

(19)



(11)

EP 4 438 286 A1

(12)

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

(43) Date of publication:

02.10.2024 Bulletin 2024/40

(51) International Patent Classification (IPC):

B31D 1/02 (2006.01)

(21) Application number: **21962281.8**

(52) Cooperative Patent Classification (CPC):

B31D 1/02

(22) Date of filing: **27.10.2021**

(86) International application number:

PCT/ES2021/070780

(87) International publication number:

WO 2023/073253 (04.05.2023 Gazette 2023/18)

(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

(72) Inventors:

- **ESTRADA TARRAGO, Franc**
08490 CONERNELLA DE LLOBREGAT (ES)
- **TORRES MONTALVO, Alberto**
08490 CORNELLA DE LLOBREGAT (ES)
- **ROMERO GUILLEN, Ignacio**
08490 CORNELLA DE LLOBREGAT (ES)

(71) Applicant: **Tecnocut, S.L.**

08940 Cornellà de Llobregat Barcelona (ES)

(74) Representative: **Toro Gordillo, Ignacio Maria**

Calle Orense, 32 11-A

28020 Madrid (ES)

(54) **DEVICE FOR POSITIONING DIE-CUTTING ROLLERS IN ROTARY AND SEMI-ROTARY CUTTING MACHINES**

(57) Disclosed is a device for adjusting the relative position between a cutting tool and a counter-die in rotary and semi-rotary machines, which can be installed on either of two cylinders, adjusting the relative position by means of an electromechanical system with an eccentric (15), which eccentric is mounted inside a track (14) and which, upon rotating, allows the position of the

track to be varied with respect to the cylinder on which the device is mounted, and an actuator that rotates the eccentric to adjust the relative position of the cutting tool and the counter-die, wherein an electronically controlled motor (19) acts on the eccentric (15) by means of mechanical speed reduction.

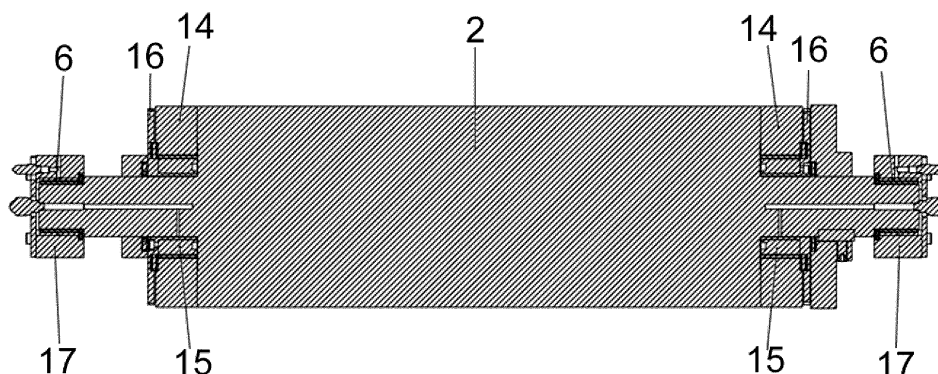


FIG. 4

EP 4 438 286 A1

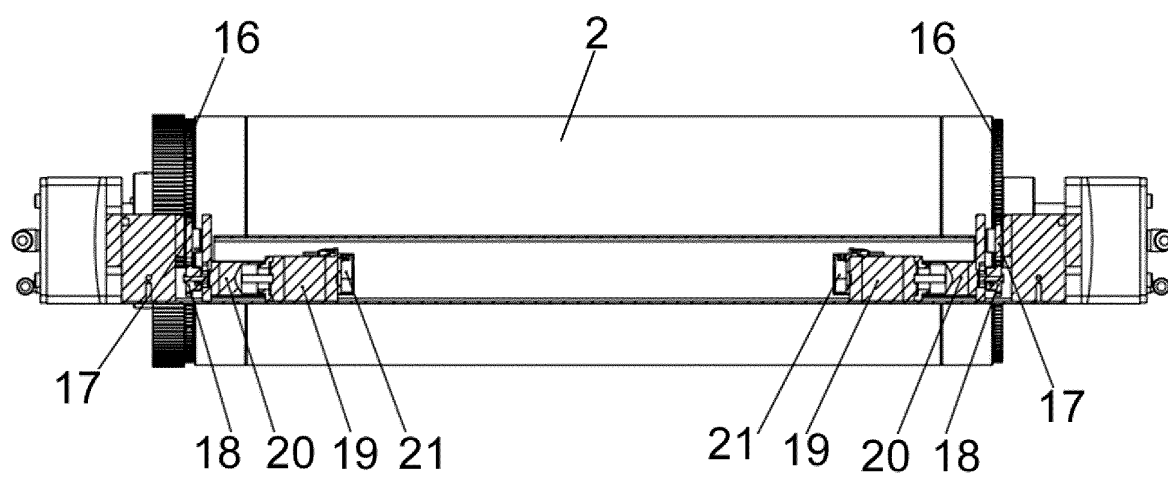


FIG. 5

Description

[0001] Device for positioning die-cutting rollers in rotary and semi-rotary cutting machines.

TECHNICAL FIELD

[0002] The present invention relates to a device to improve the production process in various fields of production that use a rotary or semi-rotary die-cutting process and allows adjusting the space between the cutting tool and the counter-die.

BACKGROUND OF THE INVENTION

[0003] The field of application of the present invention is included in any production sector that requires rotary die-cutting. The invention aims to improve the productivity of the die-cutting unit and facilitate the operator's adjustment of the work. It is therefore an improvement of an existing and widely implemented production technique in different industrial sectors.

[0004] Previously, the most used die-cutting process was flat die-cutting. This type of die-cutting is still used today although its impact in most sectors is reduced. Flat die-cutting consists of a mostly metal flat base and a die that moves perpendicularly to the base. Between the base and the die is placed the material to be die-cut. To achieve die-cutting, the die is moved perpendicularly until it impacts and pressure is applied to perform the cut. The profile of the figure to be die-cut is on the surface of the die. As the movement between base and die is perpendicular, the cutting precision is very high.

[0005] However, in order to increase productivity, rotary dies emerged on the market. These are based on the same principle of applying cutting pressure between a base (counter-die) and a cutting tool (die). By working in a rotary manner, productivity increases although the precision is not as high as in flat dies. To perform a correct cut, the speed of the material to be die-cut must be equal to that of the cutting tool at the die-cutting point. In most flat die-cutting processes, the base where the die impacts are fixed and therefore the material must be stationary to be die-cut. This implies that flat die-cutting is a cyclical process where the position of the material to be die-cut is maintained between the base and the tool and then removed.

[0006] In the rotary die-cutting process, the linear speed of the material and the linear speed of the cutting tools at the cutting point is the same. Therefore, there is a relationship between the linear speed of the material to be die-cut and the cutting tools; this relationship must be controlled mechanically or electronically for the die-cutting process to be successful.

