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(54) **SETTING DEVICE FOR A BLIND RIVET NUT**

(57) The present invention discloses a setting device for a blind rivet element, comprising an axially displaceable pulling mandrel having a work end and a drive end, wherein the work end includes an outer thread to screw-on a blind rivet nut and the drive end has a coupling structure with which a releasable torque-proof connection with a mandrel drive can be established, comprising the mandrel drive with which the pulling mandrel is rotatable by means of the drive end, comprising a linear pulling drive in an operative connection with the pulling mandrel

with which a linear deformation displacement of the pulling mandrel in the direction of the drive end is implementable deforming a blind rivet nut, and comprising a hollow-cylindrical mouthpiece, which passes the pulling mandrel and which is linearly displaceable parallel to and independent of the pulling mandrel, so that an installation state of a blind rivet nut on the work end of the pulling mandrel is detectable by means of a linear displacement of the mouthpiece.

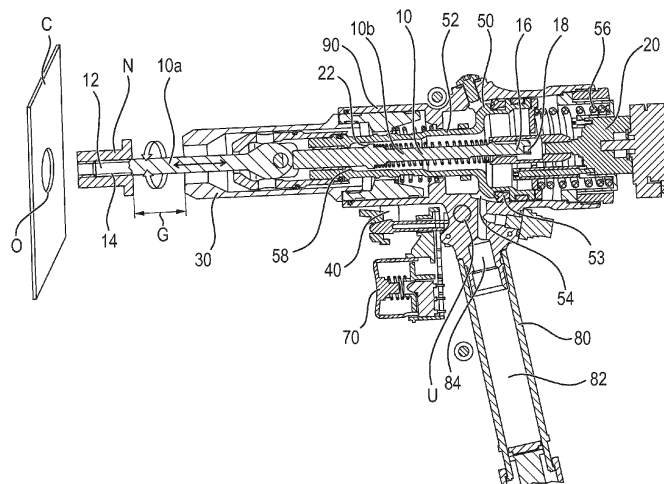


FIG. 2

Description

1. Field of the invention

[0001] The present invention relates to a setting device for a blind rivet nut, either realized by a handheld device or by an automatic setting machine. Furthermore, the present invention relates to a setting method for the blind rivet nut within a component opening by means of a setting device.

2. Background of the invention

[0002] A blind rivet element is typically configured like a blind rivet nut or a blind rivet bolt/screw. Blind rivet nuts typically have a rivet shaft that has an internal thread and a rivet head. A blind rivet bolt has a rivet shaft in which a bolt with an outer thread is arranged. The rivet shaft is inserted into a component opening within which the blind rivet nut or bolt is to be fastened. After positioning the blind rivet nut or bolt within the component opening, an axial tension is applied to the shaft of the blind rivet nut or bolt which causes a compression of the rivet shaft and the fastening of the same within the component opening. Thereafter, a pulling mandrel is unscrewed from the blind rivet shaft or the rivet bolt.

[0003] While the fastening process of a blind rivet nut within the component opening remains the same, the technology of the setting devices varies. These different technologies are described for example in EP 3 144 079 B1, DE 44 06 946 A1, US 5,605,070, EP 2 093 024 B1, and DE 19 45 820 U1. The disclosed technologies of the setting devices support different methods for setting a blind rivet nut within the component opening. According to EP 3 144 079 B1, the blind rivet nut is first manually screwed on the pulling mandrel of the setting device, before the setting process is started. As a consequence, the manual preparation step for of the setting process is ineffective and time-consuming.

[0004] A part of the other technologies favors an automatic screwing of the blind rivet nut on the pulling mandrel before starting the setting process of the blind rivet nut. As described in EP 2 093 024 B1, the blind rivet nut is screwed on the pulling mandrel as soon as the trigger of the setting device is pressed. Thereby, the blind rivet nut is quickly screwed on the pulling mandrel.

[0005] This preinstallation step is fast and time effective. Nevertheless, it often leads to an entrapment of the workers finger between the blind rivet nut and the nose piece of the setting device. Such injuries lead to delays in the working process as well as to a disadvantageous applicability of the setting device.

[0006] It is therefore the problem of the present invention to provide a setting device for a blind rivet nut preventing health risks for the worker using the setting device.

3. Summary of the invention

[0007] The above problem is solved by a setting device for blind rivet element according to independent claim 1. Furthermore, the above problem is solved by a setting method of a blind rivet element with a setting device having a pulling mandrel with an outer work end with an outer or an inner thread according to independent claim 9. Further preferred embodiments, developments and modifications of the present invention are derivable from the following specification, accompanying drawings as well as the pending claims.

