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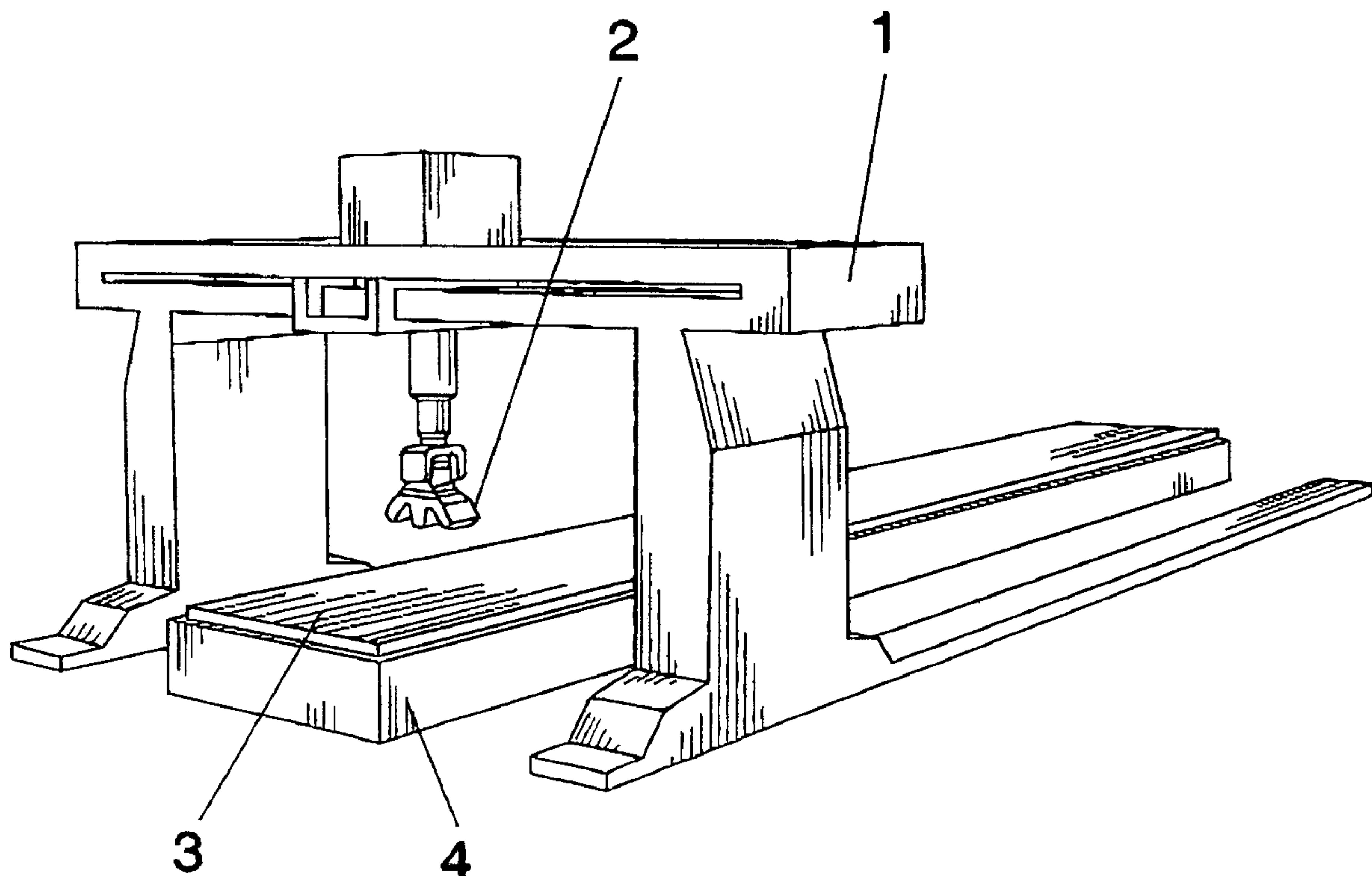
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(54) Titre : METHODE DE PREPARATION ET DE NETTOYAGE D'OUTILS SERVANT A FABRIQUER DES ELEMENTS
DE MATERIAUX COMPOSITES, ET DISPOSITIF CORRESPONDANT

