



(11) **EP 3 778 407 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
17.02.2021 Bulletin 2021/07

(51) Int Cl.:
B65B 13/18 (2006.01) B65B 13/32 (2006.01)

(21) Application number: **20745939.7**

(86) International application number:
PCT/ES2020/070017

(22) Date of filing: **13.01.2020**

(87) International publication number:
WO 2020/152379 (30.07.2020 Gazette 2020/31)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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(30) Priority: **24.01.2019 ES 201930120 U**

(54) **AUTOMATIC STRAPPING HEAD**

(57) An automatic strapping head with a frame (3) made up of six aluminium plates that are welded together to create a prismatic box-like structure. It incorporates at least one clamp (5); a series of levers (33, 34); a strapping input guiding system (8, 11, 12), a strapping output system (13, 14); a resistor (27); a counterplate (26); a number of cams (7, 21); a tool for ejecting the strapping (15); a tool for gripping and joining the strapping (16); and two servomotors (1, 2), one primary (1) and one secondary (2), connected to a conical gear reducer and a high-performance planetary gear unit, which are responsible for transmitting movement to the various elements that make up the head. All of this is controlled by a number of logical control tools connected to a display screen, or something similar, enabling the user to view the data obtained while operating the head, which is helpful for modifying operational parameters.

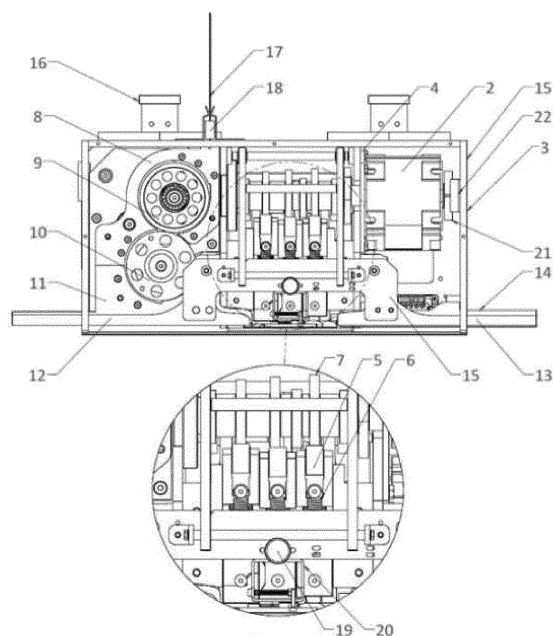


FIG.1

Description

Field of the invention

[0001] The object of the invention is an automatic strapping head, with one of its main distinctive features being the presence of servomotors, used to control the head, in addition to its ability to be used both horizontally and vertically. It is designed specifically for applying strapping to boxes and pallets of various sizes.

Background to the invention

[0002] Strapping consists of a strip, originally made of metal, which is used to secure the packaging of various loads onto pallets, or loads within boxes, and its key feature is its tensile strength. Its traditional form is produced through a process where it is cut and its edges are rounded off, to then be finished by a painting, galvanising or bluing process.

[0003] With the evolution of industrial plastic processing in the 20th century (polypropylene and polyester), the use of metal strapping began to fall out of favour, to be replaced with polymer strapping. The main reasons for this evolution were work safety (metal strapping can cause cuts), the cost of the product itself (polymer strapping is cheaper), ease of use, and the fact that polymer strapping can be heat sealed.

[0004] The primary advantages of polymer strapping over traditional steel strapping are as follows: it has better shock absorption and memory; it adapts better to packages that reduce in size over time; you can fit more metres onto a reel; it doesn't rust; it doesn't leave marks on the packaged product; you can sometimes avoid the need to use protections, such as corner protectors or similar; and it is easier to process for recycling.

[0005] This material has an approximate resistance of 55 kg/mm² and an elasticity of 13%, making it particularly effective for loads that need to support high levels of pressure. The most common dimensions for this kind of strapping are 5, 9, 12, 13, 16 and 19 mm.

[0006] Handling and using this kind of strapping in an industrial environment is commonly done through the use of automatic strapping machines, which automatically tension, seal and cut the strapping, without the need for manual intervention.

[0007] This type of strapping can also be used manually, semi-automatically or automatically, according to requirements.

[0008] For carrying out these kinds of tasks, automatic strapping machines have a head that is responsible for projecting, collecting, tensioning, cutting and sealing the strapping. But their main disadvantage is that they contain a large number of motors and elements that can become worn down through use, requiring the need for a high level of maintenance work, which can be very costly.

[0009] The applicant is unaware of the existence of any automatic strapping heads of the type used for prod-

uct packaging that have the same unique characteristics of this invention. However, there are various existing inventions that have some degree of similarity to the invention described here.

[0010] One example is the patent EP0779211, which describes a device with various stages of gripping for use with strapping machines, and which includes an end gripper, an anvil and a cam gripper. The cam gripper has an initial pressure surface for pushing the end gripper towards a section of the beginning end of the strapping, to firmly grip the beginning end of the strapping between the end gripper and the anvil; a second pressure surface to release the gripping force; and a third pressure surface to generate a lesser gripping force, gripping the beginning end of the strapping more lightly so it can be removed. The cam gripper is rotated so it can alternate between the various different pressure surfaces during the strapping cycle.

[0011] The Spanish patent ES 2336 168 describes a strapping machine of the type that is made up of a bench with the strapping supply tools at either end and a table for positioning the packages and/or reels. It also includes a cart that supports the head, with a jaw and tools for projecting the strapping. Its main distinguishing feature is the fact that the bench has runners in the centre that allow the cart that supports the head, with its tool for projecting the strapping and the jaw, to slide along, while the table for positioning the packages and/or the reels has a turning platform on top divided into four parts, in a cross shape, where packages and/or reels of strapping can be placed. The cart has a hydraulic piston that enables it to move along the runners and another hydraulic piston to lift it and lower it onto the runners. In addition to the cart and the head, there is also an intermediate strapping frame in the preceding area that guides the strapping backwards and forwards and consists of upper and lower tilting arms that are operated by hydraulic pistons from the head. Both arms are a C shape and face and relate to each other by an inner section and an outer section made up of two extensions from the arms, with the lower arm and outer section potentially being contained within the empty vertical space in the table for positioning the packages and/or the reels. Another distinguishing feature of the machine is that the intermediate frame in the upper arm contains a tool for supplying rings. Said tool consists of a horizontal ring feeder drawer with four pneumatic pistons operated by their corresponding solenoid valves and filters, positioned on one side of the cart, which also has a selector with a light to alert the user when the rings have run out.

[0012] The Spanish patent ES2382250 describes a head for an automatic strapping machine, particularly suitable for working with 32 mm polyester strapping and designed to work with strapping reels both circumferentially and radially, as well as with packages or products in various shapes, including tubes, hexagons, circular shapes, etc. It can be adapted to work with any kind of automatic strapping machine and includes mechanical

elements made up essentially of an inlet pulley connected to a bearing; two counting wheels; one drive wheel; a counter-roller; various guiding elements; a jaw with a base plate containing a drive wheel for tensioning and slackening; a cutting blade; various tensioning, slackening and sealing plates; two gears on racks that enable the head to move laterally; electric elements that mainly consist of six detectors that stop its movement, a button panel for controlling forward and backwards movements, gripping and releasing of strapping, feeding or withdrawing the strapping in the head, an emergency stop button and an encoder that controls the distance that the strapping is projected and collected; and pneumatic elements made up mostly of ten pistons, nine solenoid valves, a pneumatic motor with a pneumatic reducer, a tensioning motor and a motor for cutting and sealing. Its main distinguishing feature is that, for working with strapping reels radially and with packages and products in various shapes (tubes, hexagons, circular shapes, etc.), it contains a safety piston; a counter-roller piston that incorporates the counter-roller, positioned so that it presses the strapping against the drive wheel; a gripping piston positioned so that it presses a strapping gripping support to grip the strapping; an open/closing piston positioned so as to close the jaw; a tensioning piston that operates the tensioning motor and tensions the strapping against the reel at the desired tension; a sealing and cutting piston that operates the cutting and sealing motor via solenoid valve; a slackening piston that, via the tensioning motor, slackens the strapping and opens the jaw with a gripping bushing; and a lateral movement piston positioned horizontally on one side of the head, which enables lateral movement through the use of gears, limited by two detectors.