[0008] A setting device for a blind rivet element, comprising the following features: an axially displaceable pulling mandrel and a mandrel drive to rotate the pulling mandrel, the pulling mandrel has a work end and a drive end, wherein the work end includes an outer thread to screw-on a blind rivet element configured like a blind rivet nut or an inner thread to screw-in a blind rivet element configured like a blind rivet bolt, and the drive end has a coupling structure with which a releasable torque-proof connection to a mandrel drive can be established, a linear pulling drive in an operative connection with the pulling mandrel with which a linear deformation displacement of the pulling mandrel in the direction of the drive end is implementable deforming a blind rivet element, and a hollow-cylindrical mouthpiece, which passes the pulling mandrel and which is linearly displaceable parallel to and independent of the pulling mandrel, so that an installation state of a blind rivet element on the work end of the pulling mandrel is detectable by means of a linear displacement of the mouthpiece.

[0009] Blind rivet elements configured like blind rivet nuts and blind rivet bolts are widely used in the art and known in construction. They are installed by a setting device which is operated manually or automatically. These setting devices use a pulling mandrel. By rotating the pulling mandrel, the blind rivet nut is screwed on a working end of the pulling mandrel having an outer thread. Alternatively, the pulling mandrel has a hollow working end with an inner thread to screw a blind rivet bolt into the preferred hollow or partly hollow cylindrical working end. The rotation of the pulling mandrel is realized by means of a first drive, e.g. an electric motor. The pulling motion of the pulling mandrel is realized by a second drive displacing the pulling mandrel in a linear direction. For example, an electric drive or a hydraulic drive generates a pulling force for moving the pulling mandrel linearly.

[0010] The operation of the setting device has to preferably guarantee workers safety as well as a monitored installation process of the blind rivet nut or the blind rivet nut generally denoted as a blind rivet element. To this end, the blind rivet element is not unconditionally screwed on or in the pulling mandrel by pushing a trigger or by slightly pushing the pulling mandrel inside the setting device.

[0011] The setting device has a linearly displaceable

mouthpiece which can be shifted parallel to the pulling mandrel. The mouthpiece has a hollow cylindrical shape so that the pulling mandrel extends through the mouthpiece. The pulling mandrel can be shifted or pushed inside the setting device by plugging a blind rivet nut or a blind rivet bolt on the working end of the pulling mandrel. The inside motion of the pulling mandrel into the setting device would not start a mandrel rotation or an on-screwing of a blind rivet nut.

[0012] As a necessary additional condition, the blind rivet element, in particular the blind rivet nut or the blind rivet bolt, has to contact the mouthpiece based on its movement in the direction of the setting device together with the pulling mandrel. The contact between the blind rivet element and the mouthpiece during the motion in the direction of the setting device preferably shifts the mouthpiece together with the blind rivet element to the setting device. The shifting motion of the mouthpiece is detectable to confirm the established contact between the blind rivet nut and the mouthpiece.

[0013] Preferably, a screwing on of the blind rivet nut on the pulling mandrel or a screwing-in of the blind rivet bolt into the pulling mandrel does not start before the gap between the blind rivet element and the mouthpiece was closed. Thereby, the tight on-screwing connection between the blind rivet element and the mouthpiece does prevent any jamming or clamping of the worker's fingers.

[0014] Furthermore, the course of operation preferably assures a precise and controllable positioning of the blind rivet element before on-screwing on or in-screwing in the pulling mandrel. This operation control supports the removal of a blind rivet element from a magazine, or the installation of a blind rivet element pre-positioned in a component opening. According to preferred embodiments of the present invention, it is used in combination with a handheld setting device as well as with an automatic setting machine.

[0015] According to a preferred embodiment of the setting device the mouthpiece is spring-preloaded in a direction facing away from the setting device.

[0016] The hollow cylindrical mouthpiece can be shifted bi-directionally and parallel to the pulling mandrel. In order to prepare the mouthpiece for the contact with the blind rivet element plugged on the mandrel, the mouthpiece is pushed axially away from the setting device by a respective pretension, e.g. realized by a spring. Based on the pretension spring, the mouthpiece is positioned most outwardly in a starting position having no contact with the blind rivet nut or bolt.

[0017] Further preferred, the pretension of the mouthpiece supports close contact to the blind rivet element. Even though contact was established between the blind rivet element and the mouthpiece, a linear shifting of the mouthpiece together with the blind rivet element may take place to or away from the setting device. According to a preferred shifting region covered by a linear movability of the mouthpiece, the mouthpiece can follow a blind rivet element moving away from the setting device

within this shifting region. To this end, the spring or pretension urges the mouthpiece against the blind rivet element keeping the required contact therebetween.

[0018] According to a further preferred embodiment of the setting device, the mouthpiece is guided on the pulling mandrel and/or in a housing of the setting device and a relative movement between the mouthpiece and the housing is detectable by means of a sensor or a switch.

[0019] Further preferred, the setting device is connected to the control device which analyses sensor signals and sends control commands to the setting device based on these sensor signals (see above).

[0020] As emphasized above, the contact between the shiftable mouthpiece and the blind rivet element plugged on the shiftable pulling mandrel forms the preferred starting condition for screwing the blind rivet element on or in the working end of the pulling mandrel.

[0021] In contrast to prior art setting devices, the pulling mandrel is not able to push a switch or initiate mandrel rotation by its axial motion.

