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# (54) A METHOD AND A DEVICE FOR CLEANING AND SANITIZING STICKS FOR DRYING LONG PASTA BY MEANS OF A LASER SOURCE

(57) The method for cleaning sticks for conveying and drying long pasta uses a laser beam. To clean and sanitize the stick, at least one laser beam is projected against it while the stick to be cleaned and the laser beam are moved relative to each other in a direction substantially parallel to the longitudinal extension of the stick. Also described is a device for implementing the cleaning method.

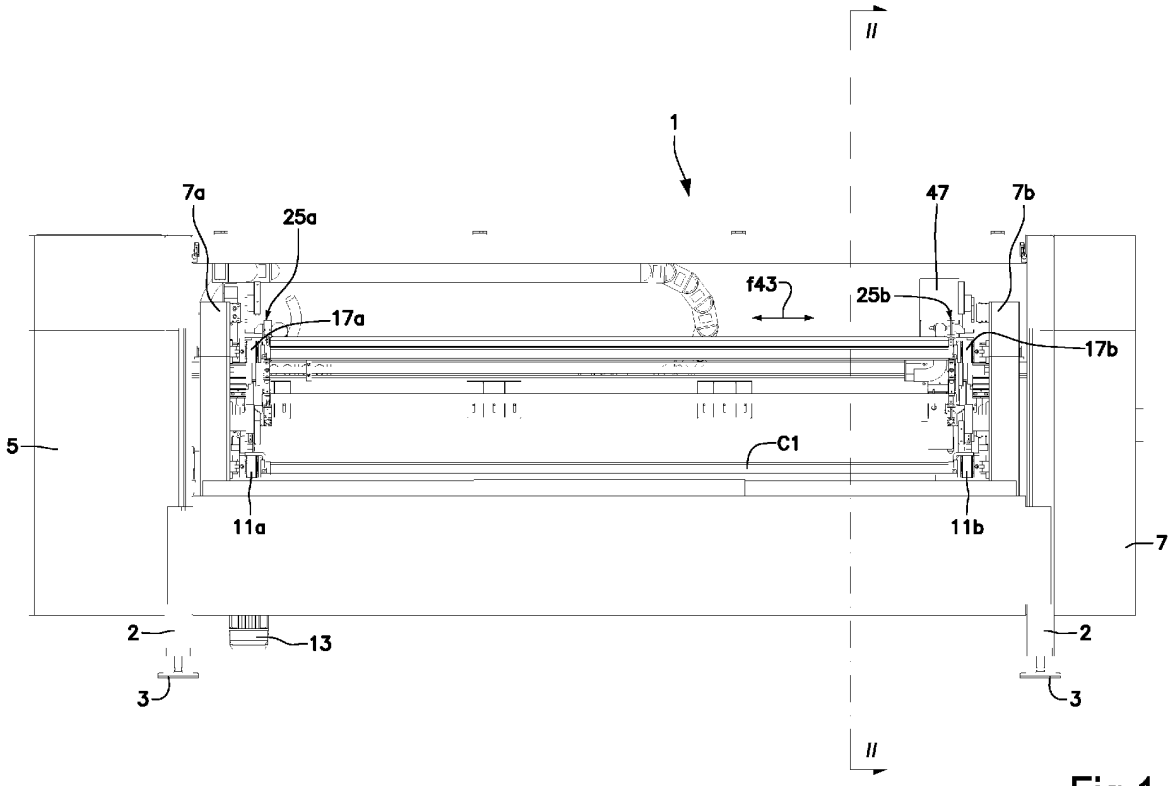



Fig.1

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## Description

### Technical field

**[0001]** The present invention relates to the field of machinery for producing pasta. More in particular, the present invention relates to devices for cleaning sticks for supporting, handling and conveying long pasta, such as spaghetti, tagliatelle or the like during drying.

### Background art

**[0002]** In the food industry, and in particular in the field of producing long pasta, such as spaghetti, tagliatelle, bucatini and the like, the pasta exiting from the dies is deposited on supporting and conveying sticks that, inserted into a more complex conveying system, convey the pasta through the dryer where the pasta is dried before being packaged.

**[0003]** In practice, these sticks are formed by metal profiles, for example made of aluminum, of rectilinear and hollow elongated shape, with a cross section having radii of curvature suitable to form surfaces for supporting the pasta. The sticks must be subjected to regular cleaning operations to remove residues of pasta and lubricants that deposit thereon.

**[0004]** The metal profile that forms the stick normally has a surface treatment, for example, in particular an anodizing treatment, and can advantageously have a non-stick polymer layer, typically made of polytetrafluoroethylene (Teflon). Cleaning of the sticks must, if possible, preserve the surface treatments of the sticks avoiding their premature wear.

**[0005]** Italian patent 1148139 discloses equipment for automatically cleaning sticks for long pasta, comprising a complex automatic sticks handling and washing system by means of suitable counter-rotating cylindrical brushes between which the sticks are conveyed. Although this washing system is efficient and particularly advantageous due to the high level of automation, it has some aspects that can be further improved. In particular, it has some difficulties in completely removing the residues of pasta that deposit on the surface of the sticks. These residues are particularly difficult to remove also due to the fact that they adhere to the surface of the sticks due to the effect of the temperature of the dryers.

**[0006]** WO2013/007529 discloses a device for cleaning sticks for the pasta production industry that uses a novel cleaning method using dry ice. A suitably shaped chamber forms a passage for the sticks to be cleaned to pass through. A jet of air and dry ice is projected inside the chamber, oriented against the surfaces of the stick to be cleaned. The impact of the particles of dry ice against the stick produces an efficient effect for removal of pasta debris from the surface of the stick. This prior art device has proved to be particularly efficient, but has an application limit in the recent regulations aimed at reducing carbon dioxide emissions into the atmosphere.

**[0007]** Italian patent 1429847 discloses a device and a method for cleaning sticks using high temperature steam. This cleaning method is efficient and does not have the drawback of the system using dry ice, but requires a system for generating steam at suitable temperature and pressure. This makes the device difficult to integrate into pasta drying lines.

**[0008]** The prior art cleaning devices are efficient, but aggressive regarding the surface treatment of the sticks.

**[0009]** Therefore, there is a need to provide a method and a device for cleaning sticks for the pasta production industry that overcome or alleviate one or more of the limits and of the drawbacks of prior art systems.

### Summary of the invention

**[0010]** According to a first aspect, a method for cleaning sticks for conveying and drying long pasta is provided, wherein at least one laser beam is projected against the stick while the stick to be cleaned and the laser beam are moved relative to one another in a direction substantially parallel to the longitudinal extension of the stick. The laser beam incident on the surface of the stick cleans the surface thereof, removing any pasta residues by ablation.

**[0011]** The laser beam is preferably a pulsed laser beam, with pulses having high peak powers, rather than a continuous laser beam. It has been found that the pulsed laser beam has an efficient removal effect of residues and debris from the surface of the sticks, and at the same time does not damage any coatings or surface treatments that may be provided on the stick.

