to the support bar 22 and adapted to slide longitudinally with respect thereto by means of a first actuator 21 a.

[0050] Said group B comprises a first pair of actuators 22a and 22b adapted to lift said group (B1) upwards so that the second rack 21 meshes with the toothed wheels 12 of the group A.

[0051] Said group B also comprises a second pair of actuators 20a and 20b adapted to lift the rack 20 in order to release rotation of the bars or profiles 4.

[0052] A sequence of movements of the handling device 1 which enable and produce rotation of the workpieces or bars 4 is described below, with the aid of Figs. 5:

5a. the first rack 20 meshes with the toothed wheels locking rotation of the workpieces 4 in each step of the production cycle except during the rotation step of the profiles 4 at the station 5,

5b, at the decoration station 5, the group B is lifted by the actuators 22a and 22b so that the rack 21 meshes with the toothed wheels 12 from below,

5c. the rack 20 is lifted by the actuators 20a and 20b releasing rotation of the toothed wheels 12,

5d. the rack 21 is made to slide horizontally on the bar 22 by the actuator 21 a, causing the toothed wheels 12 to perform, for example, a quarter of a turn,

5e. the rack 20 is lowered by the actuators 20a and 20b locking rotation of the toothed wheels 11;

5f. the group B is lowered by the actuators 22a and 22b allowing the frame 10 to be moved to the subsequent station.

[0053] After a complete rotation the decoration process of the workpieces 4 coupled with the frame 10 is terminated, and therefore the means to lock rotation, i.e. the first rack, is released until the shafts 15 and 15' are locked and the complete frame 10 is conveyed into the oven 3.

[0054] The dimension of the frame 10 is linked to the number of workpieces to be decorated simultaneously and dependent on the production capacity required by the system.

[0055] In the oven, the handling system 1 allows a vertical movement of a frame 10. Therefore, assuming that the frame 10 has entered the oven through a top opening, after curing it exits through a bottom opening, or vice versa.

[0056] Vertical movement of the frames, known per se, allows the frames to be kept in the oven for the time necessary to cure the paints, while the number of tiers, and therefore of frames, contained in the oven is linked to the production capacity of the system.

[0057] After exiting from the oven the frames advance with intermediate stops from the outlet of the oven to the unloading area. The number of stops, and consequently the length of the handling system is correlated to the cool-

ing time so as to reduce the temperature of the workpieces 4 and ensure handling of the workpieces without the risk of burns.

[0058] The advantages deriving from application of the present invention are clear.

- use of a device for applying the decoration that has allowed complete automation of the system without the use of an operator,
- use of an innovative system for coupling workpieces to speed up loading thereof,
- use of an automatic handling system of the workpieces along the various steps of the production cycle from loading, to the process to decorate the various faces, to the powder curing oven, through to unloading of the decorated product,
- powder fixing system which through the electrostatic process allows the powder to be applied to more than one side, thereby eliminating intermediate curing,
- insertion of the final curing oven in line with the decoration process, eliminating the risk of possible damage to the workpieces
- implementation of a production process and of a type of system that is flexible and can also be used for other products such as sheet metal, inserts for fencing panels or inserts for urban furniture.

[0059] The elements and features illustrated in the different preferred embodiments can be combined without however departing from the scope of protection of the present application.

[0060] The particular methods described herein do not limit the content of this application which covers all variants of the invention defined by the claims.

Claims

1. A decoration device for powder-on-powder technology, comprising:
 - a perforated roll (52) adapted to rotate about its own axis of rotation and to move horizontally parallel to said axis in order to coat a surface of an item to be decorated with powder paints;
 - an electrical source (55) adapted to electrostatically charge said item to be decorated so that the powders adhere to said surface.
2. The device according to claim 1, wherein said perforated roll comprises powder paint distribution means within the perforated roll; said powder paint distribution means being stationary with respect to rotation of the perforated roll, and internal thereto, and comprising a dispenser (53) for powder paints and a hopper (54) adapted to distribute the powder paints poured by the dispenser into the hopper (54)

onto the inner surface of the perforated roll (52) .

3. The device according to the preceding claims, comprising an overhead travelling crane (6) adapted to move said perforated roll (52) horizontally and parallel to itself, while it rotates about its own axis of rotation.