[0022] Based on the inventive construction of the setting device, the essential contact between the mouthpiece and the blind rivet element plugged on the pulling mandrel qualifies the start of the on-screwing or in-screwing rotation of the pulling mandrel. The contact is preferably sensed by a shifting of the mouthpiece in the direction of the setting device.

[0023] According to a further preferred embodiment, the contact is sensed if the mouthpiece occupies a certain position to be reached against the spring preloading of the mouthpiece, i.e. if shifted in the direction of the setting device.

[0024] The positioning and/or shifting of the mouthpiece is monitored by a sensor, e.g. a positioning sensor, a hall sensor, a light sensor or the like. According to another preferred embodiment, a switch is used and activated by a movement of the mouthpiece.

[0025] Preferably, the sensor and the switch generate an electric signal dependent on the mouthpiece position. The electric signal is transmitted to a control unit of the setting device for evaluation. In response thereto, the control unit transmits commands to the respective drives of the setting device to control the operation of the setting device.

[0026] Preferably, the setting device is a handheld device or an automatic setting machine.

[0027] The present invention has a compact construction. It is preferably used in a handheld device or in an automatic setting machine. The preferred variability of the setting device results from the fact, that a controlled pre-installation of the blind rivet element on or in the pulling mandrel is advantageous for processes using handheld devices, and for processes automatically realized.

[0028] With respect to handheld setting devices, safety measures are easily implemented. Thereby, employees are protected and handling processes are improved. With respect to automatic setting machines, processing chains are made more efficient. This results from the self-

control effect of the shiftable mouthpiece, the position of which is sensed and reported to the control unit. In response, the process of blind rivet nut setting is accelerated, and its reliability is improved.

[0029] According to different preferred embodiments of the present invention, the linear pulling drive is a hydraulic piston-cylinder-drive, the piston of which is displaceable in the direction of the drive end against an axial spring-preload. Alternatively preferred, the linear pulling drive is a linear motor with which the pulling mandrel is displaceable in a torque-free manner against an axial spring-preload in the direction of the drive end.

[0030] The present invention further discloses a setting method of a blind rivet nut, in particular with a setting device according to one of the above described alternatives, with a setting device having a pulling mandrel with an outer work end with an outer thread or an inner thread, wherein the setting method comprises the following steps: plugging a blind rivet element on the outer work end of the pulling mandrel, axially displacing the non-rotating pulling mandrel with the plugged-on blind rivet element in the direction of the setting device, further axially displacing the non-rotating pulling mandrel with the plugged-on blind rivet element until the blind rivet element abuts or contacts an axially displaceable mouthpiece of the setting device, and mutual axially displacing of the blind rivet element together with the mouthpiece in the direction of the setting device, screwing-on of the blind rivet element on or screwing-in of the blind rivet element into the work end of the pulling mandrel after the displaceable mouthpiece has been displaced by a defined way or shifted from its starting position in the direction of the setting device, and fastening the blind rivet element in a component opening by crimping the blind rivet element.

[0031] The inventive setting method for a blind rivet element is based on the above-described construction and function of the displaceable hollow cylindrical mouthpiece. Due to the pretensioned starting position of the mouthpiece, the mouthpiece can be initially only shifted in the direction of the setting device or the automatic setting machine, i.e. in the direction of the drive end of the pulling mandrel.

[0032] According to the preferred construction of the setting device, the blind rivet element is plugged on the pulling mandrel without initiating rotation of the mandrel. Even if the pulling mandrel is shifted inside the setting device, a start of an on-screwing or in-screwing rotation of the pulling mandrel is not initiated. Instead, a defined positioning of the blind rivet element, in particular a blind rivet nut or a blind rivet bolt, in contact with the mouthpiece is awaited before starting any on-screwing or in-screwing process. To this end, the mouthpiece is shifted in the direction of the setting device.

[0033] The amount of shifting of the mouthpiece for initiating and on/in-screwing is defined according to different alternatives of the present invention.

[0034] If the mouthpiece is shifted out of its starting

position, the pulling mandrel is rotated for on-screwing of the blind rivet nut or in-screwing of the blind rivet bolt.

[0035] If the mouthpiece is shifted by a predefined distance in the direction of the setting device, the pulling mandrel is rotated for an on-screwing of the blind rivet nut or an in-screwing of the blind rivet bolt.

[0036] Based on the preferred co-axial arrangement of the mouthpiece and the shiftable pulling mandrel the above-noted alternative shifting of the mouthpiece can only be realized by a blind rivet nut or a blind rivet bolt contacting or abutting the mouthpiece.

[0037] According to a preferred embodiment of the inventive setting method, it has the further step: detecting the axial displacement of the mouthpiece in the direction of the setting device with a sensor or a switch.

[0038] The position change of the mouthpiece is monitored by a sensor or a switch. Each technical solution efficiently supports the start of the on-screwing of the blind rivet nut or the in-screwing of the blind rivet bolt based on a respective contact with the mouthpiece.