**[0012]** Irradiation of the surface of the stick with the laser beam causes an ablation of residues adhering to the surface as a result of different physical mechanisms, in particular rapid vaporization, photomechanical spallation, inertial confinement and the like. This treatment makes any organic form inert.

**[0013]** An appropriate choice of the laser source, of the emission parameters and of the irradiation conditions makes it possible to optimize the ablation process, maximizing its efficiency and preventing collateral damage to the surface of the stick and to any coatings applied thereon.

**[0014]** Typically, the laser source emits in the near infrared, i.e., in particular in a range of wavelengths comprised between 760 nm and 1400 nm. This wavelength range makes it possible to reach an ablation effect of pasta debris and other debris that accumulate on the sticks, without damaging their surface.

**[0015]** For example, in advantageous embodiments, the pulsed laser beam can have a repetition frequency in the order of 1-100 Hz. However, particularly interesting results were obtained with a repetition frequency comprised between around 1 and around 80 kHz, preferably between around 2 and around 50 kHz.

**[0016]** In advantageous embodiments, irradiation is performed with an energy per pulse comprised between

around 8 and around 150 mJ, preferably between around 10 and around 100 mJ.

**[0017]** The spot size can be such as to have a fluence comprised between around 1 and around 4 J/cm$^2$, preferably between around 1.5 and around 4 J/cm$^2$, even more preferably between around 2 and around 3.5 J/cm$^2$.

**[0018]** The emission parameters defined above make it possible to obtain efficient removal of pasta debris from the sticks, preserving the surface treatment, for example of anodized aluminum sticks, which may optionally also be provided with a non-stick coating.

**[0019]** The relative movement speed between laser beam and stick to be cleaned can be modulated so as to have a partial overlapping of the single laser spots applied during the treatment. In some embodiments, the laser beam and the stick can have a relative speed in the direction of the longitudinal extension of the stick comprised between around 5 and around 40 cm/s, preferably between around 7 and around 32 cm/s.

**[0020]** It must be understood that the numerical parameters indicated above are provided by way of example and can be advantageous, but must not be considered binding.

**[0021]** The laser beam can be generated with any suitable laser source, for example capable of reaching the irradiation parameters defined above. In some particularly advantageous embodiments, the laser source comprises a fiber optic laser, or a Nd:YAG laser. The fiber optic laser can, for example, be a laser doped with Nd, to emit with wavelengths close to the Nd:YAG laser (1064 nm). The fiber optic laser is particularly advantageous, as it allows the emission parameters defined above to be easily obtained, for effective and efficient removal of pasta debris from the surface of the sticks, limiting wear of the sticks and in particular of their surface treatment.

**[0022]** According to another aspect, a device for cleaning sticks for conveying long pasta is provided, comprising in combination a laser source and reciprocal movement members between the laser source and a stick to be cleaned, configured to reciprocally move the stick to be cleaned and the laser source in a direction substantially parallel to the longitudinal extension of the stick to be cleaned.

**[0023]** Advantageous features and embodiments of the device are described below with reference to the accompanying drawings and in the appended claims, which form an integral part of the present description.

## Brief description of the drawings

**[0024]** The invention will be better understood by following the description and the accompanying drawings, which illustrate a non-limiting example of embodiment of the invention. More in particular, in the drawing:

Fig.1 shows a front view of the device;
Fig.2 shows a section along a vertical plane II-II of the device of Fig. 1;
Fig.3 shows an enlargement of a detail of Fig.2;
Fig.4 shows an axonometric view from below of the main components of the device of Figs. 1 to 3;
Fig. 5 shows an axonometric view from above of the components of Fig.4; and
Fig.6 shows an enlargement of a detail of Fig.5.

## Detailed description

**[0025]** Hereunder, with reference to the accompanying drawings, an embodiment of a device and of a method is described, wherein washing or cleaning of the sticks takes place outside the pasta production line, and in which the sticks to be washed are inserted manually and the washed or cleaned sticks are removed manually to be transferred to the production area. However, it would also be possible to integrate the cleaning device into a pasta production line, to be able to perform these transfers in an automatic or semi-automatic manner.

**[0026]** The drawings show a particularly advantageous possible embodiment of the device. However, it would also be possible to implement the cleaning method by means of laser by adapting the structure of one of the devices of the state of the art, described in the publications mentioned in the introductory part of the present description, replacing the conventional cleaning means (for example with liquids, steam or dry ice) with one or more laser sources movable relative to the stick to be cleaned.

**[0027]** In the embodiment illustrated below, the laser source is moved parallel to the stick to be cleaned, while this remains temporarily stationary with respect to the structure of the device. This solution is particularly advantageous, as it allows a rotary carousel system to be used to simultaneously process a plurality of sticks in a same device. Moreover, by allocating the forward movement to the laser source, while the stick is temporarily stopped, a particularly compact device can be obtained and, moreover, the reciprocal movement system between laser source and stick is simplified. It is also simpler and faster to perform two or more passages of the laser beam on the surface of the stick.

**[0028]** However, it would also be possible for one or more laser sources to remain in a fixed position in the device, and for the stick to move according to a movement of feed.

**[0029]** Moreover, in the illustrated embodiment a single laser source is provided, advantageously oriented so as to strike the curved surface of the stick, i.e., the surface on which the pasta rests directly, with a laser beam substantially orthogonal to the stick. In this way, a maximum energy of the laser beam is obtained in the point in which there is the maximum accumulation of debris adhering to the surface of the stick. The system is thus particularly efficient and at the same time economical, due to the fact that a single laser source is used. However, it would also be possible to use several laser sources, arranged so as to irradiate different and complementary surfaces of the

stick, or so as to irradiate the same surface in sequence.

**[0030]** The cleaning device is illustrated as a whole in Figs. 1 and 2 and indicated with 1. The device 1 comprises a bearing structure with uprights 2 and feet 3 for supporting on the floor. The reference numbers 5 and 7 indicate side casings, which can enclose the electrical and electronic components, not described in detail.

**[0031]** The main members of the device, which will be described below with reference to Figs. 2 to 6, are arranged between the two fixed sides 2. In Figs. 3 to 6 the fixed sides 2 and the coverings that enclose the moving members of the device 1 are omitted, for greater clarity of representation.

**[0032]** In some embodiments, two sides 7a and 7b are arranged on the bearing structure, between which there are positioned members for the accumulation and loading and unloading of the sticks to be cleaned, and a support and handling system of the sticks, which is used to transfer each stick inserted into the device 1 in sequence between a plurality of stations arranged in sequence, as will be clarified below.

**[0033]** In some embodiments, the sides 7a, 7b, or at least one of them, are adjustable relative to the load bearing structure, so as to vary the reciprocal distance between the sides 7a, 7b, in order to adapt the device for use with sticks of different length. In this way, the same device 1 can be used for sticks of production systems that use sticks of different sizes.

**[0034]** In the illustrated embodiment, an inlet conveyor of the sticks to be cleaned is arranged between the sides 7a, 7b. The sticks to be washed are indicated with C1. As is known, each stick consists of a profile made of aluminum or another material, preferably metal, optionally provided with a non-stick coating to prevent the pasta from adhering to the stick during drying. At each end, each stick C1 comprises a respective bracket S with which the stick rests on the means for movement through the pasta production plant. The same brackets S are used to support the sticks C1 in the device 1 on the inlet conveyor.