(54) Title: PROCEDURE FOR THE PREPARATION AND CLEANING OF TOOLS USED FOR MANUFACTURING
COMPOSITE MATERIAL COMPONENTS, AND THE CORRESPONDING DEVICE



(57) Abrégé/Abstract:

The procedure includes: a first phase of blowing and suction; a second phase of cleaning by laser where the tool (3) on a positioner (4) is held under a laser head (2); a third phase of applying a releasing agent by spray, and a fourth phase for drying off this releasing agent by means of the aforementioned head (2).

SUMMARY

- 5 The procedure includes: a first phase of blowing and suction; a second phase of cleaning by laser where the tool (3) on a positioner (4) is held under a laser head (2); a third phase of applying a releasing agent by spray, and a fourth phase for drying off this releasing agent by means of the aforementioned head (2).

- 1 -

**PROCEDURE FOR THE PREPARATION AND CLEANING OF TOOLS USED FOR
MANUFACTURING COMPOSITE MATERIAL COMPONENTS, AND THE
CORRESPONDING DEVICE**

OBJECTIVE OF THE INVENTION

5 The present invention, as described in the heading of this descriptive report, refers to a procedure for the preparation and cleaning of tools used for manufacturing components in composite material, and the corresponding device, in which the tools referred to are tools such as moulds, stocks, angles and modules which are used predominantly in the manufacture of components for the
10 aeronautical industry. The principal objective of the invention is to automate and improve the tasks of preparation and cleaning that are normally carried out manually, thereby making it possible to clean the tools, spray them with a releasing agent and drying off this releasing agent, leaving the tools ready for use.

BACKGROUND TO THE INVENTION

15 Currently, the cleaning and application of releasing agent both to stocks, angles, small modules and moulds necessary for the manufacture of components for the aeronautical industry is carried out manually, which has particular difficulties in that in order to reach an optimal level of cleanliness, invasive methods have to be used to clean particular areas of the tool. This leads to degradation of the tools and
20 an increase in the time it takes to carry out the task, itself causing further wear of the tools.

 Various possible methods for the cleaning of tools are known, such as laser and CO2 (dry ice). The conventional procedure for preparing the tools that are used in the manufacture of aeronautical components is as follows: using a clean
25 cloth, some type of sponge or similar, solvents are applied to the tool. The tool is then cleaned with the clean cloths before the solvent evaporates. Next three fine, uniform coats of Frekote 700nc (z24224) releasing agent are applied at right angles to one another, with an evaporation time for the solvent between coatings of 10 to 15 minutes. It is important to avoid applying the releasing agent to the bag vacuum
30 sealing area, and with those areas masked, the component is left to cure at room temperature for 60 minutes. When material continues to adhere to the surface of the tool in a particular area or where there are scratches that were produced during removal of mould material from the corresponding component, the following procedure is used:

35 1.- The area affected is marked with adhesive tape

- 2 -

2.- Cleaning is carried out as described above

3.- Releasing agent is applied, covering an area twice the size of the area marked.

5 This process, which is normally carried out manually, has disadvantages in that it is necessary to ensure that masking is fully achieved, that the releasing agent is applied correctly and that the releasing agent is dried off adequately.

DESCRIPTION OF THE INVENTION

10 To achieve the objectives and avoid the disadvantages indicated above, the invention consists of a procedure for the preparation and cleaning of tools used for manufacturing components in composite material, and the corresponding device, in which the tools referred to are tools such as moulds, stocks, angles and modules used predominantly in making components for the aeronautical industry.

By way of innovation, the procedure for doing this includes four automated phases, consisting of:

- 15
- A first phase of blowing and suction in which layers of surface resin are eliminated from the tools referred to
 - A second phase of cleaning by laser and by aspiration in which the tool, on a positioner, is held under a laser head, for all the surfaces and recesses to be cleaned

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 - A third phase of application by spraying of a releasing agent onto the tool
 - A fourth phase of drying off this releasing agent in which the laser head from the second phase is used with different settings.