[0039] According to a preferred embodiment of the inventive setting method, it has the further step: monitoring a displaced position of the mouthpiece during the screwing-on of the blind rivet nut or the screwing-in of the blind rivet bolt and terminating the screwing-on or the screwing-in when the displaced position changes outside a predetermined tolerance range.

4. Short description of the drawings

[0040] In the following, the present invention will be described in detail based on the accompanying drawings. In the drawings, the same reference signs denote the same elements and were components. Furthermore, the drawings illustrate preferred embodiments as well as modifications and further developments of the present invention. It shows:

Figure 1 a handheld setting device according to a preferred embodiment of the present invention indicating two preferred mandrel configurations: a) having a work end with an outer thread for screwing-on a blind rivet nut, or b) having a hollow work end with an inner thread for screwing-in a blind rivet bolt,

Figure 2 a sectional view of the inventive setting device according to a preferred embodiment,

Figure 3 an enlarged sectional view of a preferred construction of the inventive setting device,

Figure 4 a preferred illustration of the shiftable mouthpiece combined with a slide,

- Figure 5 a preferred sectional view of the present invention illustrating the preferred inner construction close to the mandrel drive,
- Figures 6 to 12 different preferred schematic illustrations of the steps of the inventively preferred setting method for setting a blind rivet nut within an opening of a component and
- Figure 13 a flowchart of a preferred embodiment of the inventive setting method for a blind rivet nut.

5. Detailed description of preferred embodiments

[0041] Figure 1 shows a preferred embodiment of a handheld setting device 1. It has a pulling mandrel 10 with a working end 12. The working end 12 of the pulling mandrel 10 is surrounded by a shiftable mouthpiece 30. Furthermore, the preferred handheld setting device 1 of figure 1 has a handle 80 for carrying and moving the setting device 1. On one end of the elongated handle 80, the housing 90 of the setting device 1 has a T-shape. The T-shaped housing part 92 contains constructive components for operating the pulling mandrel 10 and the mouthpiece 30 as described in further detail below.

[0042] Figure 1 illustrates two preferred embodiments of the pulling mandrel 10; 10'. According to the preferred alternative a), the working end 12 of the pulling mandrel 10 has an outer thread 14 to screw-on a blind rivet nut N. According to the further preferred embodiment b), the pulling mandrel 10' has a hollow working end 12' which is preferably hollow cylindrically shaped. Within the hollow working end 12', an inner thread 14' is provided to screw-in a blind rivet bolt B into the hollow working end 14'.

[0043] Opposite to the T-shape housing part 92, the handle 80 is connected to a retaining part 94 of the housing 90. The embodiments of the setting device 1 differ for example in the driving component used for linearly moving the pulling mandrel 10; 10' in a pulling motion. According to one preferred embodiment of the present invention as described in greater detail below, the pulling driving component is a hydraulic drive. The hydraulic drive has a hydraulic reservoir retained in the retaining part 94 of the housing 90.

[0044] According to a further preferred embodiment of the present invention, the setting device 1 uses at least one electric drive for rotating the pulling mandrel 10; 10'. Additionally, an electric linear drive is used providing a linear motion of the pulling mandrel 10; 10'. Preferably, the linear drive is connected to the pulling mandrel 10; 10' to realize a plastic deformation of the blind rivet element, in particular the blind rivet nut N and the blind rivet bolt B, screwed on/in the working end 12; 12' of the pulling mandrel 10; 10'.

[0045] In order to supply electric energy to the above-mentioned electric driving component, a battery or a rechargeable battery is retained in the retaining part 94 of the housing 90.

5 **[0046]** In the following, the inventive setting device 1 as well as the inventive setting method of the blind rivet element N; B are described with a preferred reference to the setting device 1 in combination with a blind rivet nut N. The description of the setting device 1 and the setting method used for processing a blind rivet nut N are analogously illustrating and explanatory as well as applicable for the preferred setting device 1 adapted to a blind rivet bolt B and the respective setting method. Therefore, the following details illustrate both alternatives a), b) of the preferred setting device 1 and the related setting method.

10 **[0047]** Figure 2 shows a preferred inner construction of the inventive setting device 1. The inner construction used for setting blind rivet nuts N within an opening O of a component C is used in the handheld setting device 1 as well as in an automatic setting machine.

[0048] Thus, the technical elements as well as their technical functioning as described in the following represent the configuration of the handheld device 1 and of the automatic setting machine.

25 **[0049]** Within a housing 90, the pulling mandrel 10 is movably arranged. According to the preferred embodiment shown in figure 2, the pulling mandrel 10 has an elongated structure which is made of two parts 10A, 10B. Alternatively, it is also preferred to provide the pulling mandrel 10 as a single integral part.

30 **[0050]** The pulling mandrel 10 furthermore has the working end 12. On the outside thereof, an external thread 14 is positioned to screw-on a blind rivet nut N.