**[0035]** In some embodiments, the inlet conveyor comprises two conveyor belts 11a, 11b. The conveyor belt 11a is carried by the side 7a and the conveyor belt 11b is carried by the side 7b. By adjusting the distance between the sides 7a, 7b, the distance between the conveyor belts 11a, 11b is adjusted accordingly. The conveyor belts 11a, 11b are operated by a motor 13 carried by one of the sides, in the example illustrated, by the side 7a. A drive shaft 15 transmits motion from the motor 13 to the side 7b. A system of belts and pulleys, not shown in detail and contained in the sides 7a, 7b, transmits motion from the drive shaft 15 to the two conveyor belts 11a, 11b. The drive shaft 15 can be lengthened telescopically, to allow the sides 7a, 7b to move toward and away from each other.

**[0036]** In some embodiments, an outlet conveyor is also placed between the sides 7a, 7b. In the illustrated embodiment, similarly to the inlet conveyor 11a, 11b, the outlet conveyor comprises two conveyor belts 17a, 17b, carried by the side 7a and by the side 7b, respectively. Clean sticks, which must be removed from the device 1 and sent back to the pasta production plant, rest on the two conveyor belts 17a, 17b by means of the respective end brackets S.

**[0037]** The conveyor belts 17a, 17b are operated by a motor 19 that transmits motion to the conveyor belts 17a, 17b by means of a drive shaft 21 and a system of belts and pulleys, not shown in detail and contained in the two sides 7a, 7b. Just as for the drive shaft 15, the drive shaft 21 is also telescoping, to allow the sides 7a, 7b to move toward and away from each other.

**[0038]** The two sides 7a, 7b are supported by means of guides and sliding blocks on the fixed structure of the device 1, as can be seen in particular in the section of Fig.2. The guide system is indicated with 23. The movement of the sides 7a, 7b toward and away from each other can be controlled by a threaded bar, with two opposite threaded portions, which engage in nuts integral with the two sides 7a, 7b and not shown. In this way, rotation of the threaded bar causes the symmetrical movement of the two sides 7a, 7b. Rotation can be controlled by a gear motor, not shown.

**[0039]** In other embodiments, the distance between the two sides 7a, 7b can be varied by acting on only one of them, while the other remains fixed relative to the load bearing structure.

**[0040]** A respective rotating head of a support and handling system of the sticks C1, C2 is mounted on each side 7a, 7b. The two rotating heads are symmetrical and indicated with 25a, 25b. The head 25b is shown in detail in the enlargements of Figs. 3 and 6. The other head 25a is only partially visible. The two heads 25a, 25b form part of a support and handling system of the sticks C1, C2, which are picked up from the inlet conveyor 11a, 11b and unloaded after cleaning onto the outlet conveyor 17a, 17b. The heads 25a, 25b rotate synchronously about a common rotation axis A-A, substantially parallel to the sticks C1, C2. In substance, the two heads 25a, 25b form a carousel device, which allows a plurality of sticks that pass through several stations of the device 1 to be processed simultaneously.

**[0041]** With specific reference to the head 25b (however, a similar structure is provided for the head 25a), in the illustrated embodiment each head 25a, 25b comprises four grippers 27.1, 27.2, 27.3 and 27.4, angularly spaced at 90° relative to one another. Each gripper comprises a pair of jaws and an actuator that controls opening and closing of the respective jaws. As will be described in more detail below, each of the four grippers performs the same operations, so that four sticks C1, C2 can be handled by the device 1 at all times to perform thereon the control and cleaning operations as described below.

**[0042]** Each gripper 27.1-27.4 passes through four stations in sequence, more precisely: a loading station of the sticks C1 to be cleaned, a stick geometry control station, a cleaning station and an unloading station of the

clean sticks C2. The sequence of the stick geometry control and washing stations can be inverted. The following operations are performed in sequence in the various stations: picking up a stick C1 to be cleaned from the inlet conveyor 11a, 11b and loading it onto the support and handling system comprising the heads 25a, 25b; transferring the stick C1 to be cleaned into the stick geometry control station and checking that the shape of the stick is within the tolerance limits relative to the theoretical shape; transferring the stick into the cleaning station and cleaning the stick; transferring the stick into the unloading station and transferring the washed stick C2 onto the outlet conveyor 17a, 17b.

**[0043]** In Fig.6, the gripper 27.1 is in the loading station, the gripper 27.2 is in the stick geometry control station, the gripper 27.3 is in the cleaning station and the gripper 27.4 is in the unloading station.

**[0044]** The two heads 25a, 25b are rotated by means of an electric motor, for example a brushless motor, which can be carried by one of the two sides 7a, 7b, for example, the side 7a. The motor is indicated with 26 in Fig.4. A system of pulleys and belts contained in the side 7a transmits motion from the motor 26 to the head 25a, while a drive shaft 28 (Fig.4) transmits motion to the side 7b, in which the pulleys and a belt for transmitting motion to the head 25b can be housed. The drive shaft 28 is a telescoping shaft, analogously to the drive shafts 15 and 21.

**[0045]** To load individual sticks C1 from the inlet conveyor 11a, 11b to the support and handling system 25a, 25b, in some embodiments a separator 33 is associated with the inlet conveyor 11a, 11b, which separates one stick C1 from the next one, to allow pick-up of the individual sticks C1 by an insertion manipulator 35. Just as for the other members associated with the sides 7a, 7b, also the insertion manipulator 35 and the separator 33 are in fact formed by two symmetrical components mounted on the two sides 7a, 7b, one of which can be seen in Fig.3, while the other is symmetrical and not shown in detail.

**[0046]** As indicated schematically in Fig.3, the insertion manipulator is provided with a double movement according to the arrows f35x and f35y and has a pair of grippers 35.1, one on each side 7a, 7b, to pick up individual sticks C1 from the inlet conveyor 11a, 11b, downstream of the separator 33, and load them onto the gripper 27.1-27.4 which is in the loading station. In the position of Fig.3 the stick C1 picked up by the insertion manipulator 35 is transferred to the gripper 27.1.

**[0047]** An extraction manipulator 37, configured to pick up clean individual sticks C2 from the support and handling system 25a, 25b and transfer them onto the conveyor belts 17a, 17b, is associated with the outlet conveyor formed by the conveyor belts 17a, 17b. The extraction manipulator 37 comprises, similarly to the insertion manipulator 35, two grippers 37.1, each associated with the respective side 7a, 7b and provided with a movement according to the arrows f37x, f37y (Fig.3).

**[0048]** A guide 41 is arranged on the load bearing structure of the device 1, parallel to the rotation axis A-A. The guide 41 defines a translation axis for a slide 43. The translation movement of the slide 43 along the guide 41, indicated with f43, is controlled by a motor 45. The movement of the slide 43 can be a numerically controlled movement, just as the movements of the other members described above, and in particular the support and handling system comprising the two heads 25a, 25b and the manipulators 35, 37.