[0007] Since the emergence of the first rotary die groups, their use quickly expanded and replaced flat dies in sectors with large volume products such as the label industry.

[0008] After the emergence of rotary die groups, another important innovation was developed in the technical field. Until then, cutting tools, whether flat or rotary dies, were solid. The shapes to be die-cut were machined on their surfaces. For correct die-cutting, the cutting profiles that cause the cut when pressure is applied to the counter-die must have a certain geometry. This geometry deteriorates over time due to the pressure applied to perform the cut until it no longer performs correct die cutting.

[0009] Once the profile of the solid tool is worn, its surface must be machined again to rectify the profile and make it suitable for work again. The rectification process to repair the cutting tool involves not having it available for a certain time and significant expense in its repair.

[0010] To reduce the costs of re-machining solid dies, magnetic dies emerged. These are cylinders usually made with a stainless steel body in which the central part of the cylinder is covered with magnets. In the margins of the central magnetic zone are the areas of the cylinder that rest with the counter-die and are not magnetic zones. The material of these support areas usually corresponds to some type of hardened and/or hardened steel to prolong its useful life. The magnetic zone of the cylinder has a slightly smaller diameter than the support areas. This reduction is necessary because the so-called magnetic flexible die or magnetic plate is placed on the magnetic zone.

[0011] Whether a solid tool or a magnetic die, different types of cuts can be made.

EXPLANATION OF THE INVENTION

[0012] The present invention relates to a device to improve the production process in various fields of production that use a rotary die-cutting process and allows adjusting the space between the cutting tool and the counter-die.

[0013] More specifically, the device of the invention is applicable in die-cutting groups of two or more rollers whether they work in a horizontal or vertical position and can be applied both in the roller that constitutes the counter-die and in the roller that constitutes the cutting cylinder, whether in solid dies or dies with vacuum extraction or air ejection systems, rotary or semi-rotary, being able to work with very different materials such as cardboard, paper, fabrics, aluminum foil, different types of polymers, etc.

[0014] For this, the device of the invention, which is equally applicable in the cutting cylinder as in the counter-die, comprises a cylindrical body whose central and major sector is of greater diameter than in the necks defined at its ends on which eccentrics are assembled.

[0015] Between the eccentric and the roller, there is a bearing that makes the rotation of the roller independent of that of the eccentric.

[0016] Concentrically surrounding each eccentric is an

element shaped like a ring called a ring or track with the same outer diameter as the central diameter of the roller.

[0017] Similarly, the rotational movements of the eccentrics and the rings are made independent with an intermediate bearing between the two elements. The lateral faces of rings and the main body of the cylinder are in contact and therefore rotate simultaneously.

[0018] Therefore, with this arrangement, rotating the eccentric varies the relative position of the ring concerning the central diameter of the roller.

[0019] Fixed to each eccentric is a toothed crown with a number of teeth such that the outer diameter of the crown is slightly smaller than the outer diameter of the ring or track and the central diameter of the roller. In this way, rotating the toothed crown transmits the movement to the eccentric and, in turn, to the relative position of the ring, track, and roller.

[0020] Meshed with each of the crowns are gears with a number of teeth lower than the crown that determines a mechanical reduction. These gears are linked to a motor on whose shaft a planetary reducer is coupled so that the mechanical reduction established from the motor shaft to the crown movement is high. The mechanical reduction must be sufficiently high for the motor to be able to move the eccentric and at the same time, the system movement is irreversible.

[0021] In this way, rotating the eccentric allows varying the position of the track concerning the cylinder in which the device is mounted.

[0022] Regarding the mechanical reduction described above, it is carried out through an actuator that modifies the position of the eccentric allowing the relative positioning between the die roller and the counter-die to be adjusted even when pressure is applied between the two rollers with irreversible system movement.

[0023] The mechanism thus described will have means to recognize the relative position between the die roller and the counter-die and transmit it to a control unit.

[0024] The control unit is associated with an internal and/or external control interface, manually and/or computerized.

[0025] Through an initial calibration process, a theoretical curve of the adjustment of the space between the cutting tool and the counter-die can be made.

[0026] The device, through the adjustments provided for it, allows performing a full cut, a half cut, or a double-height cut.

[0027] It also allows exchanging the position between the cylinder in which it is installed and the cylinder next to which the cut is made to be able to die-cut the material on the opposite surface.

[0028] The device can be adjusted to leave enough space between the cutting tool and the counter-die, allowing the material to pass between the two cylinders for process preparation.

[0029] Through the control interface, the space between the cutting tool and the counter-die can be ad-

justed discretely or continuously.

[0030] This interface includes means for detecting actuator malfunctions, indicating which one has the fault.

[0031] According to another feature of the invention, the control unit can store data on the adjustment between the cutting tool and the counter-die to use the same configuration in the future.

[0032] This unit allows working in a referenced manner, indicating a specific adjustment position to which it is positioned.

[0033] Additionally, the device can detect a fault in the equipment by performing a calibration process and comparing the results of this process with the data stored in the control unit and alerting of this fault through the interface.

[0034] Finally, through a two-dimensional code shown on the interface, the user can consult relevant information about the device.

DESCRIPTION OF THE DRAWINGS

[0035] To complement the description that will be made below and to help a better understanding of the characteristics of the invention according to a preferred example of practical realization, it is accompanied as an integral part of said description a set of drawings where illustratively and not limitatively the following has been represented:

Figure 1.- Shows a sectional view of a die-cutting group of two rollers in which a device for positioning die-cutting rollers according to the object of the present invention is applicable.

Figure 2.- Shows a view similar to that of figure 1 but in which the die-cutting group includes three rollers.

Figure 3.- Shows a perspective view of the invention set.

Figure 4.- Shows a cross-section of the invention detailing the section where the actuators, planetary reducer, pulse generator, a second reduction with two gears, and a crown are located.

Figure 5.- Finally shows a cross-section through the center of the cylinder detailing the tracks or rings, the eccentrics, and the crowns that participate in the invention device.

PREFERRED EMBODIMENT OF THE INVENTION

[0036] In view of the figures referenced, it can be observed that the present invention consists of a device to improve the production process in various fields of production that use a rotary die-cutting process and allows adjusting the space between the cutting tool and the counter-die. The adjustment of the space be-

tween the cutting tool and the counter-die is done through an electromechanical device.

[0037] This invention allows the operator to enter the desired cutting depth value that exists between the two cylinders (cutting cylinder (1) and counter-die (2)) and modify it to adjust the cut made when the material passes through them.

[0038] In this way, the operator can easily adjust the distance between the two cylinders and work with different material thicknesses and different types of cuts.

[0039] It is worth noting that the space between the cutting cylinder (1) and the counter-die (2) is adjusted on a micrometric scale, which is especially relevant to understand the reason for the different design elements that make up the invention.