35 **[0051]** Opposed to the working end 12, the pulling mandrel 10 has a driving end 16 comprising a coupling structure 18. The coupling structure 18 makes a torque-proof connection to a mandrel drive 20. The mandrel drive 20 preferably consist of an electric motor or a pneumatic motor or a hydraulic motor. According to the coupling structure 18, only a rotation of the mandrel drive 20 is transferred to the pulling mandrel 10 for a screwing-on of the blind rivet nut N on/off the working end 12.

40 **[0052]** According to a preferred constructive alternative of the present invention (not shown), the mandrel drive 20 is adapted to generate a rotation and a linear motion of the pulling mandrel 10. The linear motion is used to plastically deform the blind rivet nut N within the component opening O. To this end, the coupling structure 18 provides an additional linear coupling to displace the pulling mandrel 10 along its longitudinal axis. According to an embodiment of the present invention, the mandrel drive 20 is supported by a linear motor (not shown) realizing the linear displacement of the pulling mandrel 10.

45 **[0053]** As shown in figures 2, 3, 5, the setting device 1 has a hydraulic drive 50 realizing the linear pulling motion of the pulling mandrel 10. To this end, a connection structure 22 of the pulling mandrel 10 makes an operative connection to a hydraulic piston 52 which is guided in an

inner cylinder structure 54 of the housing 90. Preferably, the hydraulic piston 52 has a surrounding gasket 53 to make a hydraulic chamber within the cylinder structure 54.

[0054] To operate the hydraulic drive 50, hydraulic fluid is pumped from a hydraulic reservoir 82 within the handle 80 into the inner cylinder structure 54 in the housing 90. The hydraulic reservoir 82 is connected via tubes 84 with the inner cylinder structure 54. The hydraulic fluid enters the inner cylinder structure 54 to generate an inner hydraulic pressure within the inner cylinder structure 54. Based on the acting hydraulic fluid, the hydraulic piston 52 is pushed and displaced in the direction of the drive end 16 against a piston spring 56 pre-loading the inner cylinder structure 54.

[0055] The connection structure 22 of the pulling mandrel 10 preferably makes a linear operative connection with a piston connection structure 58 so that the inner cylinder structure 54 drags the pulling mandrel 10 in the direction of the working end 16 of the pulling mandrel 10. The linear dragging force applied by the hydraulic drive 50 is used for plastically deforming the blind rivet nut N within the opening O of the component C during the setting process. As best seen in figure 4, the cooperating connection structure 22 and the piston connection structure 58 each provide an undercut realizing the above dragging function.

[0056] The pulling mandrel 10 has a longitudinal axis L, and it is displaceable arranged along the axis L within the housing 90. Additionally, the pulling mandrel 10 can be rotated clockwise and anticlockwise. The preferred moveability of the pulling mandrel 10 is illustrated by arrows in figure 2.

[0057] Although the pulling mandrel 10 can be displaced along its longitudinal axis L, it is not intended to operate a switch or a similar construction by the pulling mandrel. Therefore, the pulling mandrel 10 preferably realizes mechanical interacting functions, but no electrical function in combination with electric components.

[0058] If a blind rivet nut N is plugged on the working end 12 of the pulling mandrel 10, the pulling mandrel 10 is pushed and displaced in the direction of the drive end 16 of the pulling mandrel 10. No rotation of the pulling mandrel 10 starts by this longitudinal displacement of the pulling mandrel 10. The pulling mandrel 10 is pushed in the direction of the drive end 16 until the blind rivet nut N, preferably the circumferential collar K thereof, makes contact with the linearly displaceable mouthpiece 30. The displaceable mouthpiece 30 is made of a single part or a combination of parts.

[0059] As shown in figures 2-4, the mouthpiece 30 is connected to an inner slide 32 arranged in the housing 90. The mouthpiece 30 is pretensioned by a spring 34 in the direction of the working end 12. Furthermore, a linear displacement of the slide 32, and thus of the mouthpiece 30 is sensed by a sensor 40. If the mouthpiece 30 is contacted by the blind rivet nut N and shifted in the direction of the drive end 16, the sensor 40 generates a

qualifying electrical signal which is sent to a control unit U of the setting device 1.

[0060] The sensor 40 may realize the monitoring of the mouthpiece displacement based on different constructions. Preferably, the sensor 40 is a position sensor sensing the position change of the mouthpiece 30 and/or the slide 32 relative to the housing 90. According to another embodiment, it is a light sensor 40 or a hall sensor 40 which is able to monitor the displacement of the mouthpiece 30 and/or the slide 32.

[0061] According to a further preferred embodiment, the sensor 40 performs like a switch. It preferably switches to on based on the displacement of the mouthpiece 30 and/or slide 32 by the blind rivet nut N, or it switches to off if no displacement is sensed.

[0062] Based on the sensor signal transmitted to the control unit U and qualifying a displacement of the mouthpiece 30 and/or the slide 32 in the direction of the drive end 16, the control unit U learns that a gap G is closed between the mouthpiece 30 and a blind rivets nut N plugged on the pulling mandrel 10 and pushed in the direction of the drive end 16. Based on the closed gap G, the control unit U starts the mandrel drive 20 in order to screw the blind rivet nut N on the external thread 14 of the working end 12 of the pulling mandrel 10.