**[0049]** The slide 43 carries a laser source 47 for cleaning the sticks C1, C2. The laser beam can be suitably confined in a tube 49 terminating with a shaped portion 51 that matches the profile of the sticks C1 (see in particular Fig.6). A suction duct 53 can be associated with the tube 49 for suction of the fumes generated by interaction of the laser beam with the debris to be removed from the sticks C1. The suction duct 53 is associated with a flexible hose, not shown, that allows the movements of the slide 43 along the guide 41 to be followed.

**[0050]** The laser source can preferably be a pulsed laser source, for example a fiber optic laser source.

**[0051]** Typically, the laser source 47 emits in the near infrared, i.e., in particular in a wavelength range comprised between 760 nm and 1400 nm.

**[0052]** For example, in advantageous embodiments, the pulsed laser beam can have a repetition frequency in the order of 1-100 Hz, in particular a repetition frequency comprised between around 1 and around 80 kHz, preferably between around 2 and around 50 kHz, using an energy per pulse preferably comprised between around 8 and around 150 mJ, more preferably between around 10 and around 100 mJ. To optimize the ablation effect of the pasta debris, preserving the surface of the sticks, the spot size can be such as to have a fluence comprised between around 1 and around 4 J/cm$^2$, preferably between around 1.5 and around 4 J/cm$^2$, even more preferably between around 2 and around 3.5 J/cm$^2$.

**[0053]** In addition to the laser source 47, a stick geometry control unit of the sticks C1 is mounted on the slide 43, having the function of indicating the presence of any sticks deformed beyond a tolerance limit, which must be removed, either manually or automatically, and optionally repaired. The stick geometry control unit is indicated schematically with 55 and is arranged under the laser source 47, as can be seen in particular in Figs.2 and 3. The stick geometry control unit 55 can comprise capacitive sensors 57, for instance, which in use are place side by side with a stick C1 held by the support and handling system 25a, 25b in the stick geometry control station.

**[0054]** Operation of the device described above is as follows. The sticks C1 to be cleaned are placed on the inlet conveyor comprising the conveyor belts 11a, 11b. Individual sticks C1 to be cleaned are fed downstream of the separator 33 toward the pick-up zone by the insertion manipulator 35 (see in particular the detail of Fig.3).

**[0055]** Each stick C1 to be cleaned is transferred from the insertion manipulator 35 to a respective pair of grippers 27.1-27.4 of the two heads 25a, 25b of the support

and handling system and blocked by said grippers. Fig.3 shows the step of transferring a stick C1 from the grippers 35.1 of the insertion manipulator 35 to the pair of grippers 27.1 of the support and handling system.

**[0056]** A 90° rotation about the rotation axis A-A of the heads 27a, 27b carries the stick C1 to be cleaned into the stick geometry control station. In Fig.3 the stick C1 engaged by the grippers 27.2 of the support and handling system is positioned in the stick geometry control station. In this position the sensors 57 of the stick geometry control unit 55 are moved along the longitudinal extension of the stick C1 by the translation movement of the slide 43 along the guide 41. The control unit of the device 1 notifies the operator of any sticks out of tolerance, for example by means of a control panel or other suitable user interface. Alternatively, these sticks out of tolerance can be automatically rejected. It would also be possible to perform the size control by means of the laser beam for cleaning, using it as a measurement instrument.

**[0057]** A further 90° rotation of the heads 25a, 25b about the rotation axis A-A carries the stick C1 into the cleaning station, as shown for the stick C1 engaged by the grippers 27.3 in Fig.3. Here the stick C1 is cleaned by means of the laser beam generated by the laser source 47. Cleaning of the stick is obtained by translating the laser source by means of movement of the slide 43 along the guide 41 parallel to the longitudinal extension of the stick C1. As the support and handling system comprises four pairs of grippers 27.1-27.4, the system is able to simultaneously perform control of the geometry of a stick C1 located in the stick geometry control station (position of the grippers 27.2 in Fig.3) and cleaning of a stick C1 located in the cleaning station (position of the grippers 27.3 in Fig.3). Simultaneously, a stick C1 picked up from the inlet conveyor 11a, 11b is loaded into the loading station (position of the grippers 27.1 in Fig.3).

**[0058]** After the stick has been cleaned, a 90°rotation carries the clean stick C2 from the cleaning station to the unloading station, identified in Fig.3 by the grippers 27.4. In this station the clean stick C2 is picked up by the unloading manipulator 37 and unloaded onto the outlet conveyor 17a, 17b. The unloading operation of the clean stick C2 takes place simultaneously to the loading, geometry control and cleaning operations of the three subsequent sticks C1.

**[0059]** Examples of laser source and of irradiation parameters used have been defined above.

**[0060]** The described device and the method allow thorough and efficient cleaning of the sticks, without damage to the sticks and to any non-stick coatings present on the surfaces to be cleaned. Moreover, there is no need to use consumables such as water, dry ice, detergents, etc., which can have drawbacks both from the viewpoint of environmental pollution and from the viewpoint of cost, and which also require complex circulation systems.

## Claims

1. A method for cleaning sticks for conveying and drying long pasta, wherein at least one laser beam is projected against the stick while the stick to be cleaned and the laser beam are moved relative to each other in a direction substantially parallel to the longitudinal extension of the stick.

2. The method of claim 1, wherein the laser beam is a pulsed laser beam.

3. The method of claim 2, wherein the laser beam has one or more of the following features: an emitting wavelength in the near infrared, in particular comprised between 760 and 1400 nm; a repetition frequency comprised between about 1 and about 80 kHz, preferably between about 2 and about 50 kHz; an energy per pulse between about 8 and about 150 mJ, preferably between about 10 and about 100 mJ; a fluence between about 1 and about 4 J/cm$^2$, preferably between about 1.5 and about 4 J/cm$^2$, even more preferably between about 2 and about 3.5 J/cm$^2$.

4. The method of one or more of the preceding claims, wherein the laser beam and the stick have a speed in the direction of the longitudinal extension of the stick comprised between about 5 and about 40 cm/s, preferably between about 7 and about 32 cm/s.

5. A device for cleaning sticks for conveying long pasta, comprising in combination:

   a laser source;
   reciprocal movement members between the laser source and a stick to be cleaned, configured to move the stick to be cleaned and the laser source relative to each other in a direction substantially parallel to the longitudinal extension of the stick to be cleaned.

6. The device of claim 5, wherein the laser source emits a laser beam with one or more of the following parameters: an emitting wavelength in the near infrared, in particular comprised between 760 and 1400 nm; a repetition frequency comprised between about 1 and about 80 kHz, preferably between about 2 and about 50 kHz; an energy per pulse between about 8 and about 150 mJ, preferably between about 10 and about 100 mJ; a fluence between about 1.5 and about 4 J/cm$^2$, preferably between about 2 and about 3.5 J/cm$^2$.

7. The device of claim 5 or 6, wherein the laser source comprises a fiber optic laser, preferably doped with neodymium or an Nd:YAG laser.