[0040] According to figure 1, generally, the arrangement of a die-cutting group consists of a cutting cylinder (1) and a counter-die (2). These two elements are two cylindrical bodies engaged with each other through two gears (3 and 4), each solidary to their respective cylinders to maintain the same linear speed at the point of engagement, which corresponds to the material cutting point that passes through the two cylinders.

[0041] Usually, the counter-die (2) is in a fixed horizontal position and located inside two stands (5). At each end of the counter-die (2), bearings (6) are arranged to allow the rotational movement of the cylinder. These bearings are assembled within elements fixed to the two stands (5), thus fixing the counter-die (2) between the two stands, and the bearings provide it with rotational freedom.

[0042] In die-cutting groups with two rollers, as described and shown in figure 1, the counter-die (2) is usually the drive roller, directly or indirectly transmitting rotation from a motor (7) and transmitting movement to the die through the previously mentioned gear. However, it could equally be configured the other way around.

[0043] The cutting cylinder (1) is positioned over the counter-die (2). Usually, vertical channels are provided in each stand through which the die is inserted vertically until it rests on the counter-die (2). It is crucial to highlight that the contact between the cutting cylinder (1) and the counter-die (2) is only made on the tracks of the respective cylinders. This implies that although the gears of the die and counter-die are engaged, there is some play between them. Additionally, in the space between the two tracks of each cylinder, the tracks are recessed to ensure a minimal distance between them.

[0044] There is a final crucial element that makes die-cutting possible besides the cutting cylinder (1) and counter-die (2). It is necessary to provide some working pressure between the two cylinders, as the weight of the die on the counter-die is usually insufficient to perform the die-cutting. To achieve this working pressure, support bearings (8) are usually provided on the tracks of the cutting cylinder (1). Typically, the position of these bearings is adjusted vertically by a threaded spindle (9) or pneumatic mechanism at a fixed point on the die-cutting

group structure.

[0045] Since the counter-die (2) is in a fixed position mounted on the stands of the station, varying the position of the support bearings (8) on the tracks of the die increases the pressure between the die and the counter-die. Usually, the bearing group with a spindle that adds or removes pressure on the die and counter-die is equipped with a pressure controller with a gauge (10) indicating the applied pressure. This allows the operator to identify if more or less working pressure is being applied during the cut.

[0046] This last element has been described as a threaded spindle at a fixed point on the die-cutting group structure, and its vertical dimension is modified to vary the bearing position. This fixed element is usually referred to as the pressure bridge (11). However, the variation in cutting pressure can be achieved in other ways, such as through a pneumatic piston system that modifies the position of the pressure bridge. In this case, the pressure bridge would be movable, and the gauges would be attached to it.

[0047] There are other solutions where the pressure bridge is also movable, and although the system does not have vertical movement through pneumatic pistons, it allows the operator to mechanically adjust the pressure bridge position according to the required circumstances.

[0048] Regardless of the design and operation, the purpose of this last element is the same in all cases, to apply greater or lesser cutting pressure between the two cylinders.

[0049] Although the arrangement of a die-cutting group with a counter-die (2) and cutting cylinder (1) is very common, there are also other configurations in the technique that are relevant in terms of number, use, and importance.

[0050] For example, the case of a die-cutting group shown in figure 2 involves a cutting cylinder (1), a counter-die (2), and a support cylinder (12). In this case, a third cylinder is added, the support cylinder (12), which would be the lower roller and would be in a fixed position. The counter-die (2) would be placed on it, and the cutting cylinder (1) would be on top.

[0051] This arrangement is very common in rotary machines because having a third lower roller allows the counter-die (2) to rest on the tracks instead of the bearings at its ends. As the counter-die (2) rests on the tracks, the distance between the two supports is shorter than if it rested on the bearings, as is the case with two-cylinder systems. Therefore, the counter-die (2) flexion is reduced. It is crucial that both the counter-die (2) and the cutting cylinder (1) have minimal flexion as it directly impacts the material cut.

[0052] There are also rotary die groups with both two and three cylinders but arranged vertically instead of horizontally, as previously described.

[0053] The configuration and operation follow the same reasoning, although in this case, the weight of the cylinders does not influence the cutting pressure,

as they are positioned vertically, and all the cutting pressure is applied through the pressure bearings.

[0054] Understanding the differences between these configurations is crucial, as the invention described in this document can be installed in all the configurations explained.

[0055] However, the way the device works for each of the detailed configurations is different.

[0056] A first case would be where the invention is installed in a three-cylinder die group and more specifically in the counter-die (2) of figure 2. Remember that in this case, the counter-die (2) is supported by tracks on the support cylinder (12) and, in turn, receives the weight of the die or cutting cylinder (1) which is positioned above it, also through the tracks, and correlatively the resultant of the cutting pressure added by the pressure gauges.

[0057] According to the invention and as shown in figure 3, the device comprises a counter-die body (2). The counter-die has a cylindrical shape, but in the center, it has a larger diameter than at the necks of its ends. On it, eccentrics (15) are assembled on each of the necks at the ends of its body. These eccentrics are mounted on the necks of the cylinder. Between the eccentric and the counter-die, there is a bearing (6) that makes the rotation of the roller independent of the eccentric. It should be noted that depending on the application of the invention, the eccentricity of the eccentric can be more or less pronounced, from tenths of a millimeter to millimeters, to achieve greater or lesser regulation in the cut.

[0058] Concentrically surrounding each eccentric is an element shaped like a ring, hereinafter referred to as a ring or track (14), with the same outer diameter as the central diameter of the counter-die. Similarly, the rotational movements of the eccentrics and the rings are made independent with an intermediate bearing between the two elements. The lateral faces of rings and counter-die are in contact and therefore rotate simultaneously.

[0059] Therefore, with this arrangement, rotating the eccentric varies the relative position of the ring concerning the central diameter of the counter-die.

[0060] Fixed to each eccentric is a toothed crown (16) with a number of teeth such that the outer diameter of the crown is slightly smaller than the outer diameter of the ring or track (14) and the central diameter of the counter-die (2). In this way, rotating the toothed crown transmits the movement to the eccentric and, in turn, to the relative position of the ring, track (14), and counter-die (2).

[0061] Meshed with each of the crowns are gears (17 and 18) with a significantly lower number of teeth than the crown, establishing a mechanical reduction. These gears, either through other gears or directly, are driven by a motor (19) on whose shaft a planetary reducer (20) is coupled, so that the mechanical reduction established from the motor shaft to the crown movement is high. The mechanical reduction must be sufficiently high for the motor to be able to move the eccentric and at the same time, the system movement is irreversible.

[0062] In this first case, with a three-cylinder arrange-

ment where the device is installed in the counter-die positioned in the middle of the three, the element adjusting the relative distance between the cutting cylinders in the device will be the counter-die body (2). Activating the motor rotation (19) moves the mechanism through the previously described transmission. Since the ring or track (14) is constrained in height by the track of the cutting tool and the support cylinder cannot vary in height, the counter-die body is forced to change its height position due to the rotation of the eccentrics (15).