[0013] The Spanish patent ES 2 351 002 describes a strapping head designed for strapping machines with a main frame and a strapping guide frame that moves vertically. Inside of this is an object that should be wrapped around at least once with strapping that is fed from a continuous reel of strapping. The strapping head includes a tool for projecting continuous strapping so that it travels along the guide frame around the object being strapped; a tool for collecting and tensioning the continuous strapping around the object; a sealing tool that joins the beginning end of continuous strapping to another piece of the same strapping, to form a closed loop around the object being strapped; and a cutting tool to separate the loop of strapping from the rest of the continuous strapping. The main distinguishing feature of this strapping head is that it has three individual pistons that are involved in projecting, collecting, tensioning, sealing and cutting the strapping, with each of said pistons having their own working surface oriented towards one of the sides of the object being strapped. Each piston is able to move in a direction perpendicular to the working surfaces, essentially parallel to each other, between an extreme forward position and an extreme backward position, in respect to the object being strapped and the strap-

ping that is being wrapped around it, via respective electro-pneumatic actions.

[0014] The patent ES 2 407 642 describes a strapping device for applying strapping around packages using a closing head and at least one guiding element that guides the closing head along a predetermined course. The guiding element is made up of at least two guiding segments that move in relation to each other and is variable in regard to its guide course. Its main distinguishing feature is that the two guiding segments are joined together by flexible joints.

[0015] The patent ES 2566745 describes a sealing unit for a strapping machine that includes at least one gripping unit with a movable gripper at the top end that moves towards a corresponding gripper at the opposite end, to grip a piece of strapping. The gripper is pushed elastically by a movement tool towards the opposing gripper. At least one gripping unit will include an impulse pivot that protrudes from the bottom of the gripping unit's body that will interact with the movement tool. Its main distinguishing feature is that the impulse pivot is received in an axially slidable manner onto a seat on the body and that there is a shock absorber made of elastically deformable material between the end of the impulse pivot inside the seat and the bottom of the seat.

[0016] The patent ES 2659 966 describes a strapping head for a strapping machine with a supporting frame designed to accommodate the passage of strapping as it is projected/rewound by a projection/rewinding unit. The head is made up of a number of driving wheels for said strapping, a sealing unit and a gripping and cutting device that includes locking grippers, a movable stop plate and a cutter. Said driving wheels for the projection/tensioning unit are rotated by a primary driving motor. The main distinguishing feature is that the projection/tensioning unit, the sealing unit and the gripping and cutting device have driving elements that are moved by one single lineal cam, which is designed to move alternatively in a longitudinal direction via a second driving motor. It also has cam profiles on a horizontal and a vertical plane, and said lineal cam is driven by the aforementioned second driving motor, connected in rotation with threaded spindle transmission tools that mutually cooperate with the screw nut of tools integral with said lineal cam.

[0017] The patent ES 2211 736 describes a strapping machine that includes a roller; a strapping door positioned separately from the roller; an internal box; and a restriction device between the roller and the strapping door. Its main distinguishing feature is that the restriction device includes: an upper guide with a first and a second end; a lower guide with a first and a second end, with the first end being rotationally connected to the first end of the upper guide; and tools that press together and separate the two guides so that the second end of the upper guide is separated by pressure from the second end of the lower guide, with the second end of the upper guide being positioned towards the roller and the second end

of the lower guide being positioned towards the strapping door, in a default position, being used for restricting the size of the free space between the strapping door and the roller, to prevent the strapping material from falling or sliding downwards and penetrating the internal box.

[0018] The patent ES 2 285 471 describes a strapping machine that includes a unit for extending, extracting and stretching the strapping, which itself includes a motor and a primary motorised wheel that the strapping wraps around partially to be moved in both directions. Its main distinguishing feature is that it includes two mechanisms that can be selected for transmitting movement from the motor to the primary wheel. The first mechanism causes the primary wheel to rotate at an initial speed, as well as an auxiliary traction wheel that is pressed against the primary wheel, with strapping interspersed in the vicinity of the primary wheel, where said strapping is stretched. The second mechanism causes the primary wheel to rotate in both directions at a second speed that is faster than the initial speed, in order to extend and extract the strapping, while the auxiliary traction wheel is at a certain distance from the primary wheel. A control device is used to alternate between the first and second mechanisms in order to quickly switch between extending, extracting and stretching the strapping.

[0019] The Spanish patent ES 2352402 describes a streamlined strapping machine with a package transporter that uses cross rollers; a tool for turning the packages 90°; a strapping decoiler; a strapping collector; a head with a tool for projecting strapping; a jaw; a strapping guide frame; a control panel; and a hydraulic system. Its main distinguishing feature is that its strapping decoiler has a shaft that is operated by a motor reductor and two covers, one fixed and one movable, with a hand wheel for mounting the reels of strapping. The accumulator is made up of a frame with four small guide wheels positioned inside an upper internal area and eight pulleys, four upper and four lower, through which the strapping passes, and which have between them a counterweight positioned on the four lower pulleys. The accumulator frame has an upper sensor for detecting the presence of strapping, an intermediate sensor for detecting the feeding of strapping and a lower detector for detecting that the feeding has stopped. The accumulator also has an upper vertical extension with some pulleys at its free end, where the strapping passes through to the head, towards the head's upper pulley. The head, with its corresponding jaw and strapping projection tool, is mounted on a bridge with a shim, positioned between two runners that it slides along, driven by a hydraulic upwards and downwards piston. There is also a lower mechanical stopper and a series of detectors positioned on the frame of one of the runners, which come into contact with the head's shim. The strapping guide frame has a rectangular configuration and is arranged in a form that is transversal to the package transporter. At its four corners there are curved sections, an upper horizontal section, two vertical sections and a lower section.

[0020] The patent ES2363866 describes a strapping device for a packaging machine. It has a horizontal transporter with a ring of plastic strapping that is wrapped around a load, which is moved around so it can be packaged, while also moving along the transporter. It includes a tool for transferring a part of the strapping above or below the transporter plane; a primary tool for gripping and holding an initial piece of said strapping at a predetermined distance below the transporter plane; and a tool for transporting the load in the transporter and intercepting and pulling the part of the strapping that extends between the initial piece and the strapping feed storage, for packaging the load. It also includes secondary tools for gripping and cutting a part of the strapping below the transporter plane to form the final end of the strapping; a sealing tool designed to come into contact with the initial and final ends of the strapping in sequence, softening them so that they seal together; and a countercursor tool designed to bond the initial and final ends together to complete the seal. Its main distinguishing feature is that these sealing tools include a heated cursor with a wedge head designed to work with a wedge attachment of said countercursor. The heated cursor and the countercursor move along the same axis that is substantially inside the plane of the ring of strapping and in a position underneath the transport plane.

[0021] Finally, the patent ES 2 659 966 describes a strapping head for a strapping machine with a supporting frame designed to accommodate the passage of strapping as it is projected/rewound by a projection/rewinding unit. It is made up of a number of driving wheels for said strapping, a sealing unit and a gripping and cutting device that includes locking grippers, a movable stop plate and a cutter. Said driving wheels for the projection/tensioning unit are rotated by a primary driving motor. Its main distinguishing feature is that the projection/tensioning unit, the sealing unit and the gripping and cutting device have driving elements that are moved by one single lineal cam, which is designed to move alternatively in a longitudinal direction via a second driving motor. It also has cam profiles on a horizontal and a vertical plane, and said lineal cam is driven by the aforementioned second driving motor, connected in rotation with threaded spindle transmission tools that mutually cooperate with the screw nut of tools integral with said linear cam.

[0022] After researching all of the aforementioned patents, it can be concluded that none have been located that relate to equipment or machinery for automatically strapping pallets that are the same as that which is described in this document. Some of the described inventions incorporate a pneumatic component that requires the presence and/or installation of compressed air, significantly increasing installation and/or maintenance costs and requiring increased control over potential safety issues related to the work being carried out.

[0023] Another relevant differentiating aspect is the fact that it weighs less than the majority of other existing heads, while offering better performance than other com-

pact heads currently available on the market. It offers better results in terms of handling, as the majority of other heads have high volumetric requirements, which invariably means that the operational surface is significantly larger, thus reducing the space available in the warehouse due to the operating radius of the cutting and sealing system.

[0024] Another issue with said heads, as mentioned previously, is that they are made up of a larger number of different components and up to three motors per head, increasing the mechanical and logistical complexity of their production.

Description of the invention

[0025] The technical issue resolved by this invention is managing to produce a new product that can improve automatic strapping performance and reduce production unit time, with an optimum design at both a dimensional and a performance level, providing an improved balance between performance, volume and weight in comparison to other similar solutions. As such, the main distinguishing features of the automatic strapping head, the subject of this invention report, are that it has a frame made up of six aluminium plates that are welded together to create a prismatic box-like structure, and also that it incorporates at least one clamp; a series of levers; input and output guiding systems for the strapping; a resistor; a counterplate; a number of cams; a tool for ejecting the strapping; a tool for gripping and joining the strapping; and two servomotors connected to a conical gear reducer and a high-performance planetary gear unit, which are responsible for transmitting movement to the various elements that make up the head. All of this is controlled by a number of logical control tools connected to a display screen, or something similar, enabling the user to view the data obtained while operating the head, which is helpful for modifying operational parameters.