8. The device of claim 5, 6 or 7, comprising a stick geometry control unit.

9. The device of one or more of claims 5 to 8, comprising:

a system for supporting and handling the sticks to be cleaned, configured to keep a stick to be cleaned in a substantially stationary position, while the laser source is moved parallel to the stick to be cleaned;
a slide for moving the laser source, movable along a translation axis substantially parallel to a stick engaged to the support and handling system.

10. The device of claims 8 and 9, wherein the stick geometry control unit is mounted on the slide for moving the laser source.

11. The device of claim 9 or 10, wherein the support and handling system is configured to transfer the sticks sequentially in a plurality of stations, comprising a stick geometry control station and a stick cleaning station.

12. The device of claim 9, 10 or 11, wherein the support and handling system of the sticks to be cleaned comprises a pair of grippers that retain the sticks during cleaning.

13. The device of one or more of claims 9 to 12, wherein the support and handling system is adapted to receive the stick to be cleaned in a loading station and to release the cleaned stick in an unloading station, the stick geometry control station and the stick cleaning station being arranged between the loading station and the unloading station.

14. The device of one or more of claims 8 to 13, wherein the support and handling system is adapted to rotate around a rotation axis parallel to the direction of translation of the slide for moving the laser source.

15. The device of one or more of claims 8 to 14, wherein the support and handling system comprises a pair of heads, configured to engage each stick to be cleaned in proximity to two opposite ends of the stick to be cleaned, wherein the heads preferably have an adjustable reciprocal distance.

16. The device of claim 15, wherein the heads are carried by respective sides which are movable relative to each other to adjust their mutual distance.

17. The device of one or more of claims 5 to 16, comprising an inlet conveyor adapted to receive sticks to be cleaned to be inserted into the device and an outlet conveyor adapted to receive cleaned sticks to be unloaded from the device; wherein preferably the inlet conveyor is configured to feed the sticks to be cleaned to a support and handling system and the outlet conveyor is configured to receive cleaned sticks by the support and handling system; and wherein preferably the inlet conveyor and the outlet conveyor are placed one above the other.

18. The device of claim 17, wherein an insertion manipulator, adapted to pick up individual sticks from the inlet conveyor and load them onto the stick support and handling system, is associated with the inlet conveyor; and wherein preferably an extraction manipulator, adapted to pick up individual sticks from the stick support and handling system and transfer them to the outlet conveyor is associated with the outlet conveyor.

19. The device of claim 17 or 18, when dependent on claim 16, wherein the inlet conveyor and the outlet conveyor are carried by the sides.

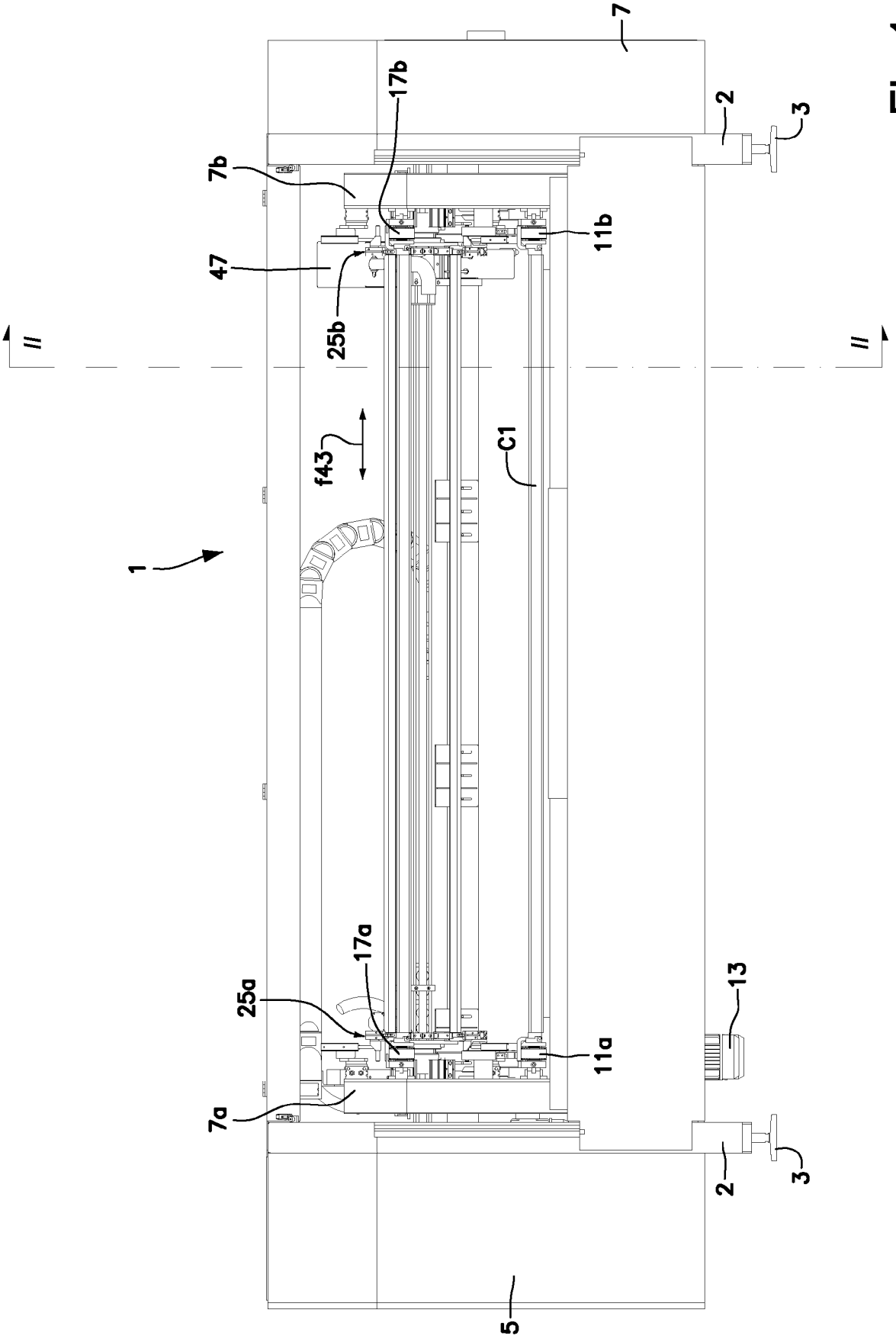
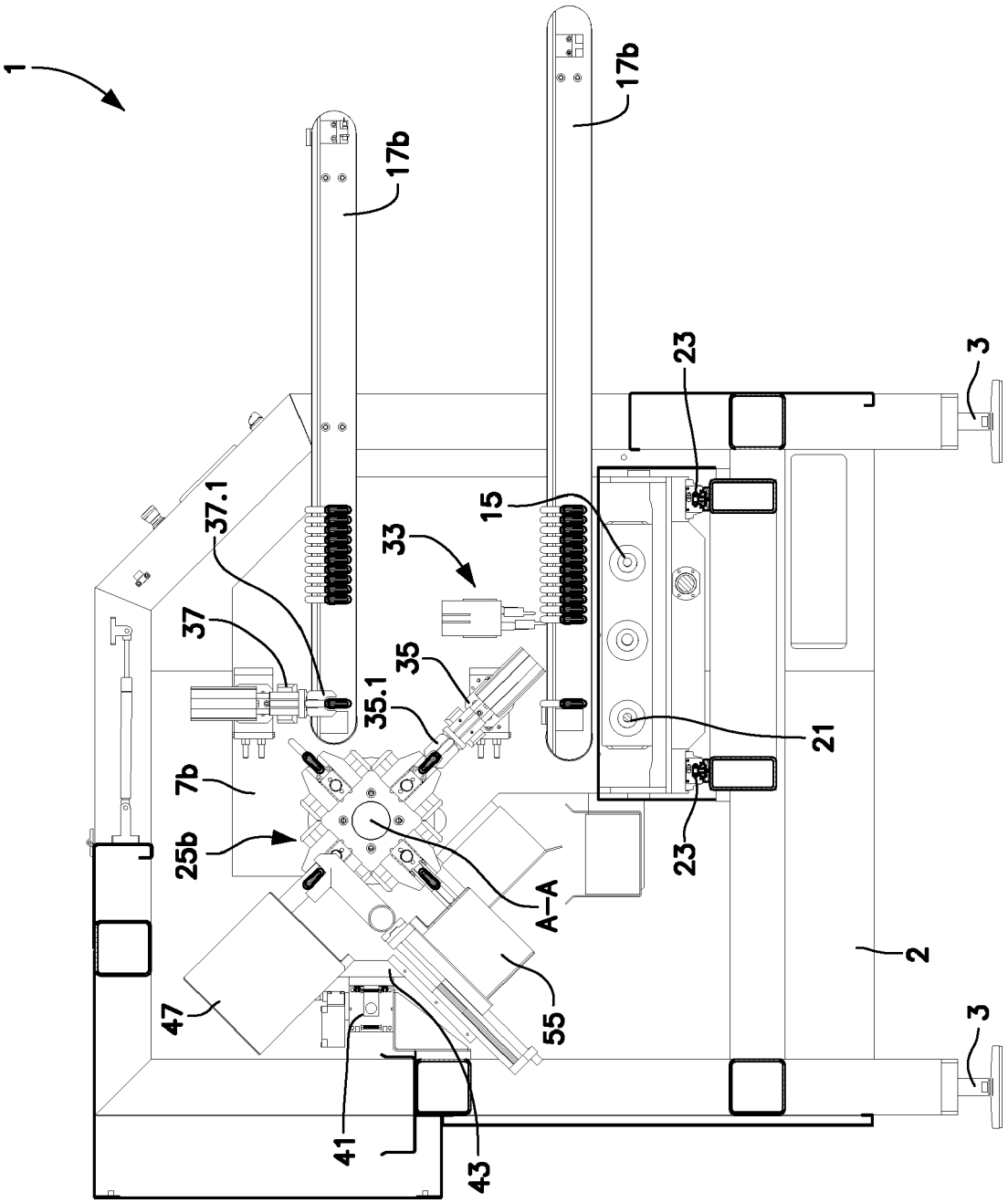