[0063] A second case of applying the invention technique also in a three-cylinder die group is possible. In this case, the invention would also be installed in the counter-die. The difference from the previous case lies in the supports of the counter-die and the support cylinder. In the first case, as previously mentioned, the counter-die rests on the tracks of the support cylinder through the ring; since the ring is constrained in height by the track of the cutting tool and the support cylinder cannot vary in height, the element that moves is the counter-die body. In this second case, the counter-die does not rest on the support cylinder through the tracks but through the body. Therefore, activating the eccentric rotation changes the height of the rings, moving the cutting tool. This movement causes vertical movement of the cutting tool and consequently a variation in cutting pressure.

[0064] A third case of applying the invention, like the previous two with three cylinders arranged vertically, would be as follows. In this case, the invention, unlike the previous two, would be installed in the cutting tool, that is, the one positioned at the top of the three-cylinder die group.

[0065] The rings of the invention installed in the cutting tool rest on the tracks of the counter-die. Activating the device adjustment changes the position of the cutting tool body relative to the counter-die since the vertical position of the rings is fixed by the tracks of the counter-die and the support bearings for adjusting working pressure.

[0066] To understand the utility of this innovation in this third application case, it is necessary to understand the market difference between rotary die groups and semi-rotary die groups. It could be said that the latter are an evolution of rotary die groups to minimize tool costs and reduce machine setup time. Semi-rotary die groups always rotate in the same direction. The cutting tool, whether a solid die or a magnetic die, has its corresponding diameter, implying a specific development. When performing a cutting job, the format must correspond to the development of the cutting tool. Therefore, depending on the dimensions of the task to be performed, the cylinder's development and consequently its diameter will be larger or smaller.

[0067] Always try to match the development of the cutting tool with the size of the figure to be die-cut. If the development of the cutting tool is much larger than the size of the figure to be die-cut, a significant portion of the material passing through the two cutting cylinders will be wasted. Since the desired product is the die-cut part, the

goal is to reduce waste and therefore adjust the size of the figure to be die-cut with the development of the cutting tool.

[0068] That is why, in a production center using magnetic dies to which magnetic plates made to measure are attached to cut the desired figure, different sizes of magnetic dies and plates are available depending on the job.

[0069] Obviously, if the production center has to perform jobs of very varied dimensions, the number of different cutting dies with their corresponding magnetic plates will be high, and therefore the investment required will also be substantial. Additionally, switching from one type of job to another requires changing the magnetic die, which takes a certain amount of time and requires stopping the machine and an operator to change the cylinder.

[0070] To reduce the operation time and achieve higher production, semi-rotary dies were developed. Thanks to a material compensation mechanism and electronic rotation control of the servomotors of the die group, semi-rotary dies adapt the cut of the die cylinder regardless of the size of the magnetic plate used. That is, in semi-rotary die groups, a single magnetic cylinder is installed on which the magnetic plate to be used in each case is adhered. Unlike the rotary die, the magnetic plate does not have to be the same length as the magnetic cylinder; it can be shorter. The unused die space is compensated for by electronic control of the servomotors and the material compensation mechanism.

[0071] It is particularly useful to install the application on a die cylinder of a semi-rotary die group, as this cylinder does not need to be removed from the die group since the same cylinder is used regardless of the format of the job to be cut.

[0072] This third application of the invention can also be applied to solid dies and even to dies with vacuum extraction or air ejection systems. Obviously, they do not have the working flexibility provided by a magnetic die installed in a semi-rotary die group since solid dies and dies with vacuum or air ejection systems are manufactured to perform a specific job. However, these types of dies are used for large runs and to die-cut thick materials.

[0073] A fourth application of the technique, like the third, would involve installing the invention in the die cylinder of a semi-rotary die group. The difference in this case is that the die group consists of two cylinders, one being the counter-die and the other the die cylinder where the invention is installed. The process of adjusting the space between the cutting tool and the counter-die would be the same as the previous case; activating the device adjusts the height of the cutting tool body while the rings remain in the same position since they are constrained in height by the counter-die tracks and the cutting pressure adjustment bearings.

[0074] A fifth application of the invention's technique corresponds to a die group with two cylinders, a counter-die and a cutting tool. In this case, the device is installed in the counter-die. This type of die group is driven by a motor that directly or indirectly drives the lower roller, i.e., the

counter-die. The rotation is transmitted to the cutting tool through the engaged gears mounted on the respective cylinders.

[0075] Therefore, in this case, the counter-die body is fixed in the die group. The ends of the counter-die are usually mounted on bearings, which in turn are mounted on the stands of the die group. Therefore, activating the device movement in this case, the element that moves vertically adjusting the space between the cutting tool and counter-die is not the counter-die body, but the rings of the device mounted on the cutting tool. This fourth configuration is also very common in both rotary and semi-rotary machines, so the possibility of using the present invention for this configuration significantly broadens the invention's application field.

[0076] All the previously detailed cases can be arranged in die groups with cylinders positioned either vertically or horizontally, depending on the die group manufacturer. In any case, the present invention can be installed. Some die groups even have the cutting pressure adjustment system at the bottom instead of the top. The invention can also be applied to this configuration.

[0077] In many die groups, axial registration is common. Axial registration is necessary to adjust the cutting tool's position relative to the material's axial position. In rotary or semi-rotary machines, the material to be die-cut passes through the die group in a specific axial position relative to the machine. If the axial position of the material is not centered with the cutting tool, the cutting process will not be correct. Therefore, axial registration is established, usually in two ways:

- The first way is for the entire die group to have axial registration. In this case, all the elements of the die group would move axially to center themselves with the material path. Usually, the entire die group is mounted on a linear mechanism that allows adjusting the axial position of the group. In this case, all the cylinders of the die group will move axially together relative to the material since they are within the die group.
- The second way is to modify only the axial position of the cutting tool. In this way, the operator can adjust the axial cutting position on the material. Commonly, a mechanical device is installed at the end of the cutting tool closest to the operator, allowing the operator to rotate a knob, which translates this rotation into a linear movement of the cutting tool for axial adjustment.

[0078] In both cases, the present invention can be installed. In the first case, it is straightforward since moving the entire die group does not present any obstacle for the device to function. In the second case, certain important points must be considered during the device's design to ensure that moving the cutting tool

axially does not damage the invention's mechanism and that the die-cutting process is correct. These damages to the mechanism can occur when the cutting tool tracks interfere with the counter-die body. However, rebates can be made at the ends of the counter-die body in the area where the cut is made, where the diameter is larger, to prevent interference when adjusting the cutting tool axially.