[0026] The design of the strapping head proposed here provides it with a number of characteristics that are ideal for performing strapping work within industries that require automatic strapping machines, providing them with a certain level of reliability for various workloads. There is also no need for excessive maintenance due to breakage or wear and tear of components, which can inhibit the desired work rate.

[0027] The head proposed here is highly versatile when it comes to strapping, as it is capable of handling loads of 5-60 mm in width and working with strapping widths of 5, 9 and 12 mm. It can also provide various levels of tension thanks to the potential provided by the servomotor that, along with the head's logical control tools, allows it to reach higher peak tensioning torque than normal maximum levels, something that would not be possible with the conventional electric motors normally used within the industry. Aside from providing strapping tension higher than normal maximum levels due to the servomotor, the torque control provided by this head also

allows you to strap fragile loads at extremely low tension levels, making it highly versatile for different types of loads as well, regardless of the size.

[0028] Another key aspect of the head described here relates to its capacity for working with various different types of strapping machines, meaning it can be used in a wide range of different industries in the market, thus reducing the cost of implementing the head. This is because it can be installed and operated with three types of automatic strapping machines commonly used within the industry: the vertical strapping machine, the horizontal strapping machine with a centring device and the box strapping machine.

[0029] This is made possible due to the compact and light structure of the head. Its aluminium frame and anchor point in a vertical line from its centre of mass make it very easy and practical to handle, so it can be mounted in various different positions. There are also a series of holes in its frame so it can be screwed onto the three different machines, with no need to change anything else.

[0030] Its structure and easy assembly make it much more mechanically simple than other similar devices on the market. This was achieved by designing the parts with this particular objective in mind, which even enables some of the parts to be interchangeable, to produce kits that can achieve even greater strapping performance than the more basic version could provide. To achieve this, the head is manufactured using numerically controlled machining centres (CNC) and the guides are made using (through additive manufacturing). This enables us to produce highly complex geometric pieces (e.g. inner channels with variable geometry for the strapping to pass through) that, without this technology, would have to be manufactured in various pieces. With additive manufacturing we were able to reduce the number of parts from 7 to 3, making savings in both time and manufacturing costs.

[0031] This is in addition to the servomotors that perform the movement function of one of the cams and the other for projecting and tensioning the strapping, which, in other heads used within the industry, is achieved through the use of three motors, or one motor and various electromagnets that provide movement to the shafts. This objective was achieved thanks to the presence of a mechanical transmission tilting system that enables one single servomotor to both project and tension the strapping, by turning in the opposite direction. This means that the total number of parts has been reduced, which in turn reduces the assembly time and the complexity of assembly operations for the various different parts.

[0032] As regards usability, our objective was to produce a head that is simpler to use than existing products on the market, and we achieved this by enabling its servomotors to be controlled via an electronic program and a display screen. Its display screen enables the user to obtain a series of data, such as alerts for production failures, the maximum number of strappings and the maximum number of strappings from the last operational pe-

riod. This makes it possible to provide a range of options that enable the machine to perform more effectively, such as changing the setpoint through which the strapping tension can be adjusted to enable different types of loads to be strapped.

[0033] Furthermore, the fact that the head lacks sensors for detecting the strapping or positioning the cams means that there is less risk of problems caused by these elements becoming broken or deteriorating due to movement and the accumulation of dirt through normal use, while also reducing the number of parts. No other known head on the market has this unique characteristic.

[0034] However, a sensor could be used for particular circumstances to detect whether the strapping has reached the end, then collect the strapping and project it again, for programmes with a double cycle of strapping projection attempts.

[0035] Finally, when it came to performance capacity, we wanted to produce a head that performed better than other heads on the market at various levels, and we tried to improve upon various crucial elements of the process, such as tensioning, guiding the strapping throughout the strapping cycle, and cutting, stopping and positioning the strapping at the end of the process, then sealing it.

[0036] We managed to improve the tensioning performance over that of current known heads on the market by using the servomotor torque control to achieve a much more precise level of tension than mechanical systems with other heads.

[0037] As for guiding the strapping, we managed to improve upon this by using complex geometric shapes, such as the interior channels in various geometric prismatic shapes that we managed to produce through 3D printing, which guide the strapping and prevent it from coming out of the circuit.

[0038] We were able to improve the cutting process by using a blade with a double edge, which is unique for this kind of machinery. It effectively provides two blades in one, so if one edge becomes worn down it can just turn over and continue working, without the need to halt production to replace the blade.

[0039] The strapping is positioned and stopped through the use of a strapping stopper, which is an L-shaped folded metal sheet. It is a highly important element of the invention as it performs three functions: first of all it prevents the strapping from colliding with the counterplate in the clamp area; secondly, it prevents the strapping from moving upwards once it arrives in the section underneath the part; and thirdly, when the strapping collides with the smaller end of the L-shaped piece, this is detected by the servomotor torque control and the motor is programmed to stop, with the strapping having reached the sealing position.

[0040] Finally, we were able to provide an improved sealing function over other heads by increasing the heat-sealing surface to 28 mm, enabling us to achieve a higher sealing breaking strength, which is one of the critical factors in applying higher levels of tension.

Brief description of the figures

[0041] Below are brief descriptions of a series of drawings that help to better understand the invention and they explicitly relate to a setup of this invention that is presented merely as an example, without limiting it.

FIG 1. Shows a front view of the automatic strapping head that is the subject of this invention report.

FIG 2. Shows a side view of the automatic strapping head that is the subject of this invention report.

FIG 3. Shows a schematic view of the strapping projection process (17) via the automatic strapping head that is the subject of this invention report.

FIG 4. Shows a schematic view of the movement of the strapping (17) when it is being projected by a part of the automatic strapping head that is the subject of this invention report.

FIG 5. Shows a schematic view of the automatic strapping head during a work process where the strapping is being tensioned (17) around the load, in preparation for the cutting and sealing process.

FIG 6. Shows a schematic view of the automatic strapping head during a work process where the strapping (17) is being heat sealed, while simultaneously being cut.

FIG 7. Shows a schematic view of the automatic strapping head during a work process where a movement is taking place in preparation for the strapping to come out (17).

FIG 8. Shows a schematic view of the automatic strapping head during the initial strapping output process (17).

FIG 9. Shows a schematic view of the automatic strapping head during the second strapping output process (17).

Detailed explanation of how the invention should be set up

[0042] The attached figures show how the invention should ideally be set up. The main distinguishing feature of the automatic strapping head, which is the subject of this invention report, is that its frame/structure (3) is made up of six aluminium plates that are welded together to produce a prismatic box-like structure, which houses at least two interior plates that in turn house the majority of the head's integral components.

[0043] The head is divided into independent parts or mechanical systems, such as the frame (3), at least one clamp (5), a series of levers (33, 34), a strapping input guiding system (8, 11, 12), a strapping outlet guiding system (13, 14), a resistor (27), a counterplate (26), a series of cams (7, 21), a tool for ejecting the strapping (15) and a tool for gripping and joining the strapping (16). The head also has two servomotors (1, 2) connected to a conical gear reducer and a high-performance planetary gear unit, which will be responsible for transmitting move-

ment to the various elements that make up the head. All of this is controlled by a number of logical control tools that incorporate a control computer program, which is connected to a display screen, or something similar. This enables the user to view the data obtained while operating the head, which is helpful for modifying parameters as required at any point.

[0044] The servomotors (1, 2) are fixed in place by a bracket (4), which secures them in position within the frame (3).

[0045] The clamps (5), the cams (7, 21) and a traction spring (6) combine to produce a cam-follower mechanism. These are made up of mechanised prismatic pieces that each slide onto seats or rails created on another mechanised piece that serves as a support (29). The clamps (5) are made up of two parts screwed together. The upper part is a fork that supports a roller that is in constant contact with the cams (7, 21), and between the upper and lower parts there is a series of Belleville washers (30) that overlap around the connecting screw and are housed inside a cylindrical bore on the lower part, which is the part that comes into contact with the strapping, whether it be to support it, cut it or seal it.

[0046] The ideal setup should include three clamps (5).

[0047] The levers (33, 34) will be composed of steel plates that rotate on a shaft (39), and this is the part of the head that is responsible for transforming the circular movement of the cams (7, 21) to the lineal movement of the counterplate (26) and the resistor (27).