25 The device which forms part of the invention and is used in the above mentioned procedure has a positioner on which the tool to be prepared and cleaned is placed. It is held under a robotised head with three different functional positions and into which the following three systems are integrated:

- 30
- A laser system with independent cleaning and drying functions which has numerical control programs adapted to the requirements of the particular areas of the tools to be treated. This system includes means of refrigeration and means of controlling the laser system
 - A releasing agent spraying system
 - A blowing and aspiration system.

35 The controls of the laser referred to above can include the verification, control and recording of the settings amongst which are the angle of incidence of the laser, the distance to the tool, the power of the laser, the frequency of the pulse

- 3 -

and the temperature of the laser.

With the structure described, the invention and its procedures offer various advantages, in that by using the invention it is possible to: prepare and clean the whole surface of components, irrespective of their complexity, continuing until they are completely clean; subsequently apply releasing agent by spraying, and finally dry off the releasing agent. This is all done automatically, thereby making it possible to save many hours of work, achieving an improvement in the safety and hygiene for the worker due to the absence of acetone in the cleaning process, and ensuring a much lower risk of damaging the tools.

Furthermore, by means of numerical control programs adapted to the requirements of the particular areas of the tool to be cleaned, it is possible to programme different settings for different areas, such as for example applying a higher laser intensity to areas which are scratched or drilled. In addition, cleaning by laser has two physical effects: the dirt is vaporised by sublimation, and dirt removal is also effected by thermal induction. This heating is carried out only for a few milliseconds as the pulses are powerful but very short, which makes it possible for the tool being treated to remain unaffected by the changes in temperature, as it only increases in temperature by approximately 5° each time the laser is applied to a point, even with repeated applications. Furthermore, the laser cleaning system makes it possible to avoid corrosion of the tools.

Another advantage, when the laser is used appropriately, (i.e. with the correct adjustments of power and wavelength settings necessary for cleaning a particular tool), is that the metals are not damaged or indented, thereby avoiding the erosion of the tools that is caused by manual cleaning systems. The behaviour of the laser with aluminium, steel and invar is excellent. The dilation coefficients do not affect cleaning, given that heating is minimal due to the use of short pulses (more than 110,000 per second). Furthermore, with laser cleaning, any releasing agent that may have been on the tool also disappears from the surface, and is subsequently reapplied.

Another advantage of laser cleaning is that it eliminates the accumulation of releasing agent that currently occurs on the tools and that is then transferred to the carbon fibre components, making their inspection with ultrasound difficult.

The distance of the component from the laser head to the surface to be cleaned is within the range that the laser can accommodate.

Another advantage is that the invention's procedure and the device are not

- 4 -

contaminating as they do not produce emissions of any type, since the dust resulting from the corresponding sublimation is absorbed by an aspirator. Furthermore, the technology is silent, which means that the invention has advantages compared with cleaning with CO₂.

5 In one aspect, the invention provides a procedure for the preparation and cleaning of tools used for manufacturing composite material components, said tools being used in an aeronautical industry; wherein the automatic procedure is carried out by a robotized head with different end-effectors and comprises the following automated phases:

10 carrying out a first phase of blowing compressed air for removing layers of surface resin and dirt from the tools, and of suctioning airborne all particulates, where this first phase is carried out by a blowing and suction system comprised in the robotized head;

15 carrying out a second phase of cleaning comprising holding the tool with a positioner under a laser system comprised in the robotized head, so that the tool is cleaned for all its surfaces and its recesses by a laser beam from the laser system and airborne particulates are suctioned;

20 carrying out a third phase of application by spraying of a releasing agent product onto the tool, where this third phase is carried out by a releasing agent spraying system comprised in the robotized head; and

carrying out a fourth phase of drying off said releasing agent product in which the laser system from the second phase is used with different laser settings so that the releasing product is drying off by the heat effect provoked by the laser beam.

25 The invention's device and procedure makes cleaning quite fast and produces a quality of finish that is far superior to that of manual cleaning.

To provide a better understanding of this descriptive report and as an integral part of the report, some drawings are provided below in which the invention is described for illustrative purposes. The drawings are not definitive.