[0063] Preferably, the control unit U monitors the torque of the mandrel drive 20 while on-screwing the blind rivet nut N. If the torque exceeds a predefined torque value, the blind rivet nut N is tightly screwed against the mouthpiece 30 and/or the sensor or switch is still activated.

[0064] Under this condition, the control unit U stops the rotation of the mandrel drive 20, and the preinstalled blind rivet nut N is ready to be plastically deformed or crimped within the opening O of the component C.

[0065] According to a preferred embodiment of the present invention, the control unit U monitors the position change of the mouthpiece 30 and/or the slide 32 by means of the sensor 40 during the on-screwing of the blind rivet nut N on the pulling mandrel 10. The monitoring is intended to guarantee that the gap G remains closed until completion of the on-screwing process of the blind rivet nut N. Thereby, it is assured that the operator of the setting device 1 will not jam his/her fingers in the gap G.

[0066] Further, it is preferably assured that the blind rivet nut N is optimally positioned for later fastening in the component opening O. To this end, a tolerance range of the position of the mouthpiece 30 and/or the slide 32 during on-screwing of the blind rivet nut N is availably stored in the memory of the control unit U.

[0067] If the sensor 40 functions as a switch, the switch has to stay on "gap-closed" for the complete on-screwing process of the blind rivet nut N.

[0068] If the sensor 40 indicates to the control unit U that the permissible tolerance range was left or that the switch turned to "gap-open", then the control unit U stops the rotation of the pulling mandrel 10. Preferably, the blind rivet nut N is re-positioned and the process re-started.

[0069] After the successful pre-installation of the blind rivet nut N on the working end 12 of the pulling mandrel 10, the blind rivet nut N is positioned in the opening O of the component C. Thereafter, a trigger 70 is pressed by an operator of the handheld setting device 1. With respect to the automatic setting machine, a robot informs of the control unit U about the completed positioning of the blind rivet nut N in the component opening O. Based on the trigger actuation or the positioning information, the control unit U starts the hydraulic drive 50 so that the pulling mandrel 10 is pulled in the direction of the drive end 16. Thereby, the blind rivet nut N is plastically deformed and fastened within the opening O.

[0070] The setting process of the blind rivet nut N is described based on the schematic drawings shown in figures 6 to 12. The reference signs refer to the same elements as discussed above.

[0071] A flowchart illustrating a preferred embodiment of the setting method is shown in figure 13.

[0072] Figure 6 shows a schematic generalization of the above-described setting device 1. The general description of the setting method applies in the same manner to the handheld setting device 1 as well as to the automatic setting machine.

[0073] The pulling mandrel 10 is rotated by the mandrel drive 20. Inside the housing 90, the pulling mandrel 10 can be displaced in the direction of the drive end 16 adjacent to the mandrel drive 20. The hydraulic piston 52 carries out the pulling motion of the pulling mandrel 10, and the displaceable mouthpiece 30 identifies the presence of a blind rivet nut N to be pre-positioned on the working end 12. A hydraulic fluid is transferred by means of a driven piston 62 from a reservoir 60 to the inner cylinder structure 54. The piston 62 is moved by the drive 64.

[0074] First, the blind rivet nut N is plugged on the working end 12 of the pulling mandrel 10. The same situation occurs if a robot (not shown) picks up a blind rivet nut N from a magazine (Figure 7, step S1).

[0075] Plugging the blind rivet nut N on the working end 12 does not start a rotation of the pulling mandrel 10.

[0076] After the plugging on of the blind rivet nut N on the pulling mandrel 10, the pulling mandrel 10 is pushed or displaced in the direction of the drive end 16 of the pulling mandrel 10 (step S2). Thereby, the gap G is reduced between the blind rivet nut N and of the mouthpiece 30 (Figure 8).

[0077] After realizing a contact between the blind rivet nut N and the displaceable mouthpiece 30, the mouthpiece 30 is at least slightly shifted to the drive end 16 (Figure 9, step S3).

[0078] The combined displacement of the blind rivet nut N and the mouthpiece 30 is sensed by the sensor 40. The sensor 40 transmits a corresponding signal to the control unit U. In response thereto, the control unit U starts an on-screwing rotation of the mandrel drive 20 as illustrated in figure 9 (step S4).

[0079] While the blind rivet nut N is screwed on the

external thread 14 of the working end 12 of the pulling mandrel 10, the sensor 40 preferably monitors the position of the mouthpiece 30. The sensor signal representing the position of the mouthpiece 30 is preferably transferred to the control unit U. If the monitoring reveals a mouthpiece position outside a predetermined tolerance range, then the control unit U terminates the on-screwing process of the blind rivet nut N (step S7).

[0080] Otherwise, the blind rivet nut N is completely screwed on the external thread 14 to have it tightly positioned at the mouthpiece 30.