[0048] The strapping input guiding system (17) is essentially made up of a number of strapping input bearings (18) that enable it to enter more easily. This is connected to an upper guide (8), which is in turn connected to a lower guide (11) and a mobile guide (12) that are also connected to an idler wheel (9) and a drive wheel (10), which works with a strapping tensioning bearing (31) to apply the appropriate tension to the strapping (17). The strapping output guiding system is made up of a mobile strapping output guide (13) and a lower strapping output guide (14), and all of this is connected to the primary servomotor (1) via its gear transmission system. In an ideal setup, all the guides (11, 12, 13, 14) should be polymeric in nature.

[0049] The resistor (27) should be made of AISI 304 stainless steel, or something equivalent, and should be housed in a Bakelite support (32). This resistor (27) is responsible for heating the strapping (17) to the desired point so it can then be sealed.

[0050] The counterplate (26) is made up of various plates that overlap so that a mechanised steel plate slides over a fixed bronze plate. The sliding plate moves in a lineal manner as it is where the clamps (5) are supported and the strapping is sealed (17), and it is also responsible for releasing the strapping once it has been tensioned, sealed and cut.

[0051] The cams (7, 21) are connected to the secondary servomotor (2) and the transmission shaft, which is supported by a bracket (42), and they are designed to

transmit movement to the clamps (5), the counterplate (26), the levers (33, 34) and the resistor (27).

[0052] The ejecting tool (15) is responsible for ejecting the strapping (17) once it has been sealed, and is made up of a series of metal guides with lineal movement, so it can be opened to eject the strapping once it has been guided. The ideal setup should include a knob (19) and a stopper for the strapping (20).

[0053] The head has a number of different protections, generally consisting of parts made of metal sheet that are screwed to the frame (3). They protect the systems from atmospheric dust and other elements, but also protect the user from injury when handling the head.

[0054] Finally, the head also has several elements for fastening and joining it to the strapping machine structure (16), consisting of two symmetrical welded units that enable the head to be adapted to any model of strapping machine currently available on the market.

[0055] As shown in figure 1, there is a point 0 indicator (22) and a point 0 cam (21) connected to the servomotor (2). Aside from the other elements already mentioned, figure 2 also shows the presence of an electrical connector (24) for powering the head, as well as a transformer cover (23) so it can be accessed from the exterior.

[0056] Figure 3 shows how the head works during the strapping projection process (17). It is driven from the driving pulley (10) and passes along the lower guide (11), past the coupling (25) of a clamp (5), the upper part of the strapping stopper (20) and above the counterplate (26) and leaves via the lower strapping output guide (14).

[0057] Figure 4 shows how the strapping (17) moves during the projection process, wrapping the load via an external frame separate from the machine that is the subject of the invention report, until it reaches the lower part of the strapping stopper (20) that halts the strapping (17) while positioning it on top of the other end of the strapping in the clamp area (5), where they will both be pressed together to form a seal.

[0058] Figure 5 shows the sequence where first the coupling (25) of a clamp (5) lowers until it presses down the strapping (17), then the main servomotor (1) rotates in the opposite direction to tension the strapping (17) onto the load, up to the programmed tension level. Next, another clamp (5) lowers to fix the two pieces of strapping (17) into the desired position, so they can then be cut and sealed, and finally the resistor (27) moves in a straight line until it is positioned between the two pieces of strapping (17) for the programmed length of time to heat the polyester or polypropylene material to the optimum bonding temperature.

[0059] Figure 6 shows how the clamp (5) lowers to heat seal the two pieces of strapping (17) together, while also cutting the strapping with the double blade (28) that is attached to the same clamp (5).

[0060] Figure 7 shows how the three clamps (5) rise once the strapping (17) has been sealed, with the sealed surface being equivalent to the length of the welding and cutting clamp (5). Once this movement has been com-

pleted the strapping will be free to leave, held only by the counterplate (26).

[0061] Figures 8 and 9 show the final sequence where the counterplate (26) begins from the resting position in figure 8 and then slides backwards in figure 9 via the movement of the levers (33, 34), to enable the strapping to leave (17). They also show how both the mobile strapping output guide (13) and the strapping stopper (20) change position, moving forward to allow the strapping (17) to leave downwards.

[0062] These figures show the counterplate (26) lug (38) located near the secondary servomotor (2), adjacent to the counterplate (26) itself, which is in turn connected to a bronze brushing (37) of the levers (33, 34). They also show where said levers (33, 34) are connected, the first lever for moving the resistor (33) and the second lever for moving the counterplate (34), and that they are connected with at least one traction spring and a return lever (35) that is anchored in at least one lug (41), while at the top there is a lever shaft (39), housed in a second bronze bushing (43) and solidly attached to a lever bearing (36). And how, in an adjacent position, there is a camshaft (40) housed in a bracket (42) that acts as a support.

Claims

1. An automatic strapping head with a frame (3) made up of six aluminium plates that are welded together to create a prismatic box-like structure. Its main distinguishing feature is that it incorporates at least one clamp (5); a series of levers (33, 34); a strapping input guiding system (8, 11, 12), a strapping output system (13, 14); a resistor (27); a counterplate (26); a number of cams (7, 21); a tool for ejecting the strapping (15); a tool for gripping and joining the strapping (16); and two servomotors (1, 2), one primary (1) and one secondary (2), connected to a conical gear reducer and a high-performance planetary gear unit, which are responsible for transmitting movement to the various elements that make up the head. All of this is controlled by a number of logical control tools connected to a display screen, or something similar, enabling the user to view the data obtained while operating the head, which is helpful for modifying operational parameters.
2. An automatic strapping head, as per claim 1, wherein the servomotors (1, 2) are fixed by means of a bracket (4) that secures them in place within the frame (3).
3. An automatic strapping head, as per claims 1-2, wherein the clamps (5), the cams (7, 21) and a traction spring (6) combine to produce a cam-follower mechanism.
4. An automatic strapping head, as per claim 3, wherein the clamps (5) are made up of mechanised prismatic

pieces that each slide onto seats or rails created on another mechanised piece that serves as a support (29).

5. An automatic strapping head, as per claims 3-4, wherein the clamps (5) are made up of two parts screwed together, with a forked upper part that supports a roller that is in constant contact with the cams (7, 21), and between the upper and lower parts there is a series of Belleville washers (30) that overlap around the connecting screw and are housed inside a cylindrical bore on the lower part, which is the part that comes into contact with the strapping (17).
6. An automatic strapping head, as per claims 1, 3, 4 and 5, which contains three clamps (5).
7. A strapping head, as per claim 1, wherein the levers (33, 34) are made up of steel plates that rotate on a shaft (39) and wherein the first lever (33) is for moving the resistor (33); the second lever (34) is for moving the counterplate (26); and both are connected by at least one traction spring and a release lever (35) that is anchored in at least one lug (41). There is a lever shaft (39) located at the top housed in a second bronze bushing (43), a lever bearing (36) solidly attached to said shaft (39) and, adjacent to this, a camshaft (40) housed in a bracket (42) that acts as a support.
8. An automatic strapping head, as per claim 1, wherein the strapping input guiding system (1) is essentially made up of a number of strapping input bearings (17) that enable it to enter more easily. This is connected to an upper guide (18), which is in turn connected to a lower guide (8) and a mobile guide (11) that are also connected to an idler wheel (12) and a drive wheel (9), which works with a strapping tensioning bearing (10) to apply the appropriate tension to the strapping (31). The strapping output guiding system is made up of a mobile strapping output (17) and a lower strapping output guide (13), and all of this is connected to the primary servomotor (14) via its gear transmission system.
9. An automatic strapping head, as per claim 1, wherein all the guides (11, 12, 13, 14) are polymeric in nature.
10. An automatic strapping head, as per claim 1, wherein the resistor (27) is made of AISI 304 stainless steel, or an equivalent material, and is located above a Bakelite support (32).
11. An automatic strapping head, as per claim 10, wherein the counterplate (26) is made up of various plates that overlap so that a mechanised steel plate slides over a fixed bronze plate.