4. A handling device comprising:

- a frame (10) comprising coupling means (A) which are rotatably associated with the frame and adapted to keep at least one workpiece (4) to be decorated in the horizontal position, with a face to be decorated facing upwardly, and with a major dimension of the workpiece perpendicular with respect to a frame feed direction, and so that said workpiece is rotatably associated with the frame with respect to a longitudinal axis thereof relative to said major dimension;
- means (20) for locking rotation of said coupling means (A);
- at least one pair of mutually parallel tracks (7), on each of which a drive chain (71), adapted to drive a frame (10), slides longitudinally thereto;
- actuation means (B), integral at one point with respect to said at least one pair of tracks (7), and comprising means (20a and 20b) for releasing rotation of the coupling means (A), and rotation actuation means (B1) adapted to promote at least partial rotation of the coupling means (A).

5. The handling device according to claim 4, wherein said coupling means (A) comprise:

- at least one first shaft (15) rotatably associated with the frame (10), comprising:
- a ratchet (14), integral in a first end (15a), adapted to be inserted into the profile of a workpiece (4) to be decorated; and
- a toothed wheel (12) integral concentrically to the shaft (15); and
- a rack (20), adapted to mesh from above with said toothed wheel (12), acting as locking means for the shaft (15);
- at least one second shaft (15') coaxial to said first shaft (15), rotatably associated with said frame, and comprising at one end a further ratchet (14').

6. The handling device according to claim 5, wherein said first shaft (15) or second shaft (15') comprises a spacer bushing (11) with respect to the rotating coupling with the frame, wherein each shaft (15 or 15') can slide telescopically; each shaft comprising a tightening nut (13) at a second threaded end (15b).

7. The handling device according to claim 5, wherein said means for locking rotation of a shaft (15) comprise a first rack (20) adapted to mesh with said toothed wheel (12), and said release means comprise a first pair of actuators (20a and 20b) adapted to lift said first rack parallel to itself in order to release rotation of said shaft (15).

8. The handling device according to claim 5, wherein said rotation means (B1) comprise a support bar (22) and a second rack (21), horizontally overlapping and parallel to the support bar (22) and adapted to slide longitudinally with respect thereto by means of a first actuator (21a).

9. The handling device according to claim 8, wherein said actuation means (B) comprise a second pair of actuators (22a and 22b) adapted to lift said rotation means (B1) until meshing with said toothed wheel (12) from below.

10. A decoration system of the powder-on-powder type, comprising a decoration device according to the claims 1 to 3.

11. The decoration system according to claim 9, further comprising a handling system according to the claims 4 to 9.

12. The system according to claim 11, wherein said decoration device (51) is adapted to move transversally with respect to a feed direction of a workpiece (4) holding frame (10), wherein said workpieces advance while having said major dimension perpendicular to a frame feed direction.

13. The system according to claim 12, further comprising a curing oven (3) for the powder paints, wherein said frames (10) are moved vertically.

14. The system according to claim 13, comprising a first handling device adapted to move at least one frame (10), from a loading/unloading area (8), first below the decoration device (51), and then into said curing oven (3), and a second handling device adapted to move said at least one frame (10) from said oven to said loading/unloading area (8).