[0079] In the different application cases mentioned previously, depending on the characteristics of each die group, the present invention is positioned above or below the material path. This fact does not limit the operation of the invention; it only requires adapting the device control for each case so that the cutting orders are correct. The factor that the user inputs through the interface is to move the cylinder where the invention is installed up or down to increase or decrease the cutting space as needed. Since there are various scenarios where the cylinder can be positioned above or below the material, each case must be considered, and the rotation direction of the invention's motors must be controlled to ensure they rotate correctly.

[0080] For example, in a die group with a counter-die and the present invention installed in the cutting tool, the material will be positioned below the cutting tool. Therefore, when the user inputs the command to lower the cylinder from the interface, it will reduce the distance between the counter-die and the cutting tool. Conversely, if the die group has the present invention installed in the counter-die and a cutting tool, the material will also be positioned between the two cylinders. However, when the user inputs the command to lower the cylinder, it will increase the distance between the counter-die and the cutting tool.

[0081] Similarly, the device adapts flexibly to a series of cases like those discussed so far and offers another intrinsic work possibility. In die-cutting groups, depending on the job to be performed, different types of cuts are required. It may be necessary to make a full cut of the material or only cut one of the different layers that can compose the material. Since this invention allows adjusting the cutting height, the same cutting tool can be used to cut through the material or cut one of its layers. This reduces tool costs for material production in rotary machines. Of course, it is also possible to work with a cutting tool that has different cutting heights and adjust both heights simultaneously thanks to the invention.

[0082] As mentioned, the present invention offers great versatility, allowing it to be installed in machines from different industrial sectors that require a die-cutting process. The labelling sector might be the most recurrent for its application. However, the invention allows installation in any die body from any other application sector. Therefore, it can be installed in rotary machines that work with less common materials such as fabrics, insulating materials, aluminium foil, different types of polymers, etc. Many of these sectors work with high material width measurements, which is not an impediment for the in-

novation to be installed; it only needs to be correctly dimensioned, and the motors moving the regulation must be adjusted according to the required efforts.

[0083] It is also possible that applications with higher-than-usual material thicknesses exist, where it would be interesting for the innovation's adjustment to have a broader range. For these cases, the eccentrics would be designed with greater eccentricity to work in this application without being impeded by high material thicknesses.

[0084] Thanks to the invention's design, in many die groups, it is possible to interchange the cutting tool's position with the counter-die. This interchange is viable in most existing die groups with a support cylinder, a counter-die, and a cutting tool. This possibility lies in the fact that, as previously described, the support cylinder is fixed within the die group, but the other two cylinders are positioned by gravity, and their movement, whether vertical or horizontal, is through channels provided in the die group's stands for this purpose. The possibility of interchanging the cutting tool and counter-die positions, with either cylinder having the innovation installed, allows changing the type of die-cutting. That is, it enables cutting from the top or bottom of the material depending on the job to be performed, while also adjusting the space between the two rollers thanks to the device.

[0085] For all the application cases mentioned previously, the operation of both the mechanical and the electronic and control parts of the invention proceeds in the same manner. As mentioned earlier, the invention consists of two electric actuators piloted through the control unit. A pulse generator is attached to each actuator's shaft to keep track of the device's position. This control requires an initial calibration process during the equipment assembly. The calibration process aims to position the cylinder at a cutting height of 0 microns or, in other words, the point where the tracks and the roller are perfectly concentric. This 0 point corresponds to a specific position of the eccentrics and, consequently, of the crowns.

[0086] To define the working area and facilitate the calibration process, each crown incorporates two mechanical stops that delimit the working area. Within this working range established by the mechanical stops, the equipment is guaranteed to work in both the most cut and the least cut directions.

[0087] At the beginning of the calibration process, the actuators move the crown clockwise to find the lower stop. The PLC detects the lower stop because pulse generation stops. Once the lower stop is detected, the actuators move the crowns counterclockwise to reach the upper stop. During the journey between the two stops, the pulse generator produces a specific number of pulses that the PLC stores for future calibrations, as the journey must be the same. The mid-point is calculated from the journey. This midpoint, due to the mechanical assembly process, usually does not correspond with the 0 point.

Therefore, it is determined what value of pulses must be added or subtracted from the journey as an offset to reach the actual 0 point. This value is also stored in the PLC for future calibrations.

[0088] This process allows the equipment user to perform a calibration process whenever desired. Subsequent calibration processes compare the results with the initial calibration to verify the equipment's correct operation. If the total pulses generated from one mechanical stop to the other do not match the pulses stored in the PLC during the initial calibration, an alarm will be triggered and displayed through the interface to inform the user of a problem with the equipment.

[0089] The pulse generator and the sending and management of information to the PLC also allow showing the user useful details in case of failure or malfunction of the invention. For instance, if one of the actuators does not move due to an external impediment, the PLC may be piloting the actuator to rotate its shaft, but it may not be moving because it is externally blocked. This malfunction can be detected by the pulse generator, as in this specific case, it would not generate pulses and would transmit this information to the PLC. Once the PLC detects that it is sending the movement order to the actuator but does not receive pulse feedback, it will issue a warning through the interface to the user indicating a problem with the specific motor.

[0090] To facilitate the use of the invention by the user and adapt it as closely as possible to their needs, the user can select two operating modes through the interface. The equipment can work in step-by-step mode or continuously. Practically, if the user decides to work in discrete mode, when indicating through the touch interface to move the equipment, it will only move one micron in the direction specified by the user. To move another micron, the user must release and press the indicated area on the screen again. This option is very useful for small adjustments. Conversely, if the user decides to move the equipment many microns to another position, continuous movement mode can be used, where the equipment moves as long as the user applies pressure on the indicated area of the interface.

[0091] There is also a third way to adjust the equipment. Thanks to the initial calibration and the data file provided by the pulse generator to the PLC, the equipment can adjust to a specific position. Therefore, if the user decides to adjust the equipment to a specific position, they can indicate the value through the interface, and the actuators will move the crowns as needed.

[0092] This third adjustment option provided by the invention can be very useful in a very common situation: passing the material to be processed through the machine. When the operator needs to prepare the machine for operation, they must pass the material from the input reel to the output reel. At the point where the operator needs to pass the material through the die-cutting group, there must be enough space between the cutting tool and the counter-die to accommodate the material's thick-

ness. Usually, some die-cutting groups allow the user to mechanically raise the cutting tool to create this space. Other die-cutting groups do not have these mechanisms, requiring the operator to use a crane, which takes a significant amount of time. Using this third adjustment option, the user can command the equipment to adjust to a position where the space between the cutting tool and the counter-die is greater than the material's thickness, facilitating and speeding up the process without requiring the operator to exert effort and speeding up the preparation process.

[0093] Furthermore, once a specific adjustment position has been configured through the interface, the user can save this configuration and store it in the PLC's available memory. This way, if the same job needs to be performed in the future, the user only needs to select the previously saved job through the interface, and the device will adjust to the stored parameters.