[0081] Then, the operator or the robot positions the blind rivet nut N within the opening O of the component C for fastening.

[0082] Thereafter, the operator presses the trigger 70 or the control unit U starts the pulling process of the pulling mandrel 10. To this end, hydraulic liquid is pressed by the piston 62 from the reservoir 16 into the inner cylinder structure 54 within the housing 92. The hydraulic piston 52 is moved in the direction of the drive end 16. During this motion, the hydraulic piston 52 drags the pulling mandrel 10 in the same direction by means of the cooperating connection structure 22 and the piston connection structure 58. The movement of the pulling mandrel 10 is transferred to the blind rivet nut N leading to a crimping plastic deformation within the opening O of the component C (step S8, see figure 11).

[0083] Finally, the control unit U reverses the rotation direction of the pulling mandrel 10 and removes the external thread 14 from the fastened blind rivet nut N (see figure 12).

6. List of reference signs

[0084]

1	handheld setting device
10	pulling mandrel with outer thread
10'	pulling mandrel with a hollow working end and an inner thread 14'
10A, 10B	parts of the pulling mandrel 10
12	working end
14	external thread of the working end 12
14'	inner thread of the pulling mandrel 10'
16	drive end
18	coupling structure
20	mandrel drive
22	ended connection structure
30	mouthpiece
32	slide
34	spring
40	sensor
50	hydraulic drive
52	hydraulic piston
53	surrounding gasket
54	inner cylinder structure within the housing 90
56	piston spring

58	piston connection structure
60	hydraulic reservoir
62	piston
70	trigger
80	handle
90	housing
92	T-shaped housing part
94	retaining part of the housing
B	blind rivet bolt
N	blind rivet nut
O	component opening
C	component
L	longitudinal axis of the pulling mandrel 10
K	circumferential collar of the blind rivet nut N
U	control unit
G	gap

Claims

1. A setting device (1) for a blind rivet element (N; B), comprising the following features:

a. an axially displaceable pulling mandrel (10) and a mandrel drive to rotate the pulling mandrel (10), the pulling mandrel (10) has a work end (12; 12') and a drive end (16), wherein

a1. the work end (12; 12') includes an outer thread (14) to screw-on a blind rivet element configured like a blind rivet nut (N) or an inner thread (14') to screw-in a blind rivet element configured like a blind rivet bolt (B) and

a2. the drive end (16) has a coupling structure (18) with which a releasable torque-proof connection with the mandrel drive (20) can be established,

b. a linear pulling drive (50) in an operative connection with the pulling mandrel (10; 10') with which a linear deformation displacement of the pulling mandrel (10; 10') in the direction of the drive end (16) is implementable deforming a blind rivet element (N; B), and

c. a hollow-cylindrical mouthpiece (30),

c1. which passes the pulling mandrel (10; 10') and

c2. which is linearly displaceable parallel to and independent of the pulling mandrel (10; 10'),

c3. so that an installation state of a blind rivet element (N; B) on the work end (12) of the pulling mandrel (10; 10') is detectable by means of a linear displacement of the mouthpiece (30).

2. The setting device (1) according to claim 1, in which the mouthpiece (30) is spring preloaded in a direction facing away from the setting device (1).

3. The setting device (1) according to claim 1 or 2, in which the mouthpiece (30) is guided on the pulling mandrel (10; 10') and/or in a housing (90) of the setting device (1), and a relative movement between the mouthpiece (30) and the housing (90) is detectable by means of a sensor (70) or a switch.

4. The setting device (1) according to one of the preceding claims which is connected to a control unit which analyses sensor signals and sends control commands to the setting device (1) based on these sensor signals.

5. The setting device (1) according to one of the preceding claims which is a handheld device.

6. The setting device (1) according to one of the preceding claims which is an automatic setting machine.

7. The setting device (1) according to one of the preceding claims in which the linear pulling drive (50) is a hydraulic piston-cylinder-drive, the piston (52) of which is displaceable in the direction of the drive end (16) against an axial spring preload.

8. The setting device (1) according to one of the preceding claims 1 to 6 in which the linear pulling drive (50) is a linear motor with which the pulling mandrel (10) is displaceable in a torque-free manner against an axial spring preload in the direction of the drive end (16).

9. A setting method of a blind rivet element (N; B), in particular with a setting device (1) according to one of the preceding claims, with a setting device (1) having a pulling mandrel (10; 10') with an outer work end (12) with an outer thread (14) or an inner thread (14'), wherein the setting method comprises the following steps:

a. plugging a blind rivet element (N; B) on the outer work end (12) of the pulling mandrel (10), (S1),

b. axially displacing the non-rotating pulling mandrel (10; 10') with the plugged-on blind rivet element (N; B) in the direction of the setting device (1), (S2),

c. further axially displacing the non-rotating pulling mandrel (10) with the plugged-on blind rivet element (N; B) until the blind rivet element (N; B) abuts an axially displaceable mouthpiece (30) of the setting device (1), and mutually axially displacing of the blind rivet element (N; B) with the mouthpiece (30) in the direction of the setting

device (1), (S3),

d. screwing-on of the blind rivet element (N; B) onto or screwing-in of the blind rivet element into the work end (12) of the pulling mandrel (10) after the displaceable mouthpiece (30) has been displaced by a defined way in the direction of the setting device (1), (S4),

e. fastening the blind rivet element (N; B) in a component opening (O) by crimping the blind rivet element (N; B), (S8).