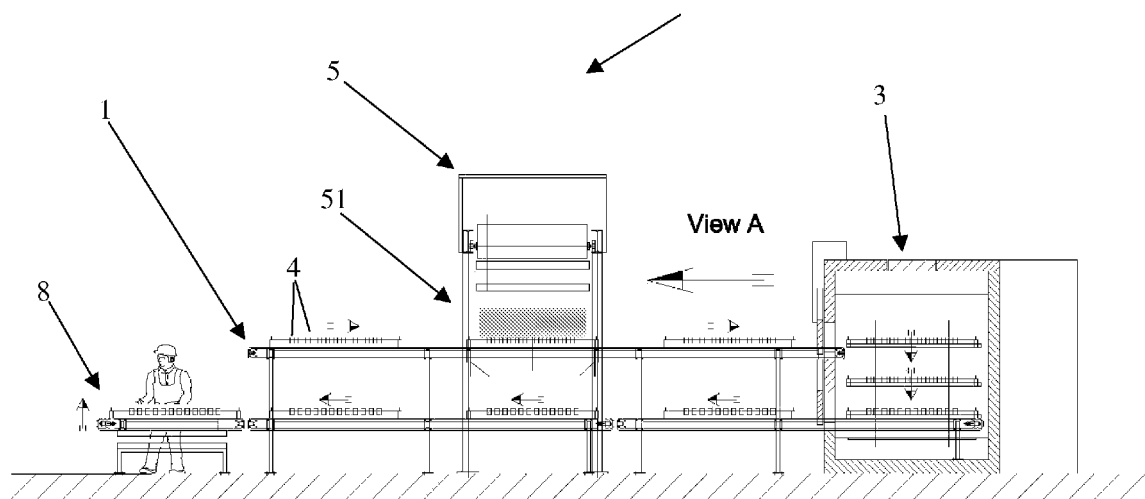


Fig. 1

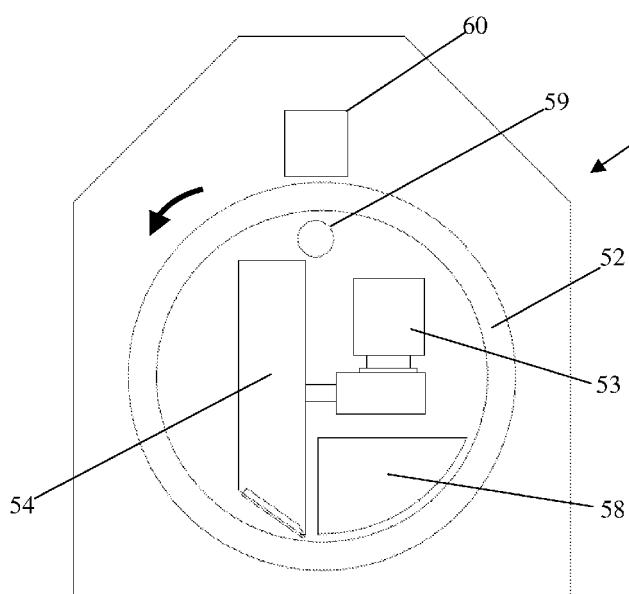


Fig. 2

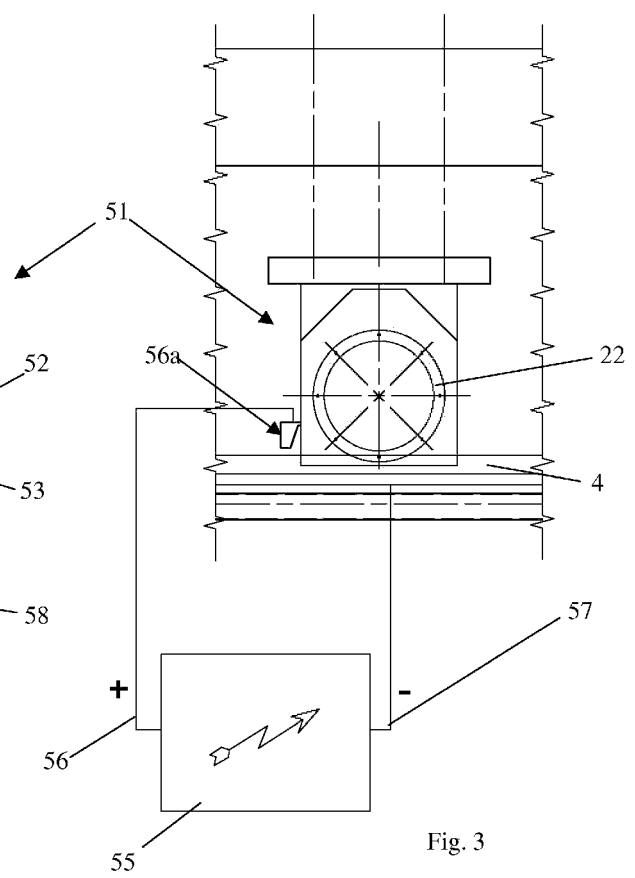


Fig. 3

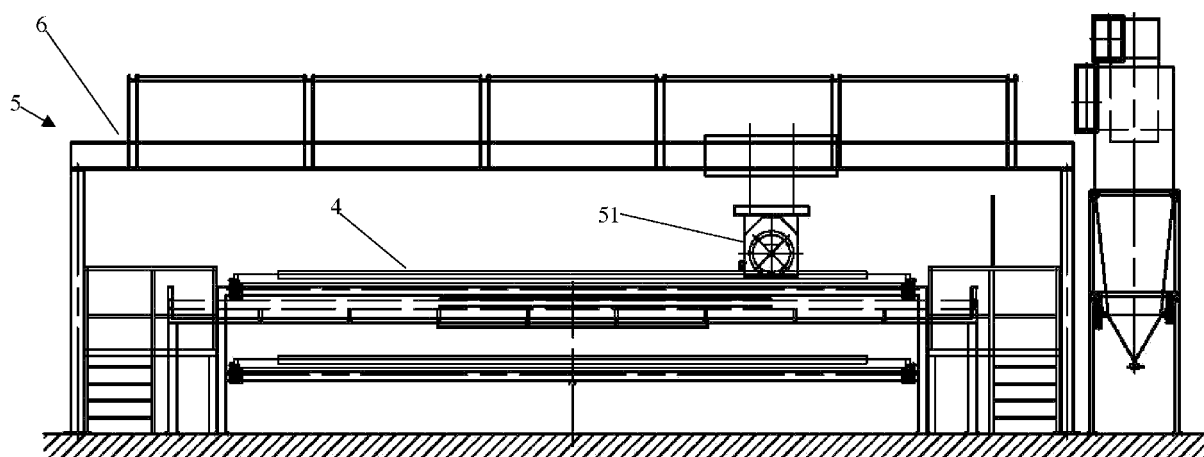
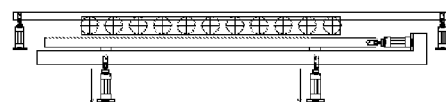
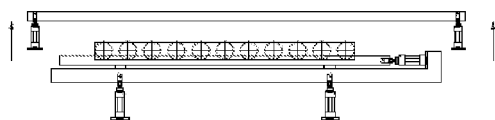
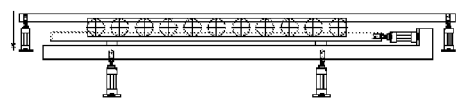