[0094] The device interface can be presented in various forms. It can be a dedicated interface for the device with a variable size depending on the user's implementation and positioned at any point on the machine, or it can be integrated directly into an existing machine, eliminating the device's dedicated interface and controlling it from the main equipment. It is also possible to connect from an external device and control it externally for maintenance purposes.

[0095] Moreover, thanks to the device's connectivity and versatility, the user can select the language on the interface and consult the installation and usage manuals through an external device via a QR code displayed on the invention's interface.

[0096] Regardless of the type of die-cutting group and the form of implementation of the control and interface, the innovation allows the operator to adjust the cutting distance between the cutting tool and the counter-die. This allows continued use of the cutting tool even if it wears out, thus extending its useful life.

Claims

1. Device for positioning die-cutting rollers in rotary and semi-rotary cutting machines, in which at least two cylinders are involved, the device being installable in either of the two cylinders, including means for adjusting the relative positioning between said cylinders through an electromechanical system involving eccentrics (15) mounted inside respective tracks (14) that are linked to the cylinder ends through respective smaller diameter necks, the tracks (14) having the same outer diameter as the central diameter of the cylinder on which the eccentrics (15) are applied, the rotation of which varies the position of said tracks (14) relative to the cylinder on which the device is mounted, **characterized in that** each eccentric (15) is electronically controlled through a motor (19) with a mechanical reduction interposed

between them.

2. Device for positioning die-cutting rollers in rotary and semi-rotary cutting machines according to claim 1, **characterized in that** it includes a control actuator for the position of the eccentric with an irreversible mechanical reduction.
con una reduccion mecánica irreversible. 5
3. Device for positioning die-cutting rollers in rotary and semi-rotary cutting machines according to claims 1 and 2, **characterized in that** the mechanical reduction consists of a planetary reducer (20) coupled to the motor shaft (19) linked to the eccentric (15) through a second reduction by a pair of gears (17 and 18) that transmit the rotation to a toothed crown (16) integral with the eccentric (15). 10
4. Device for positioning die-cutting rollers in rotary and semi-rotary cutting machines according to claims 1 to 3, **characterized in that** the toothed crown (16) integral with the eccentric (15) has a number of teeth such that the outer diameter of the crown is slightly smaller than the outer diameter of the ring or track (14). 20
5. Device for positioning die-cutting rollers in rotary and semi-rotary cutting machines according to claim 2, **characterized in that** it includes means for detecting the relative position between the die roller and the counter-die associated with a control unit. 25
6. Device for positioning die-cutting rollers in rotary and semi-rotary cutting machines according to claims 1, 2, and 5, **characterized in that** the control unit is associated with an internal and/or external control interface, manual and/or computerized. 30
7. Device for positioning die-cutting rollers in rotary and semi-rotary cutting machines according to previous claims, **characterized in that** it includes calibration means and obtaining a theoretical curve for adjusting the space between the cutting tool and the counter-die. 40
8. Device for positioning die-cutting rollers in rotary and semi-rotary cutting machines according to previous claims, **characterized in that** it is installed in die-cutting groups with means for driving the cylinder on which the device is installed through an actuator or through a gear. 45
9. Device for positioning die-cutting rollers in rotary and semi-rotary cutting machines according to previous claims, **characterized in that** the adjustment means between the cutting tool and the counter-die define specific positions for performing a full cut, a half cut, or a double-height cut. 50

10. Device for positioning die-cutting rollers in rotary and semi-rotary cutting machines according to previous claims, **characterized in that** it is interchangeable between the cylinder on which it is installed and the cylinder next to which the cut is made. 5
11. Device for positioning die-cutting rollers in rotary and semi-rotary cutting machines according to previous claims, **characterized in that** it is installed in die-cutting groups with axial movement adjustment means for the die-cutting group or only one of its cylinders. 10
12. Device for positioning die-cutting rollers in rotary and semi-rotary cutting machines according to previous claims, **characterized in that** its adjustment means define a limit position in which the separation space between the rollers is at least the same as the material thickness to be processed. 15
13. Device for positioning die-cutting rollers in rotary and semi-rotary cutting machines according to previous claims, **characterized in that** the control interface includes means for discrete or continuous adjustment of the space between rollers. 25
14. Device for positioning die-cutting rollers in rotary and semi-rotary cutting machines according to previous claims, **characterized in that** it includes means for detecting and identifying actuator malfunctions through the control interface. 30
15. Device for positioning die-cutting rollers in rotary and semi-rotary cutting machines according to previous claims, **characterized in that** the control unit includes means for storing the adjustment parameters used. 35
16. Device for positioning die-cutting rollers in rotary and semi-rotary cutting machines according to previous claims, **characterized in that** the control interface includes means for working in a referenced manner from a specific adjustment position to which it can be positioned. 40
17. Device for positioning die-cutting rollers in rotary and semi-rotary cutting machines according to previous claims, **characterized in that** it includes means for detecting failures through its calibration process and comparing the results of this process with the data stored in the control unit and generating alerts through the interface. 45