12. An automatic strapping head, as per claim 1, wherein the cams (7, 21) are connected to the secondary servomotor (2) and the transmission shaft, which is supported by a bracket (42), and they are designed to transmit movement to the clamps (5), the counterplate (26), the levers (33, 34) and the resistor (27). 5
13. An automatic strapping head, as per claim 1, wherein the ejecting tool (15) is made up of a series of metal guides with lineal movement, so it can be opened to eject the strapping once it has been guided; and wherein said ejecting tool (20) is connected to a knob (19) and a strapping stopper (20). 10
14. An automatic strapping head, as per claim 1, which incorporates several elements for fastening and joining it to the strapping machine structure (16), consisting of two symmetrical welded units that enable the head to be adapted to a strapping machine. 15
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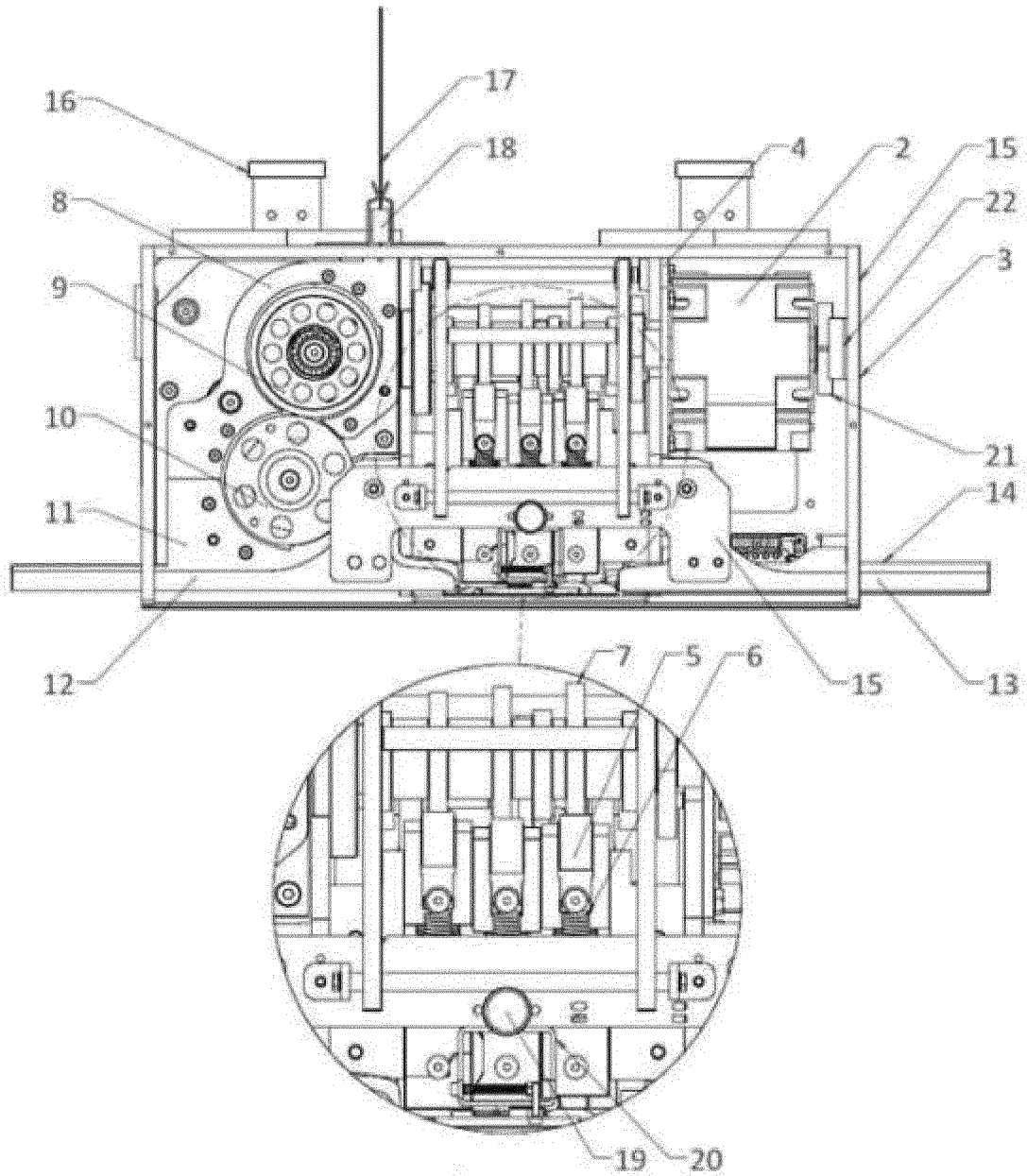