BRIEF DESCRIPTION OF THE DRAWINGS

30 **Figure 1.-** This represents a schematic view in perspective of the device for preparing and cleaning tools used for manufacturing components in composite material, used in the procedure of the present invention.

Figure 2.- This represents an enlarged detail drawing. It is a view of the device referred to in figure 1 above and is also schematic and in perspective. It consists of a detailed view of the head of the device referred to.

- 4a-

DESCRIPTION OF AN EXAMPLE OF THE INVENTION IN USE

Below is a description of one example of the invention. The numbers refer to those used in the drawings.

5 The procedure for the preparation and cleaning of tools used for manufacturing components in composite material for the present example of the invention is applied to moulds, stocks, angles and modules used primarily in making components for the aeronautical industry.

The procedure for the purposes of the present example includes four automated phases consisting of:

- 10 - A first phase of blowing and suction in which layers of surface resin are eliminated from the tools referred to
- A second phase of cleaning by laser and by aspiration in which the tool (3) on a positioner (4) is held under a laser head (2) for all the surfaces and recesses to be cleaned
- 15 - A third phase consisting of the application of a releasing agent onto the tool by spraying (3)
- A fourth phase of drying off this releasing agent in which the laser head from the second phase is used with different settings.

20 The device (1) corresponding to the procedure referred to can be seen in

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- 5 -

figure 1, with a positioner (4) on which a tool to be prepared and cleaned is positioned (3) and held under a robotic head (2) which has three different functional positions and in which three systems are integrated, each different from the other. The head (2) can be seen in figure 2, enlarged in relation to its size in figure 1 and
5 separated from the rest of the device.

The three systems integrated into the head (2) consist of:

- A laser system with independent cleaning and drying functions, and with numerical control programs adapted to the needs of the areas of the tools (3) to be treated. It is envisaged that the device's (1) laser system
10 will have a means of refrigeration by water and/or air and means of control that include the verification, control and recording of the settings, which include the angle of incidence of the laser, the distance to the tool, the power of the laser and the temperature of the laser.
- A releasing agent spraying system
- 15 - A blowing and aspiration system.

With these three systems integrated into the head (2), and in accordance with the three corresponding application positions, the procedure described above is used.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A procedure for the preparation and cleaning of tools used for manufacturing composite material components, said tools being used in an aeronautical industry; wherein the automatic procedure is carried out by a robotized head with different end-effectors and comprises the following automated phases:

carrying out a first phase of blowing compressed air for removing layers of surface resin and dirt from the tools, and of suctioning airborne all particulates, where this first phase is carried out by a blowing and suction system comprised in the robotized head;

carrying out a second phase of cleaning comprising holding the tool with a positioner under a laser system comprised in the robotized head, so that the tool is cleaned for all its surfaces and its recesses by a laser beam from the laser system and airborne particulates are suctioned;

carrying out a third phase of application by spraying of a releasing agent product onto the tool, where this third phase is carried out by a releasing agent spraying system comprised in the robotized head; and

carrying out a fourth phase of drying off said releasing agent product in which the laser system from the second phase is used with different laser settings so that the releasing product is drying off by the heat effect provoked by the laser beam.

2. The procedure of claim 1, wherein the fourth phase of the procedure further comprises verifying, controlling and recording the laser settings; where said laser settings are selected between the angle of incidence of the laser, the distance to the tool, the power of the laser, the temperature of the laser and combinations thereof.

3. The procedure of claim 1 or 2, wherein said tools being selected from the group consisting of molds, stocks, angles and modules used in manufacturing components for an aeronautical industry.

4. A device for the preparation and cleaning of tools used for manufacturing composite material components, for carrying out the procedure defined in any one of claims 1 to 3, wherein the device having a positioner on which a tool is positioned and held under a robotized head to be prepared and cleaned, said positioner having three

different functional positions, and in which the three following systems are integrated respectively:

a laser system with independent cleaning and drying functions, and with numerical control programs adapted to the particular areas of the tools to be treated, the device comprising means of refrigeration and means of controlling the laser system;

a releasing agent spraying system; and

a blowing and suction system, so that the laser system is used to carry out the second and fourth phases of the method, the releasing agent spraying system is used to carry out the third phases of the method and the blowing and suction system is used to carry out the first phase of the method.