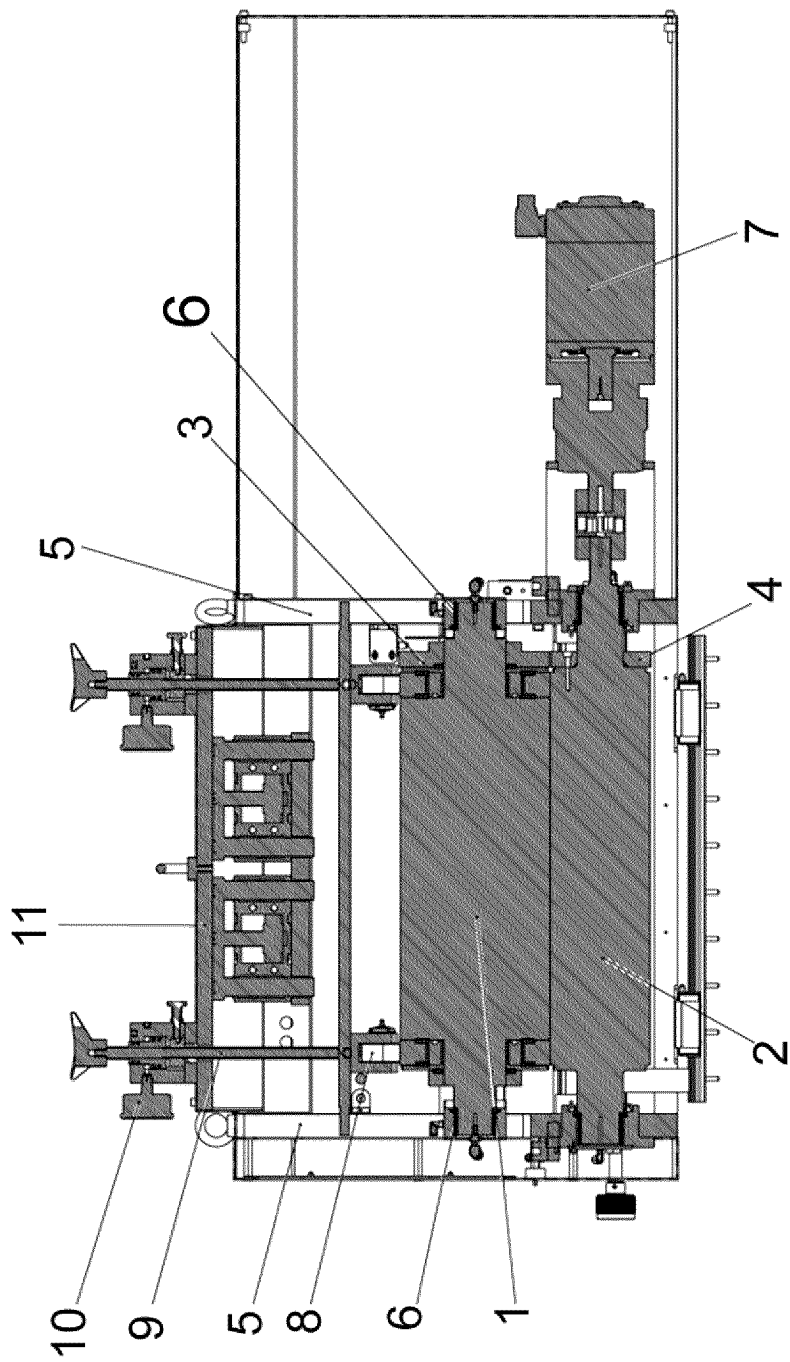


FIG. 1

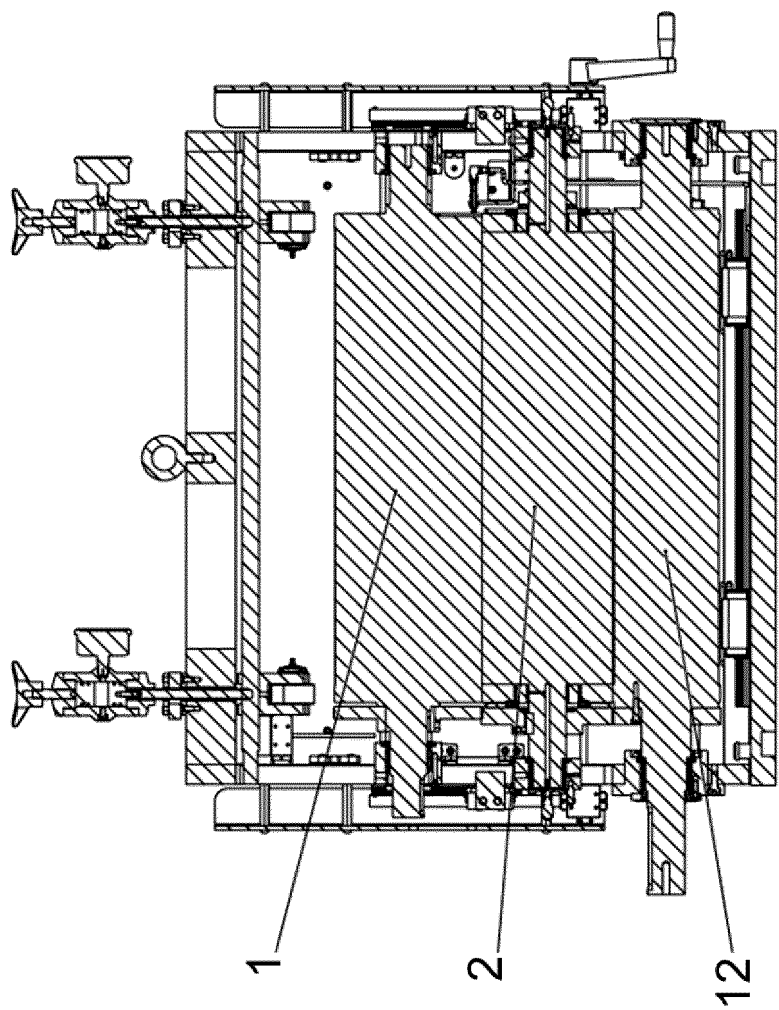


FIG. 2

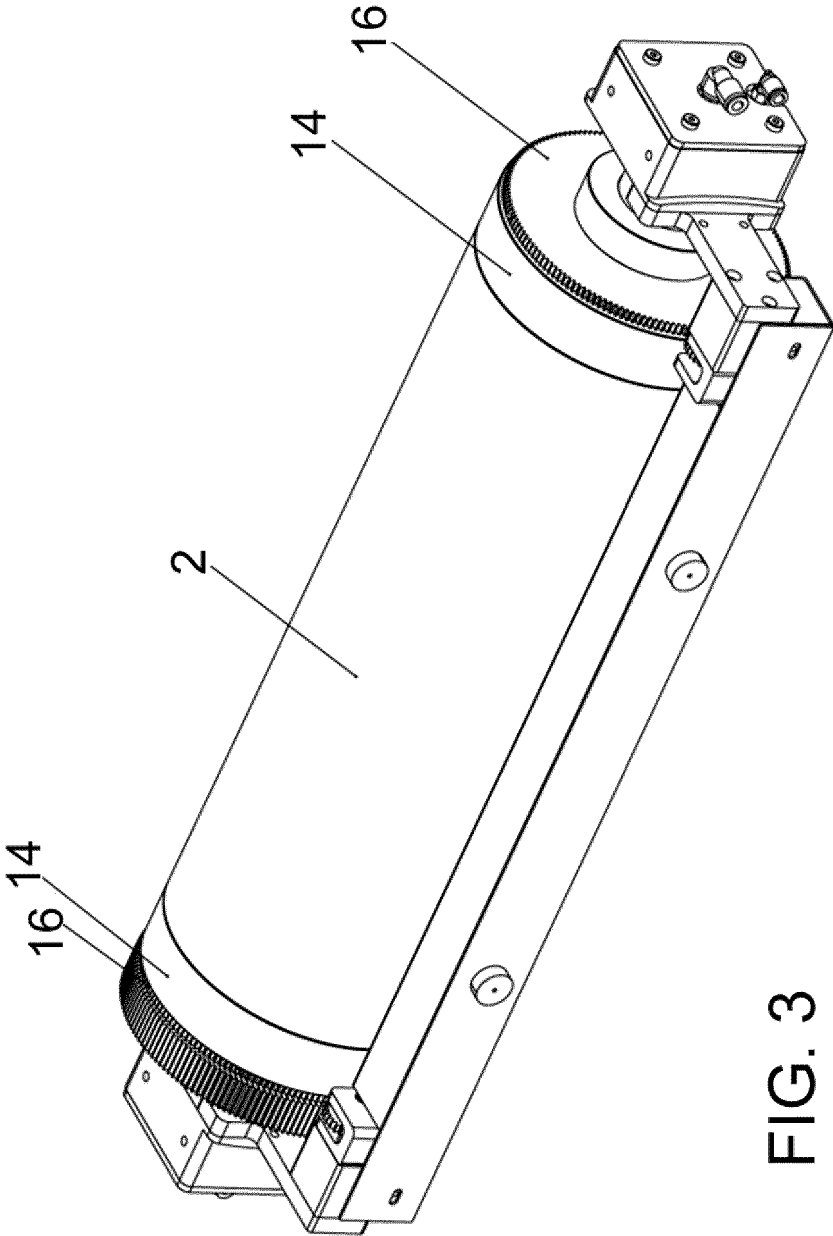


FIG. 3

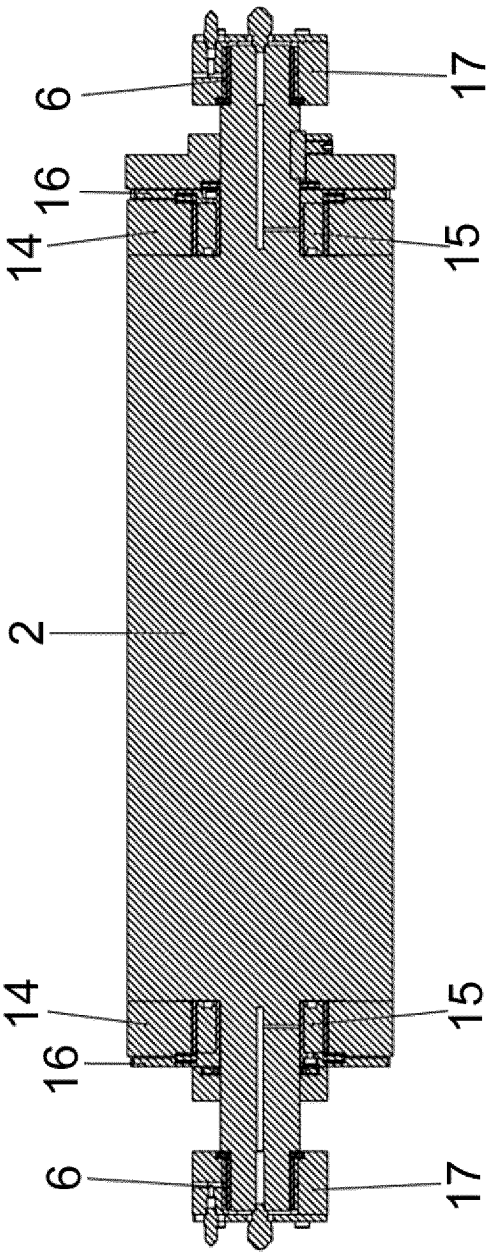


FIG. 4

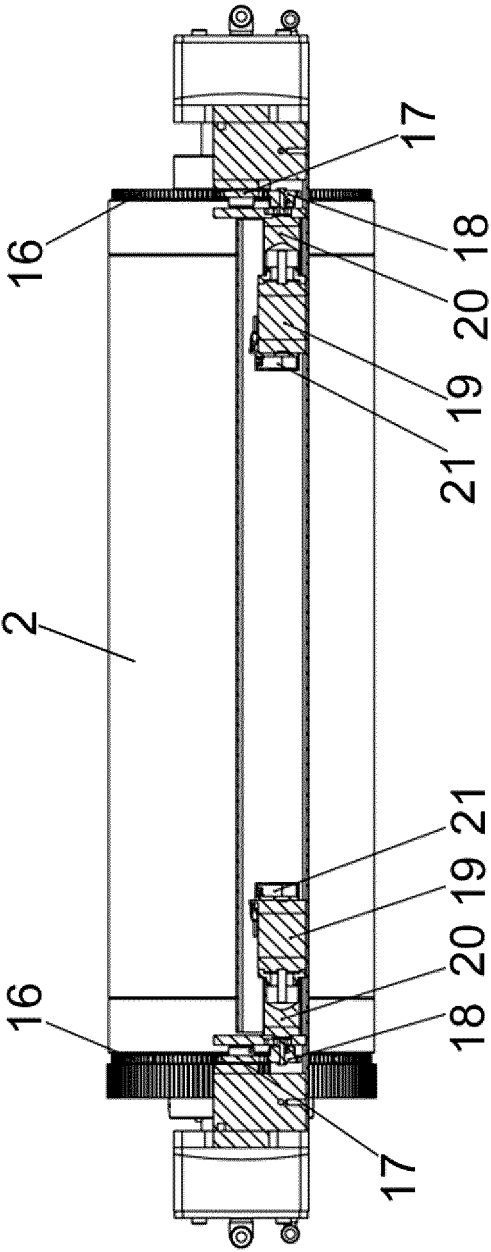


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ES2021/070780

A. CLASSIFICATION OF SUBJECT MATTER

B31D1/02 (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)

B31D

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, WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2020157344 A1 (TECNOCUT, S.L.) 06/08/2020, page 4, line 1 – page 5, line 9; claims 1-4; figures.	1-17
Y	JP 2014083778 A (TOPPAN TDK LABEL CO LTD) 12/05/2014, paragraph 17, figures 3- 5 & Abstract from DataBase EPODOC. Retrieved from EPOQUE; AN - JP-2012235015-A & Abstract from base of datos WPI. Retrieved from EPOQUE; AN - 2014-J03361.	1-17
A	US 1785250 A (HENRY EBERHARDT STANLEY LEOPOL) 16/12/1930, page 3, line 90 - page 4, line 5, figures 12, 13.	1-17
A	GB 532018 A (MAURICE BEZENCENET) 15/01/1941, page 9, lines 39-79; figures.	1-17

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance.

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure use, exhibition, or other means.

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
06/07/2022

Date of mailing of the international search report
(07/07/2022)

Name and mailing address of the ISA/

OFICINA ESPAÑOLA DE PATENTES Y MARCAS
Paseo de la Castellana, 75 - 28071 Madrid (España)
Facsimile No.: 91 349 53 04

Authorized officer
F. Riesco Ruiz

Telephone No. 91 3496869

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ES2021/070780

C (continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of documents, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP S5964295 A (ISOWA INDUSTRY CO) 12/04/1984, figures.	1-17

Form PCT/ISA/210 (continuation of second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/ES2021/070780

Information on patent family members

5

10

15

20

25

30

35

40

45

50

55

Patent document cited in the search report	Publication date	Patent family member(s)	Publication date
WO2020157344 A1	06.08.2020	EP3919264 A1	08.12.2021
JP2014083778 A	12.05.2014	JP6043584B B2	14.12.2016
US1785250 A	16.12.1930	NONE	
GB532018 A	15.01.1941	NONE	
JPS5964295 A	12.04.1984	JPS6258879B B2	08.12.1987

Form PCT/ISA/210 (patent family annex) (January 2015)