FIG.1

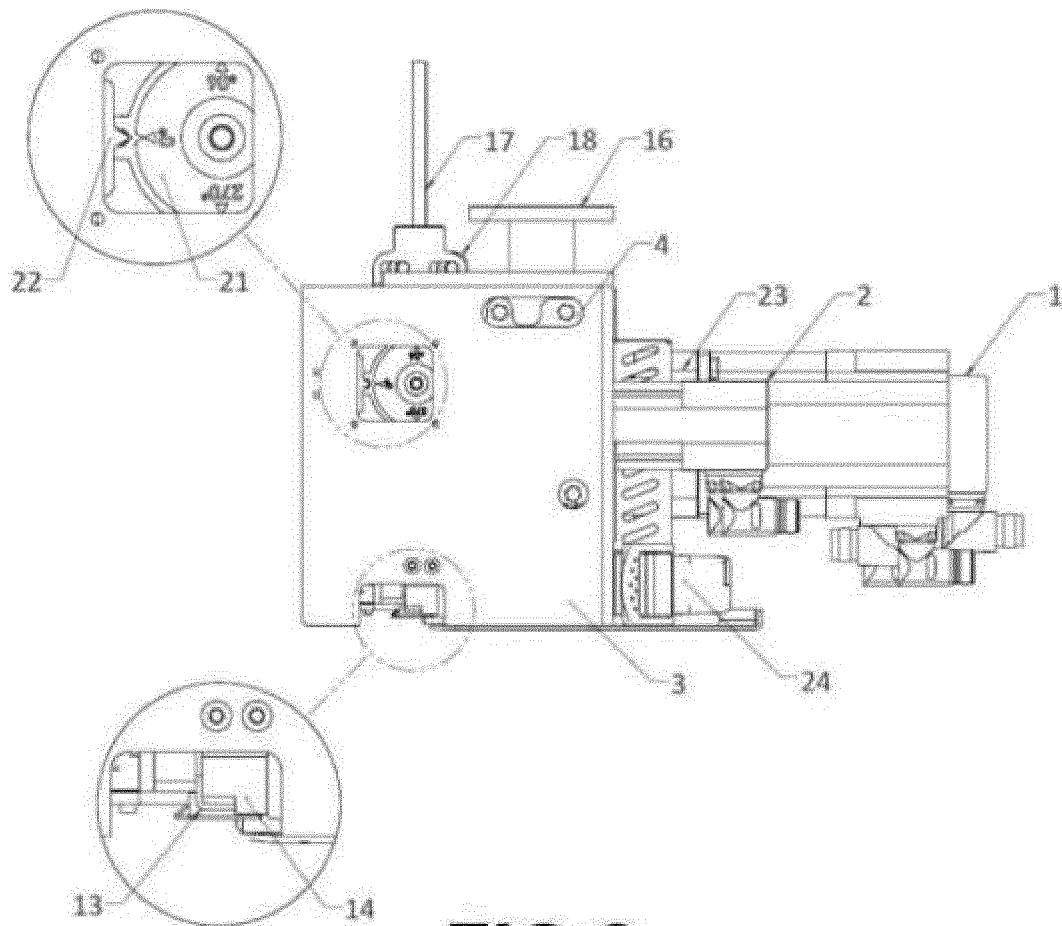
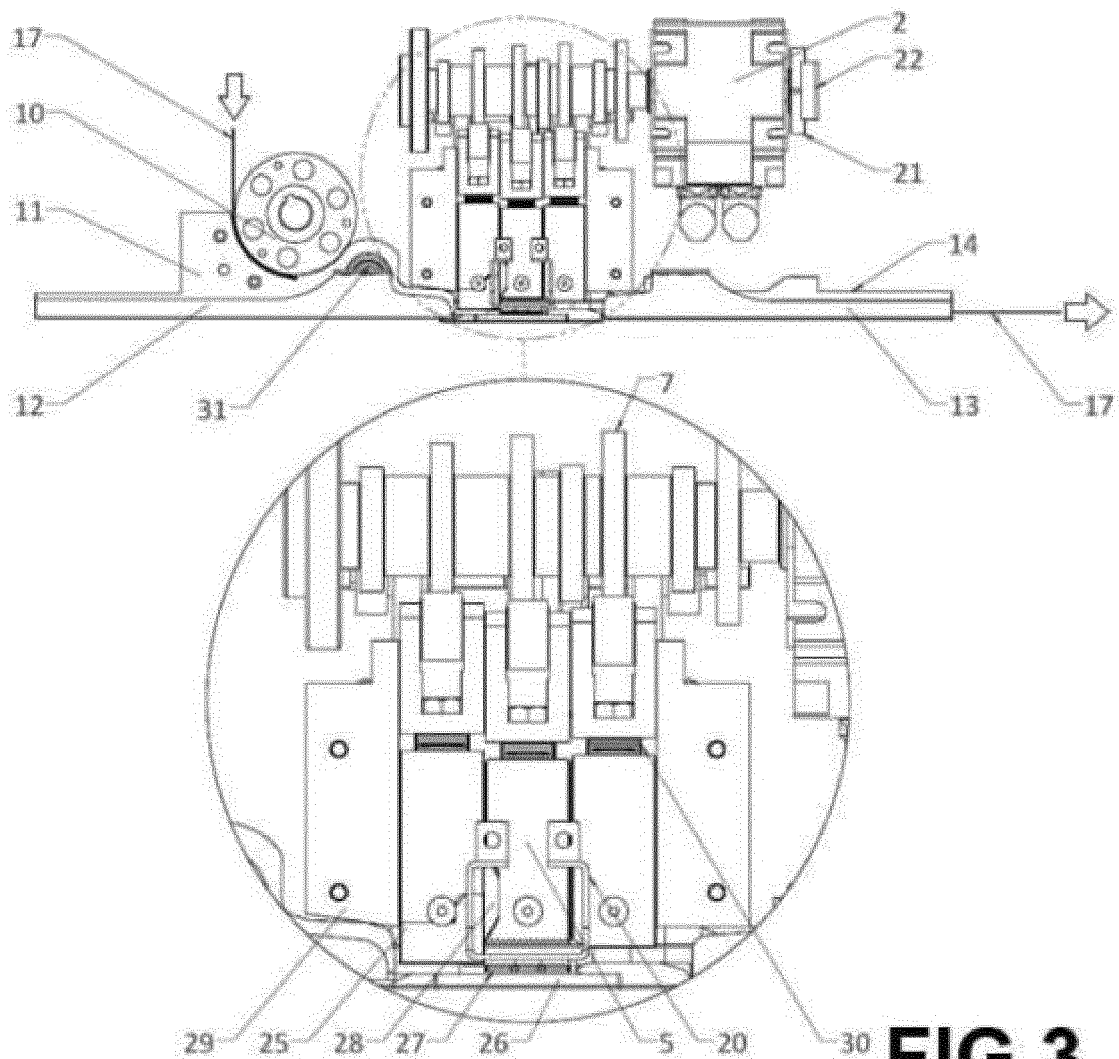
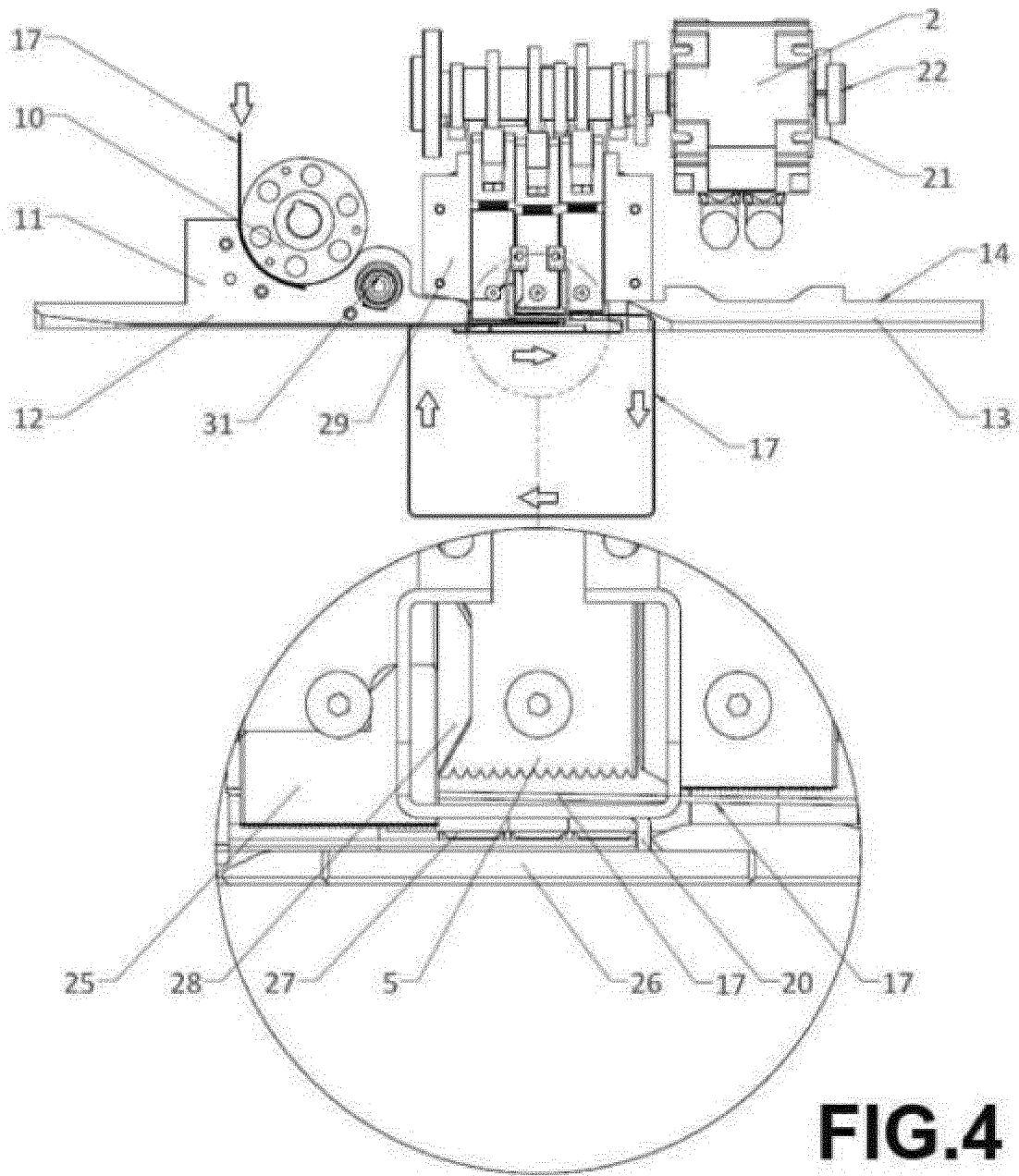