Fig.1

Fig.2



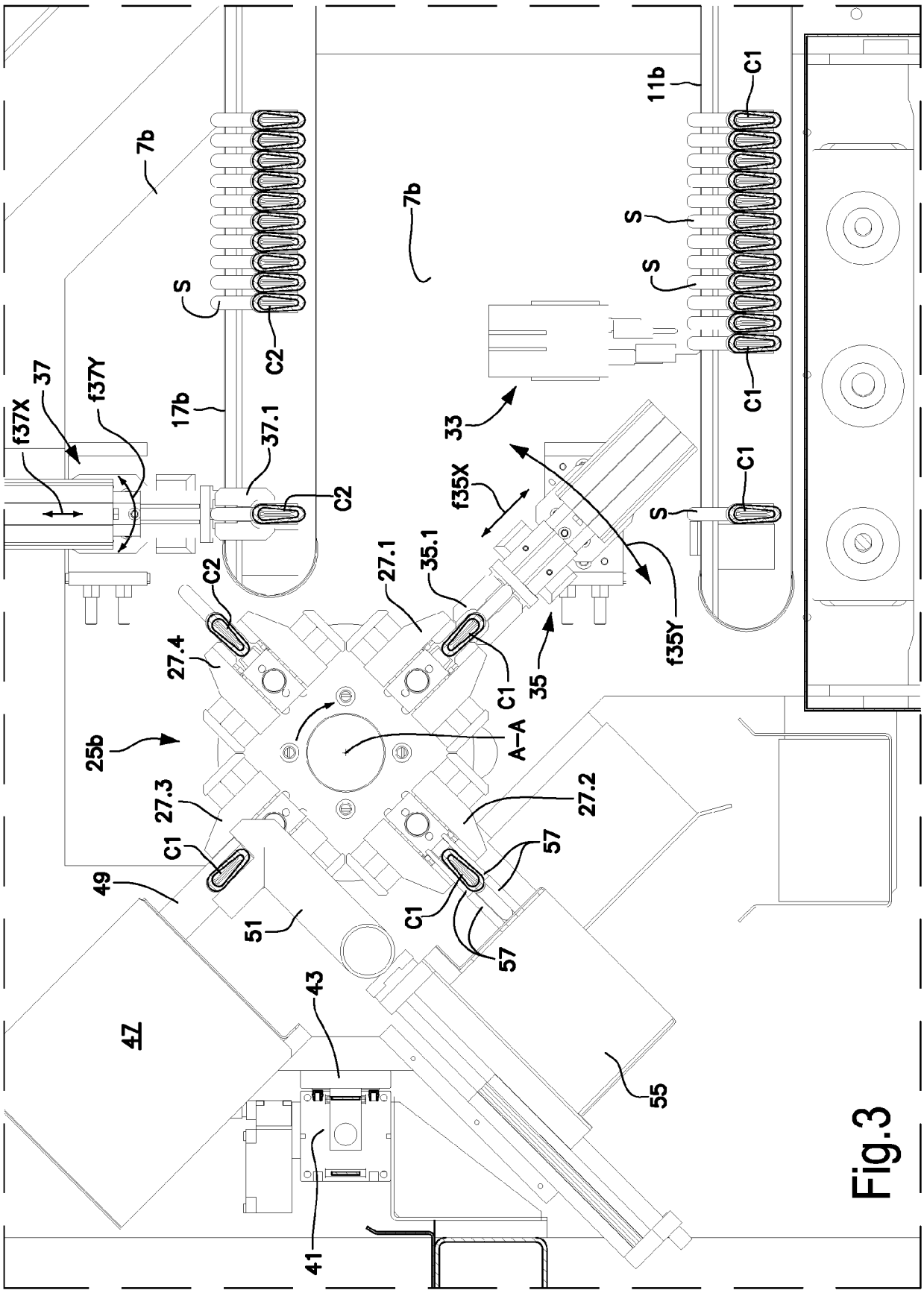

7b
S
C2
37
f37X
f37Y
17b
37.1
C2
C2
27.4
25b
27.3
C1
49
51
47
43
41
7b
11b
C1
S
S
C1
C1
33
f35X
S
35.1
27.1
C1
35
f35Y
A–A
27.2
57
C1
57
55