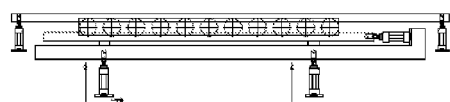
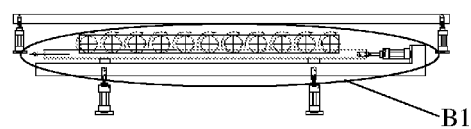
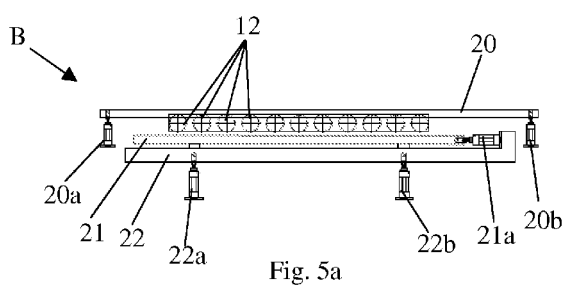


Fig. 4
(View A)



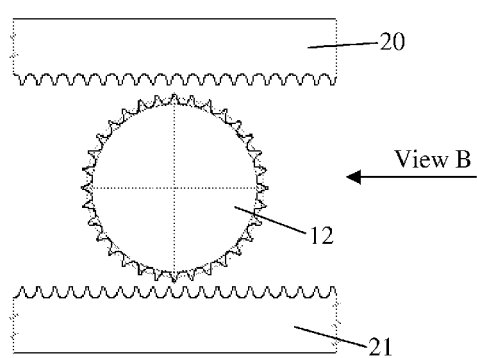


Fig. 6

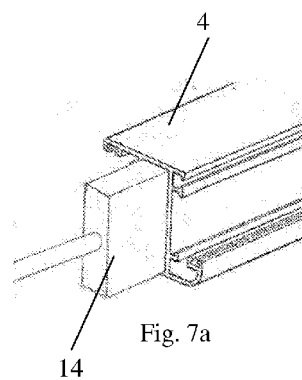


Fig. 7a

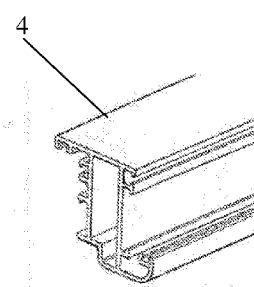


Fig. 7b

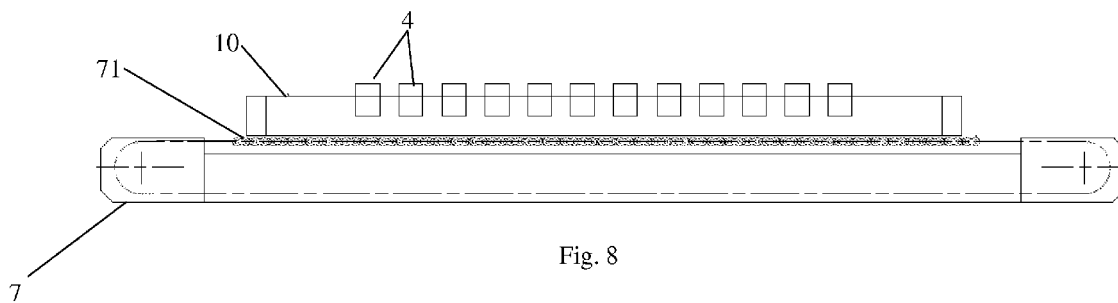


Fig. 8