FIG.2





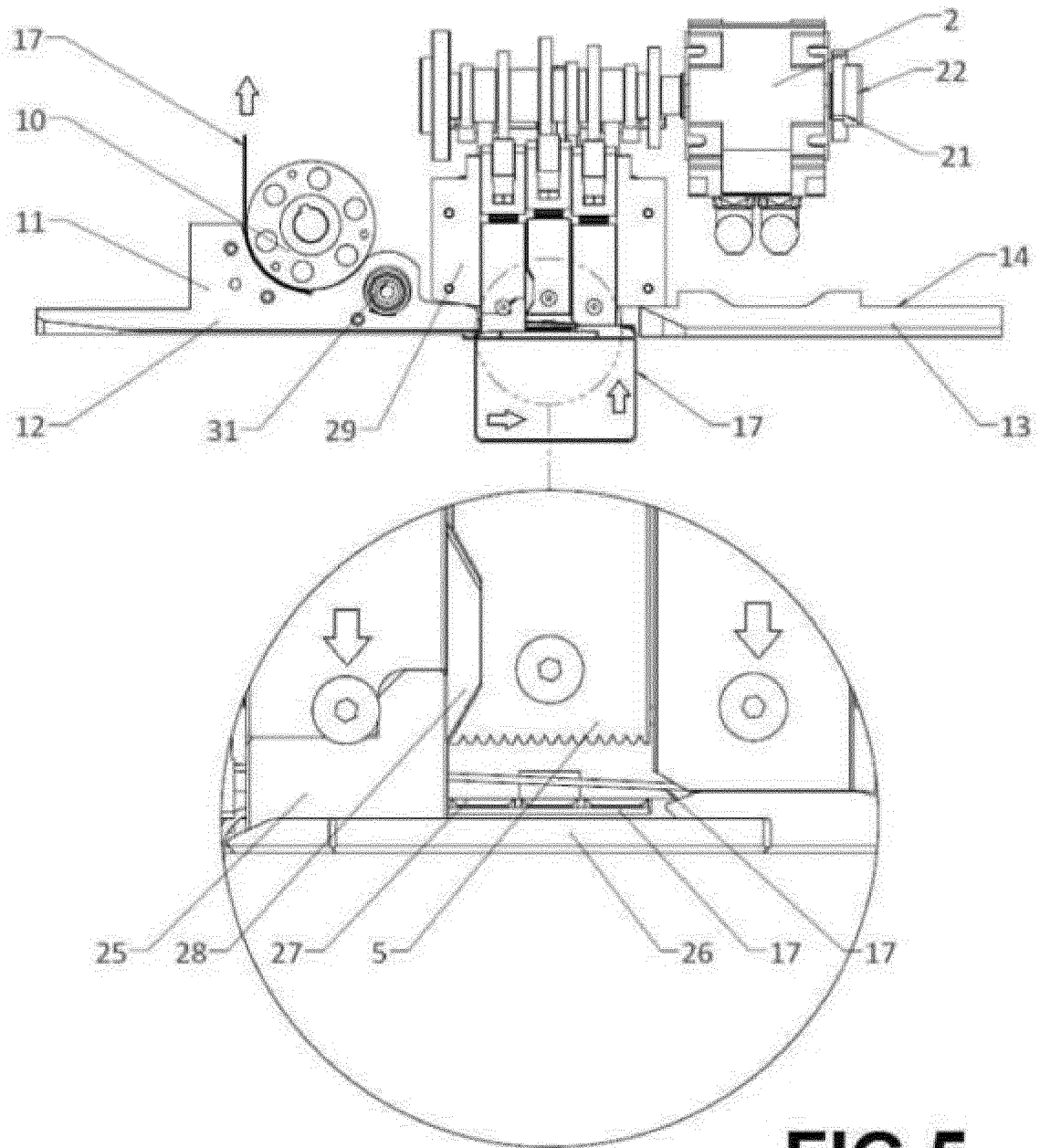


FIG.5

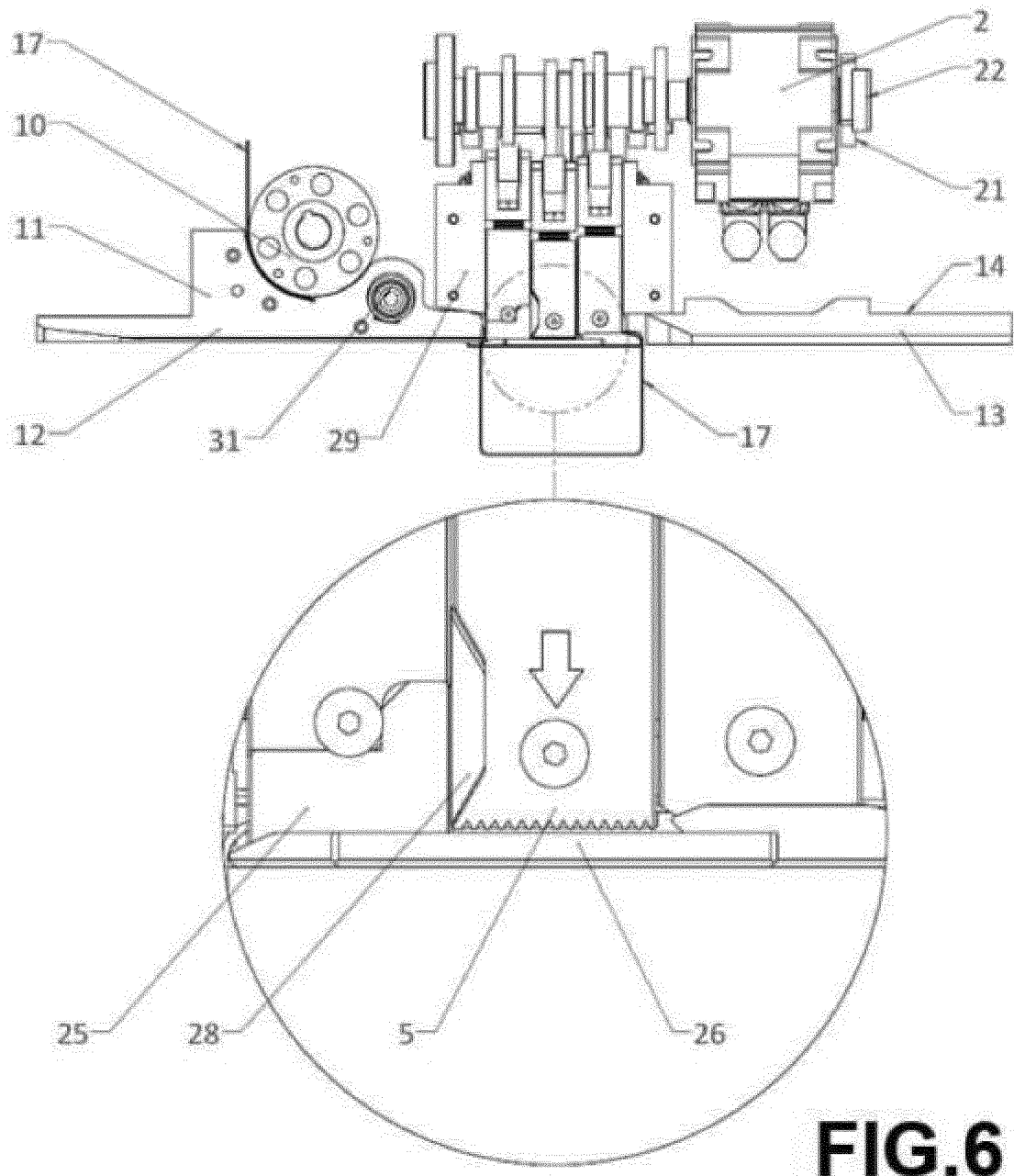


FIG.6

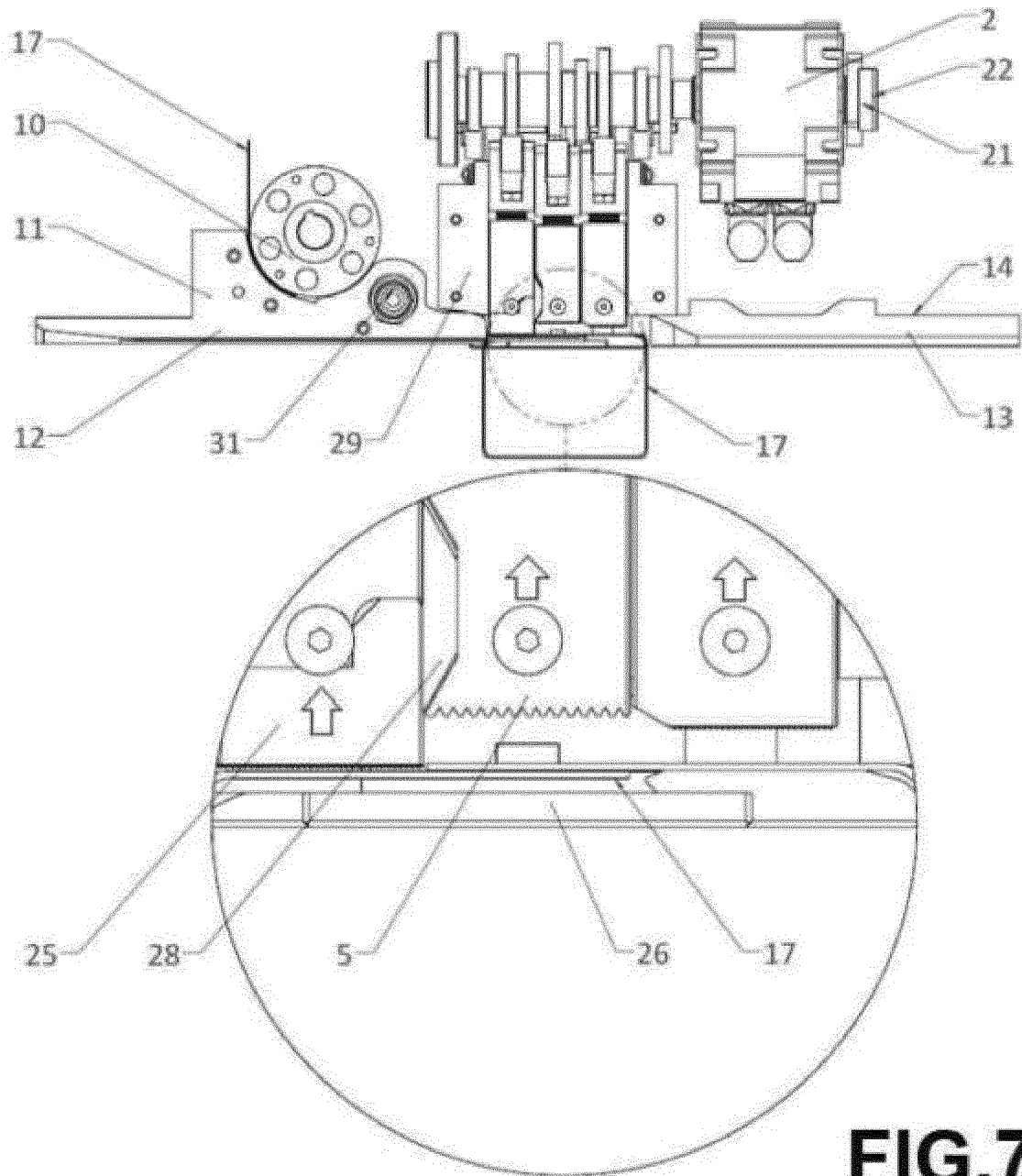


FIG.7

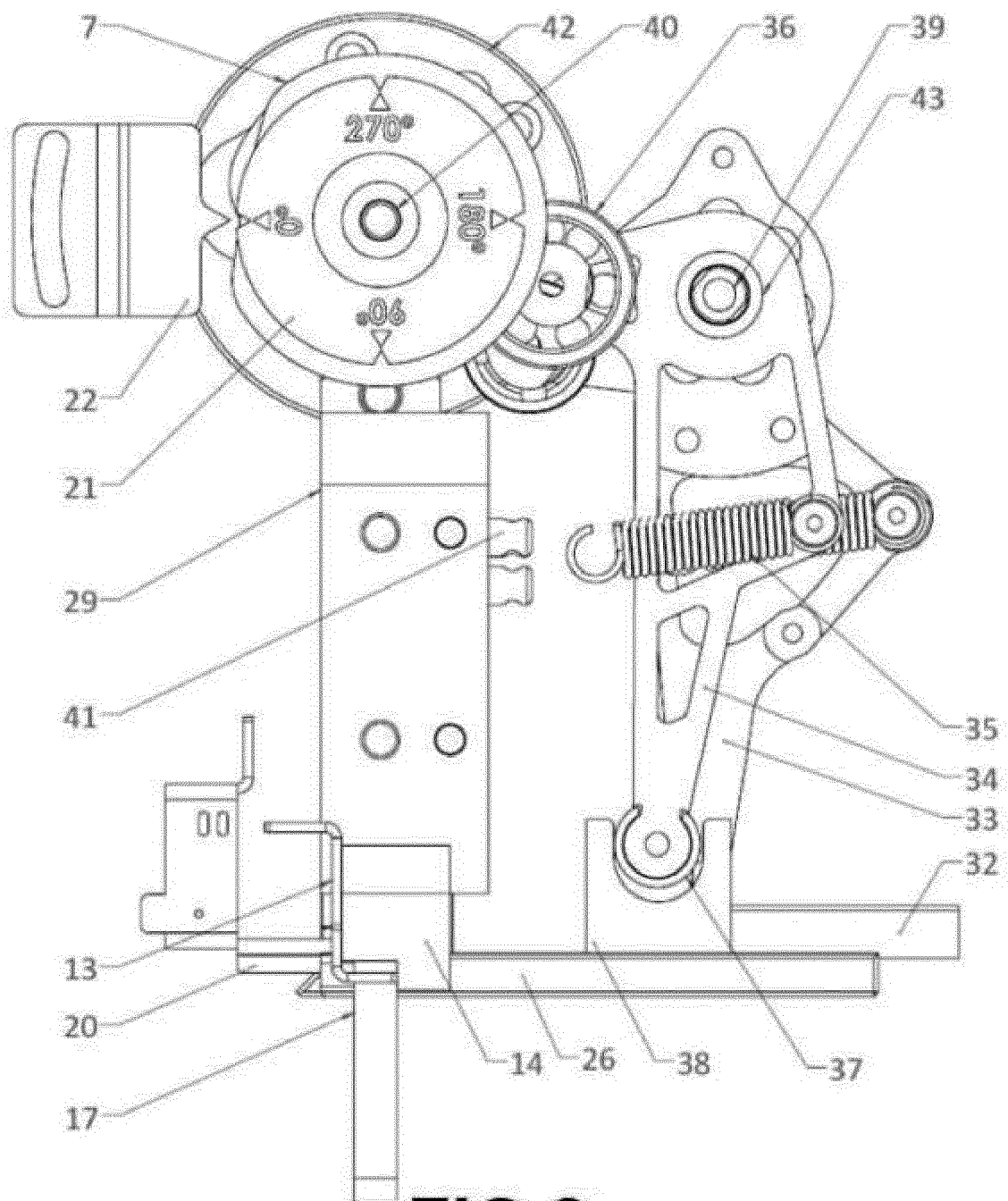
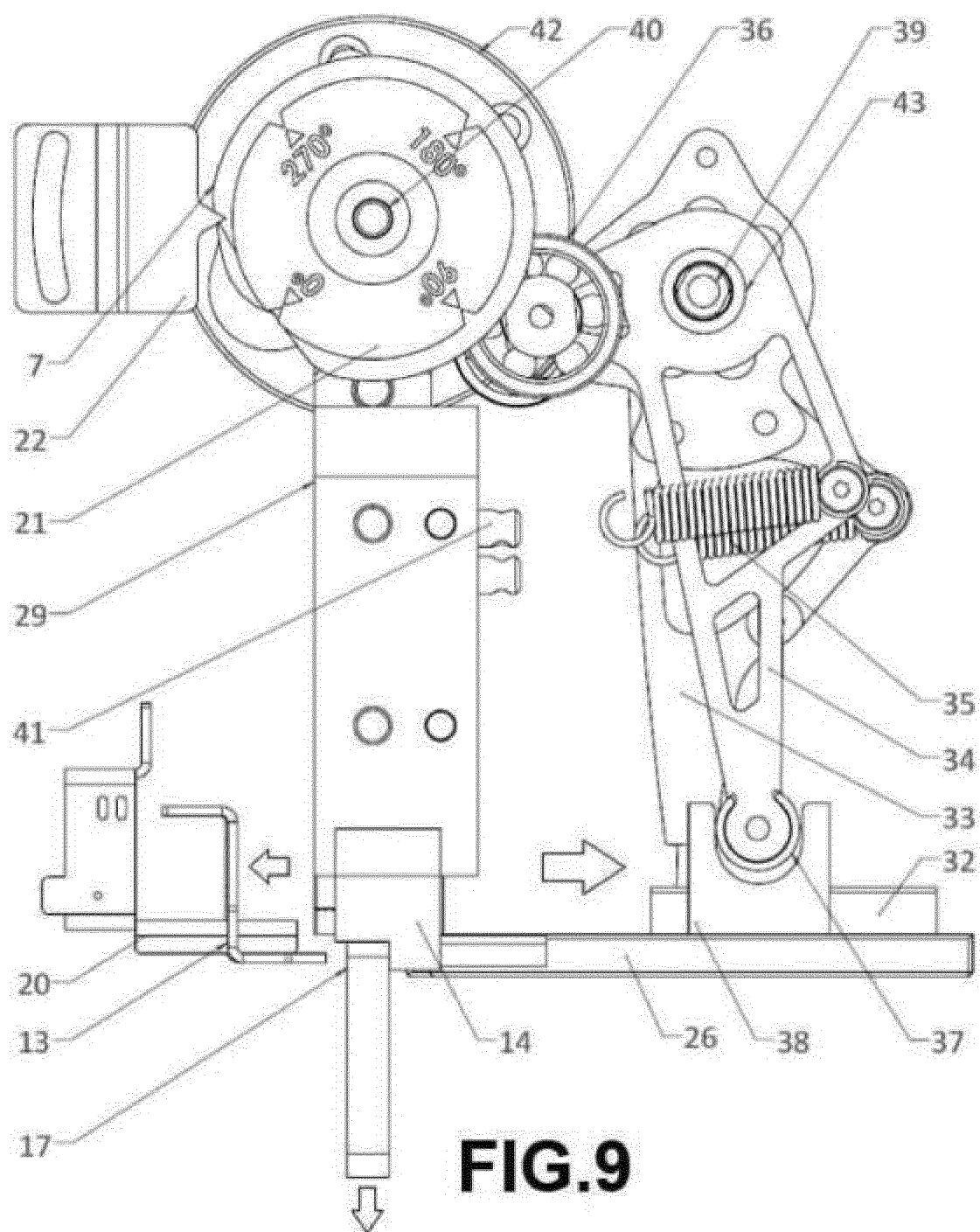


FIG.8



INTERNATIONAL SEARCH REPORT

International application No.
PCT/ES2020/070017

A. CLASSIFICATION OF SUBJECT MATTER

B65B13/18 (2006.01)**B65B13/32** (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B65B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, INVENES

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	US 2018311716 A1 (YEO) 01/11/2018, Abstract; figures	1-14
A	ES 2659966 T3 (OFFICINA MECCANICA SESTESE) 20/03/2018, Claims 1-9, figures (cited in the application)	1-14
A	ES 2351002 A1 (RODA IBERICA) 28/01/2011, Abstract; figures (cited in the application)	1-14

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Date of the actual completion of the international search
06/05/2020Date of mailing of the international search report
(08/05/2020)

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

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Category *	Citation of documents, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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