5. The device of claim 4, wherein the means of control of the laser system comprises the verification, control and recording of the settings such as: the angle of incidence of the laser, the distance to the tool, the power of the laser and temperature of the laser.

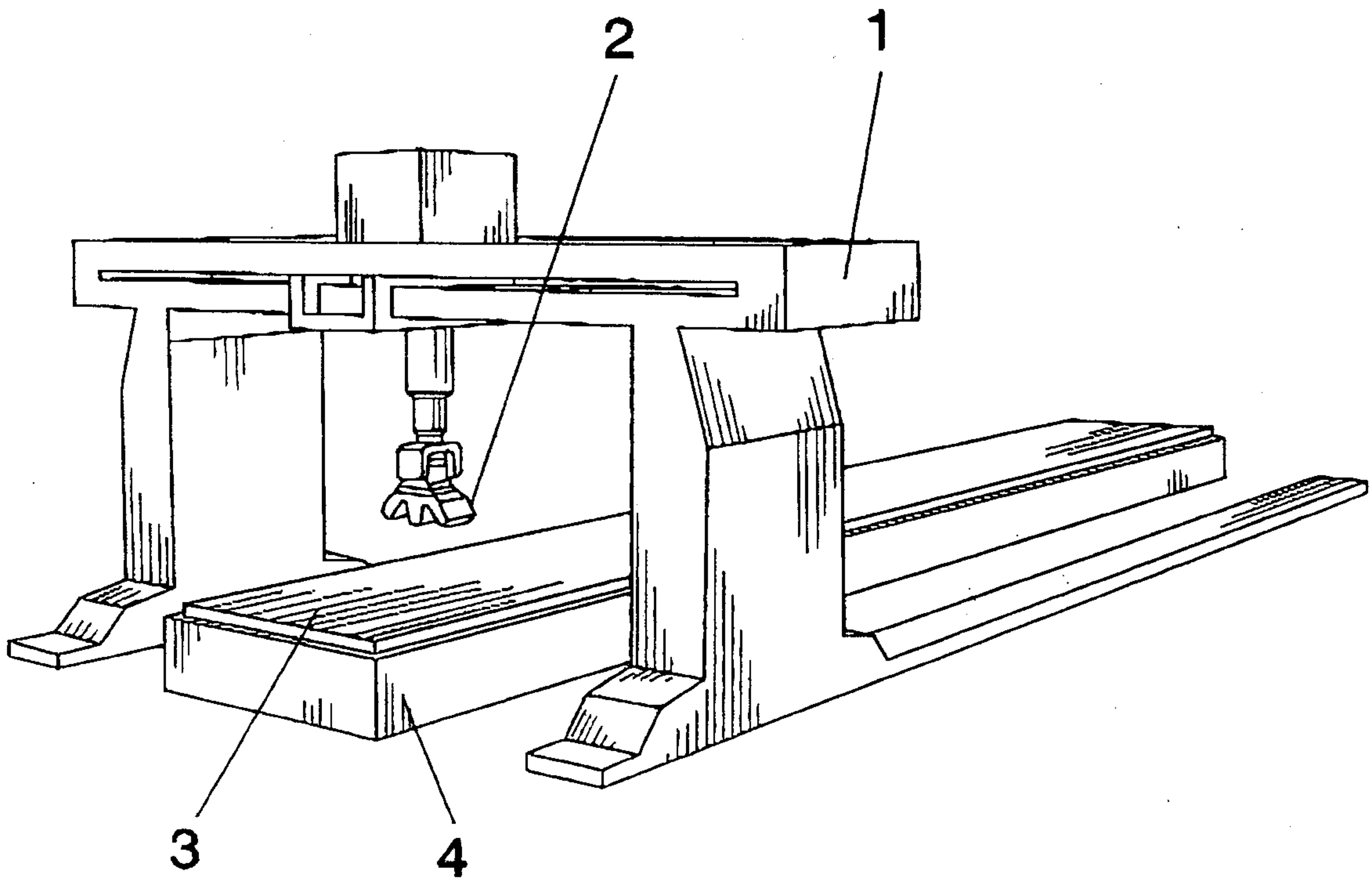


FIG. 1

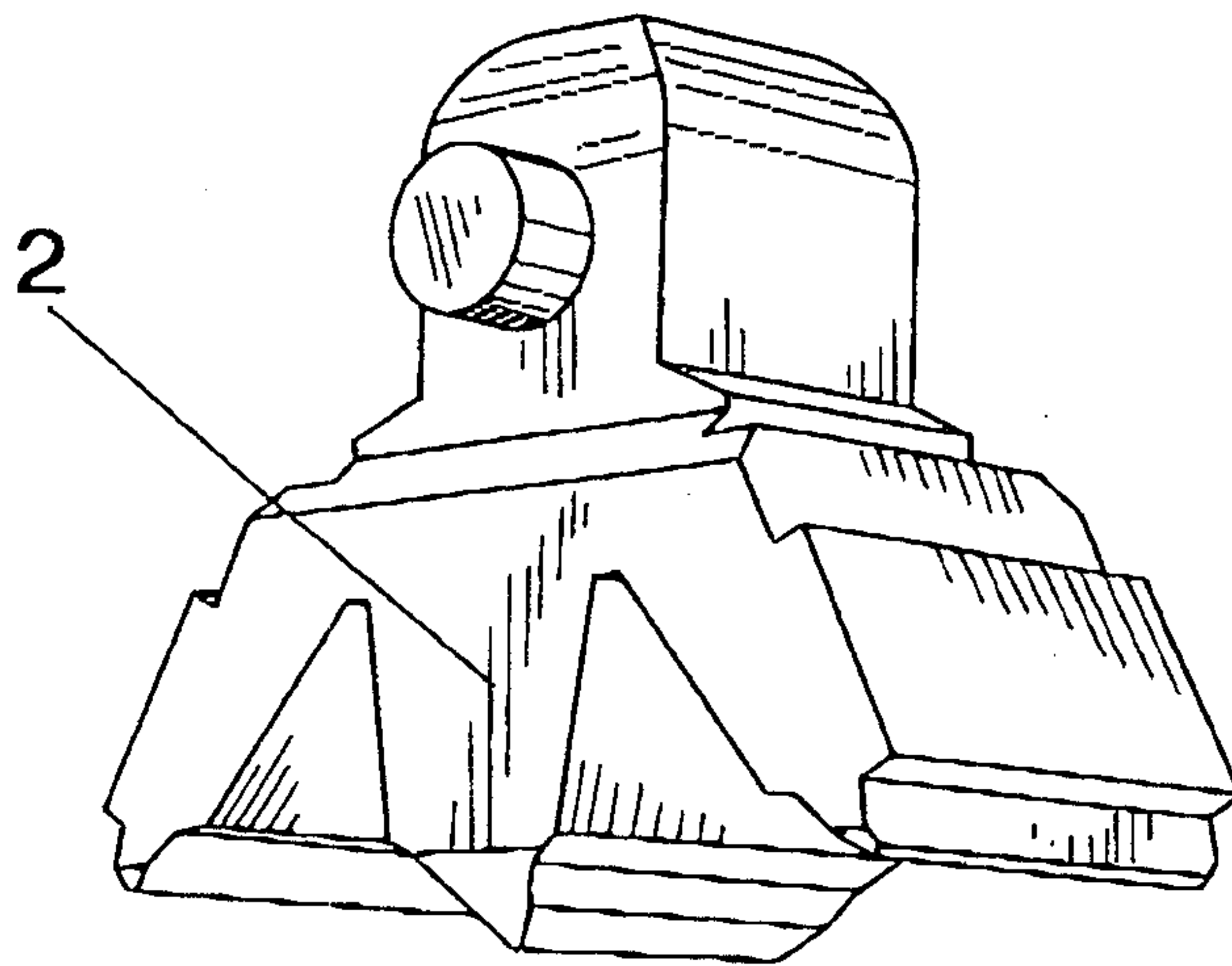


FIG. 2