Fig.3

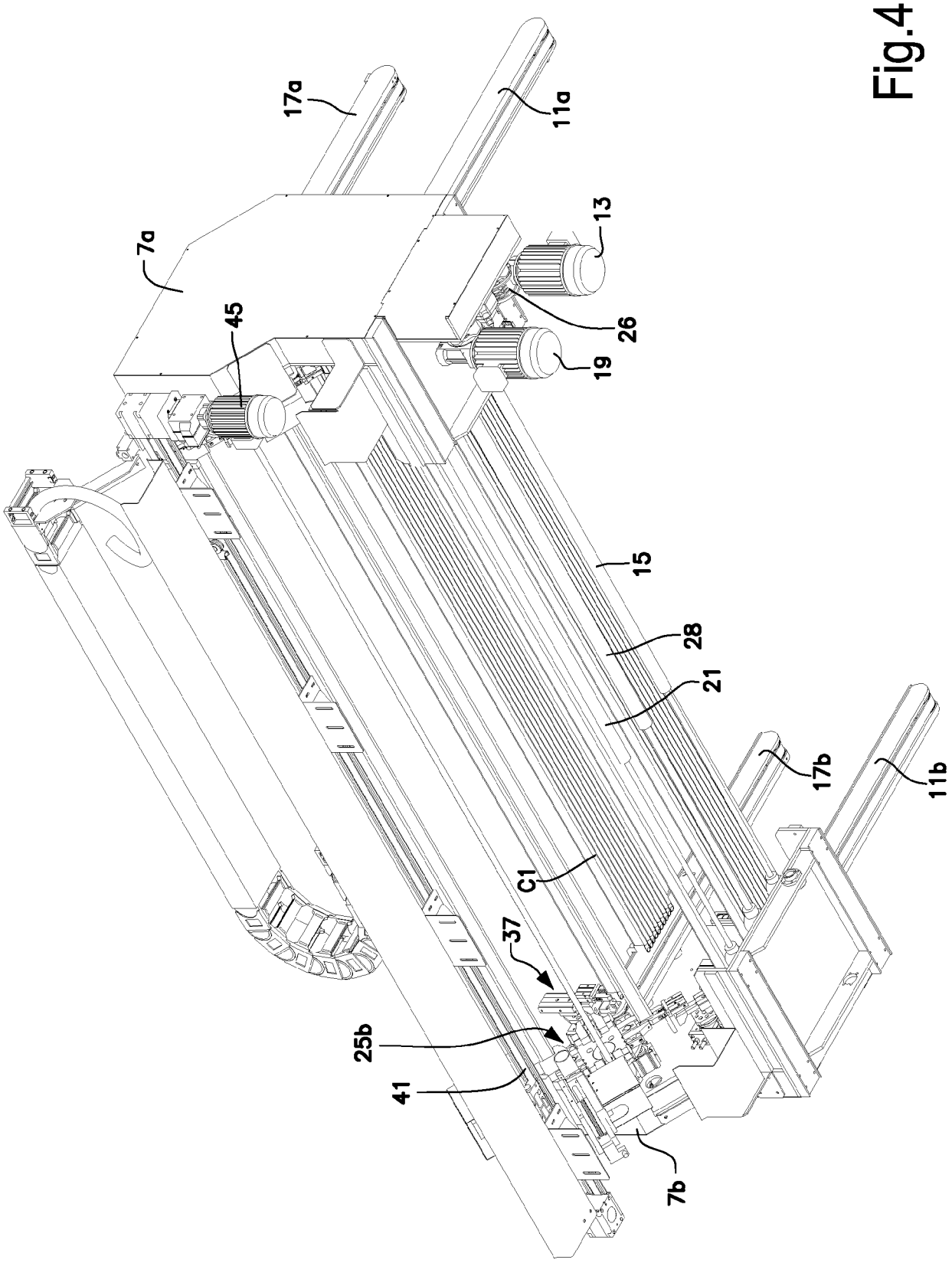



Fig.4

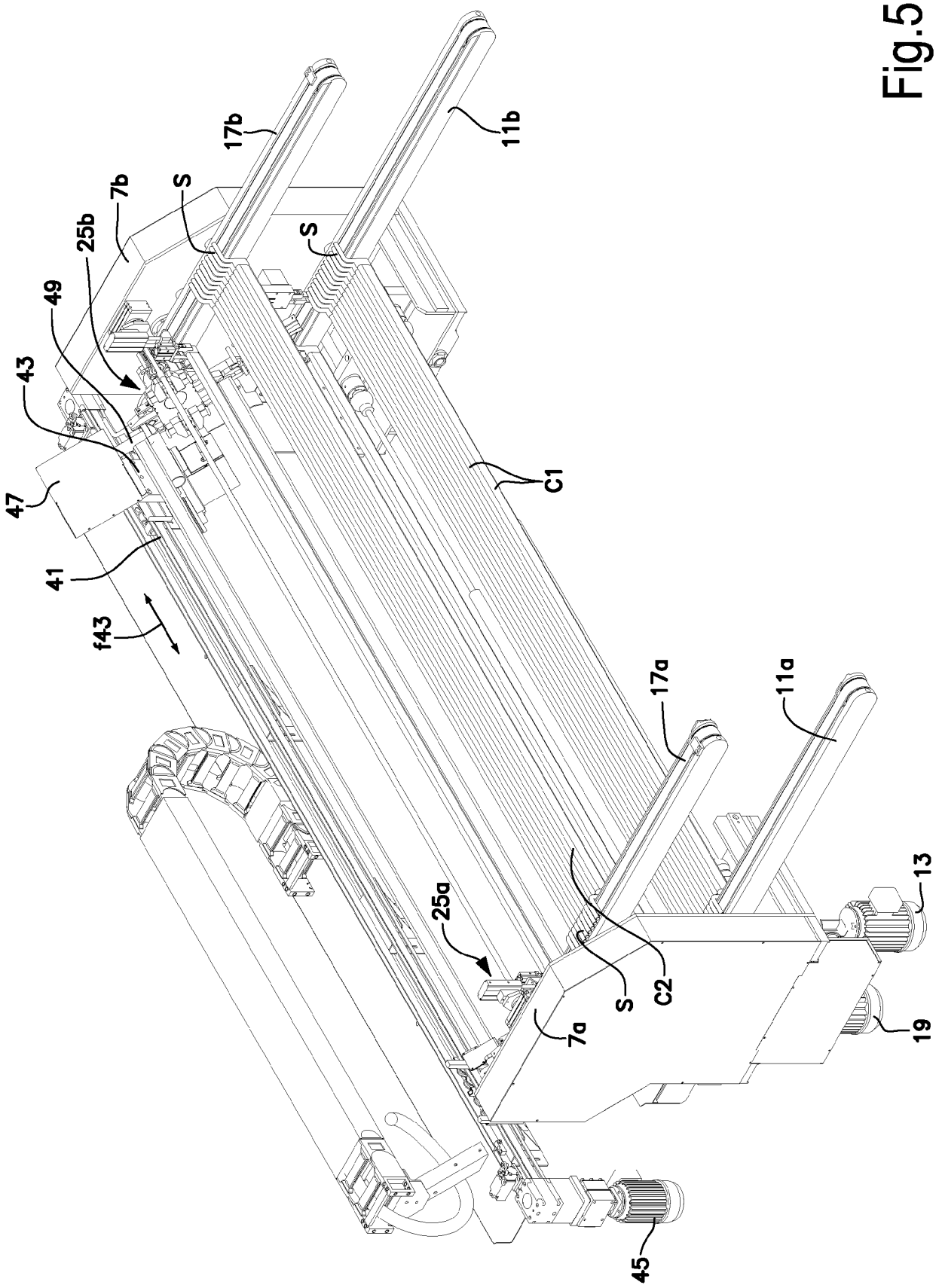
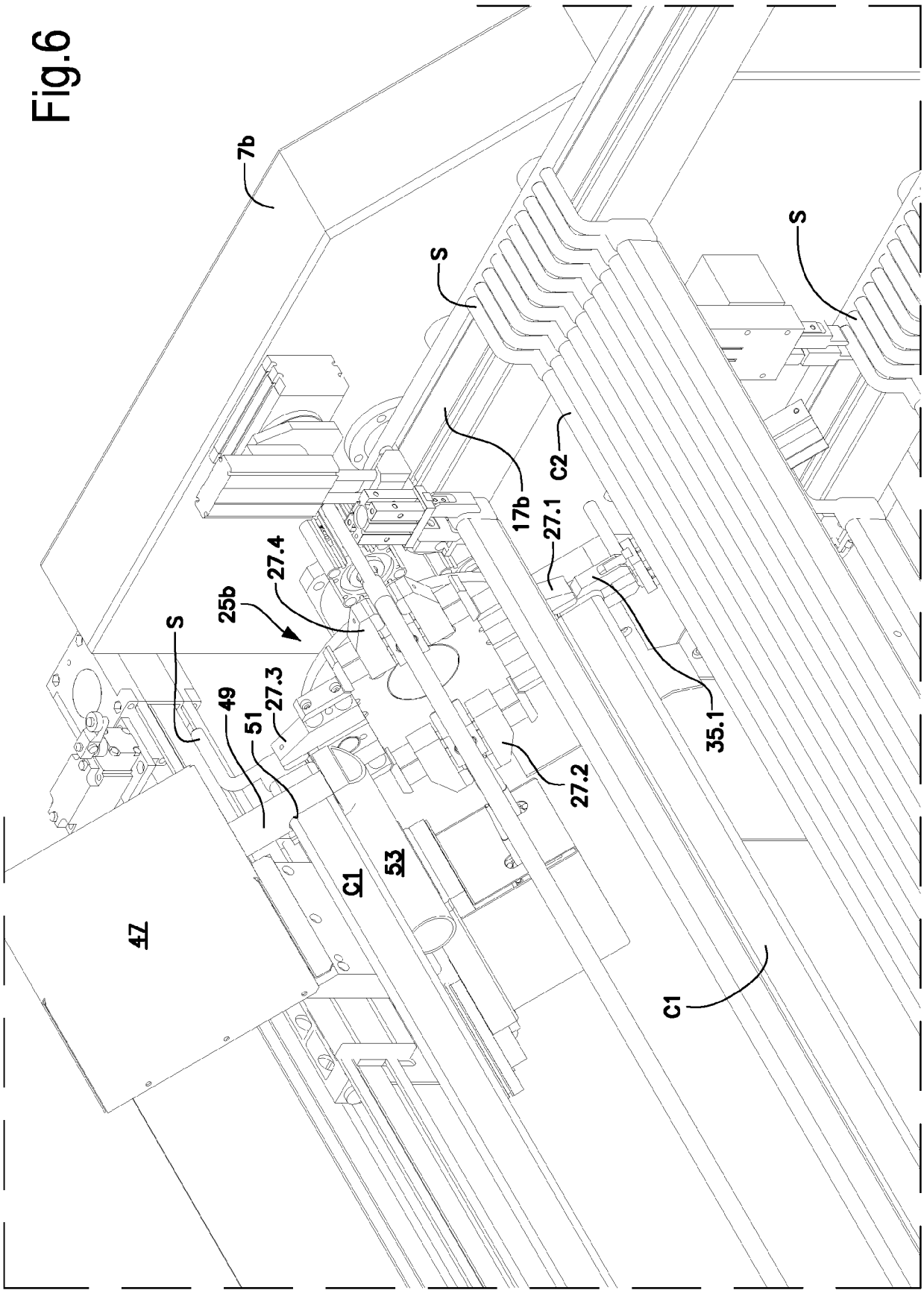



Fig.5

Fig.6



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# EUROPEAN SEARCH REPORT

Application Number
EP 22 16 9195

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
|---|---|---|---|
| X<br>Y<br>A | CN 106 513 381 A (SUZHOU FEELTEK LASER TECH CO LTD) 22 March 2017 (2017-03-22)<br>* abstract *; figures *<br>----- | 5,6,9,17<br>1-4,6-8,11-14<br>10,15,16,18,19 | INV.<br>B08B7/00<br>A21C9/02 |
| Y,D | IT 1 148 139 B (LANDUCCI FABIANO [IT]) 26 November 1986 (1986-11-26)<br>* abstract *; figures *<br>* pages 19,20 *<br>----- | 1-4,6,8,11-14 | |
| Y | US 2015/189891 A1 (HAAS JOHANNES [AT] ET AL) 9 July 2015 (2015-07-09)<br>* abstract *; figures *<br>* paragraph [0049] - paragraph [0128] *<br>----- | 7,8 | |

| TECHNICAL FIELDS SEARCHED (IPC) |
|---|
| B08B<br>A21C<br>F26B |

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| The Hague | 26 August 2022 | Plontz, Nicolas |

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 22 16 9195

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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26-08-2022

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| CN 106513381 A | 22-03-2017 | NONE | |
| IT 1148139 B | 26-11-1986 | NONE | |
| US 2015189891 A1 | 09-07-2015 | AT 513222 A1 | 15-02-2014 |
| | | BR 112015001956 A2 | 04-07-2017 |
| | | CN 104519744 A | 15-04-2015 |
| | | EP 2879500 A1 | 10-06-2015 |
| | | JP 2015524661 A | 27-08-2015 |
| | | KR 20150034813 A | 03-04-2015 |
| | | PH 12015500234 A1 | 30-03-2015 |
| | | RU 2015107379 A | 27-09-2016 |
| | | US 2015189891 A1 | 09-07-2015 |
| | | WO 2014020117 A1 | 06-02-2014 |

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


- IT 1148139 **[0005]**
- WO 2013007529 A **[0006]**
- IT 1429847 **[0007]**