10. The setting method according to claim 9 with the further step:
detecting the axial displacement of the mouthpiece (30) in the direction of the setting device (1) with a sensor (70) or a switch. (S5).

11. The setting method according to claim 9 or 10 with the further step:

monitoring a displaced position of the mouthpiece (30) during the screwing-on of the blind rivet nut (N) or a screwing-in of the blind rivet bolt (B) (S6) and

terminating the screwing-on or screwing-in when the displaced position changes outside a predetermined tolerance range. (S7)

Amended claims in accordance with Rule 137(2) EPC.

1. A setting device (1) for a blind rivet element (N; B), comprising the following features:

a. an axially displaceable pulling mandrel (10) and a mandrel drive to rotate the pulling mandrel (10), the pulling mandrel (10) has a work end (12; 12') and a drive end (16), wherein

al. the work end (12; 12') includes an outer thread (14) to screw-on a blind rivet element configured like a blind rivet nut (N) or an inner thread (14') to screw-in a blind rivet element configured like a blind rivet bolt (B) and

a2. the drive end (16) has a coupling structure (18) with which a releasable torque-proof connection with the mandrel drive (20) can be established,

b. a linear pulling drive (50) in an operative connection with the pulling mandrel (10; 10') with which a linear deformation displacement of the pulling mandrel (10; 10') in the direction of the drive end (16) is implementable deforming a blind rivet element (N; B), and

c. a hollow-cylindrical mouthpiece (30),

c1. which passes the pulling mandrel (10; 10') and

c2. which is linearly displaceable parallel to and independent of the pulling mandrel (10; 10'),

c3. so that an installation state of a blind rivet element (N; B) on the work end (12) of the pulling mandrel (10; 10') is detectable by means of a linear displacement of the mouthpiece (30).

2. The setting device (1) according to claim 1, in which the mouthpiece (30) is spring preloaded in a direction facing away from the setting device (1).

3. The setting device (1) according to claim 1 or 2, in which the mouthpiece (30) is guided on the pulling mandrel (10; 10') and/or in a housing (90) of the setting device (1), and a relative movement between the mouthpiece (30) and the housing (90) is detectable by means of a sensor (70) or a switch.

4. The setting device (1) according to one of the preceding claims which is connected to a control unit which analyses sensor signals and sends control commands to the setting device (1) based on these sensor signals.

5. The setting device (1) according to one of the preceding claims which is a handheld device.

6. The setting device (1) according to one of the preceding claims which is an automatic setting machine.

7. The setting device (1) according to one of the preceding claims in which the linear pulling drive (50) is a hydraulic piston-cylinder-drive, the piston (52) of which is displaceable in the direction of the drive end (16) against an axial spring preload.

8. The setting device (1) according to one of the preceding claims 1 to 6 in which the linear pulling drive (50) is a linear motor with which the pulling mandrel (10) is displaceable in a torque-free manner against an axial spring preload in the direction of the drive end (16).

9. A setting method of a blind rivet element (N; B) with a setting device (1) according to one of the preceding claims, wherein the setting method comprises the following steps:

a. plugging a blind rivet element (N; B) on the outer work end (12) of the pulling mandrel (10), (S1),

b. axially displacing the non-rotating pulling mandrel (10; 10') with the plugged-on blind rivet element (N; B) in the direction of the setting de-

vice (1), (S2),

c. further axially displacing the non-rotating pulling mandrel (10) with the plugged-on blind rivet element (N; B) until the blind rivet element (N; B) abuts an axially displaceable mouthpiece (30) of the setting device (1), and mutually axially displacing of the blind rivet element (N; B) with the mouthpiece (30) in the direction of the setting device (1), (S3),

d. screwing-on of the blind rivet element (N; B) onto or screwing-in of the blind rivet element into the work end (12) of the pulling mandrel (10) after the displaceable mouthpiece (30) has been displaced by a defined way in the direction of the setting device (1), (S4),

e. fastening the blind rivet element (N; B) in a component opening (O) by crimping the blind rivet element (N; B), (S8).

10. The setting method according to claim 9 with the further step:

detecting the axial displacement of the mouthpiece (30) in the direction of the setting device (1) with a sensor (70) or a switch. (S5).

11. The setting method according to claim 9 or 10 with the further step:

monitoring a displaced position of the mouthpiece (30) during the screwing-on of the blind rivet nut (N) or a screwing-in of the blind rivet bolt (B) (S6) and terminating the screwing-on or screwing-in when the displaced position changes outside a predetermined tolerance range. (S7)

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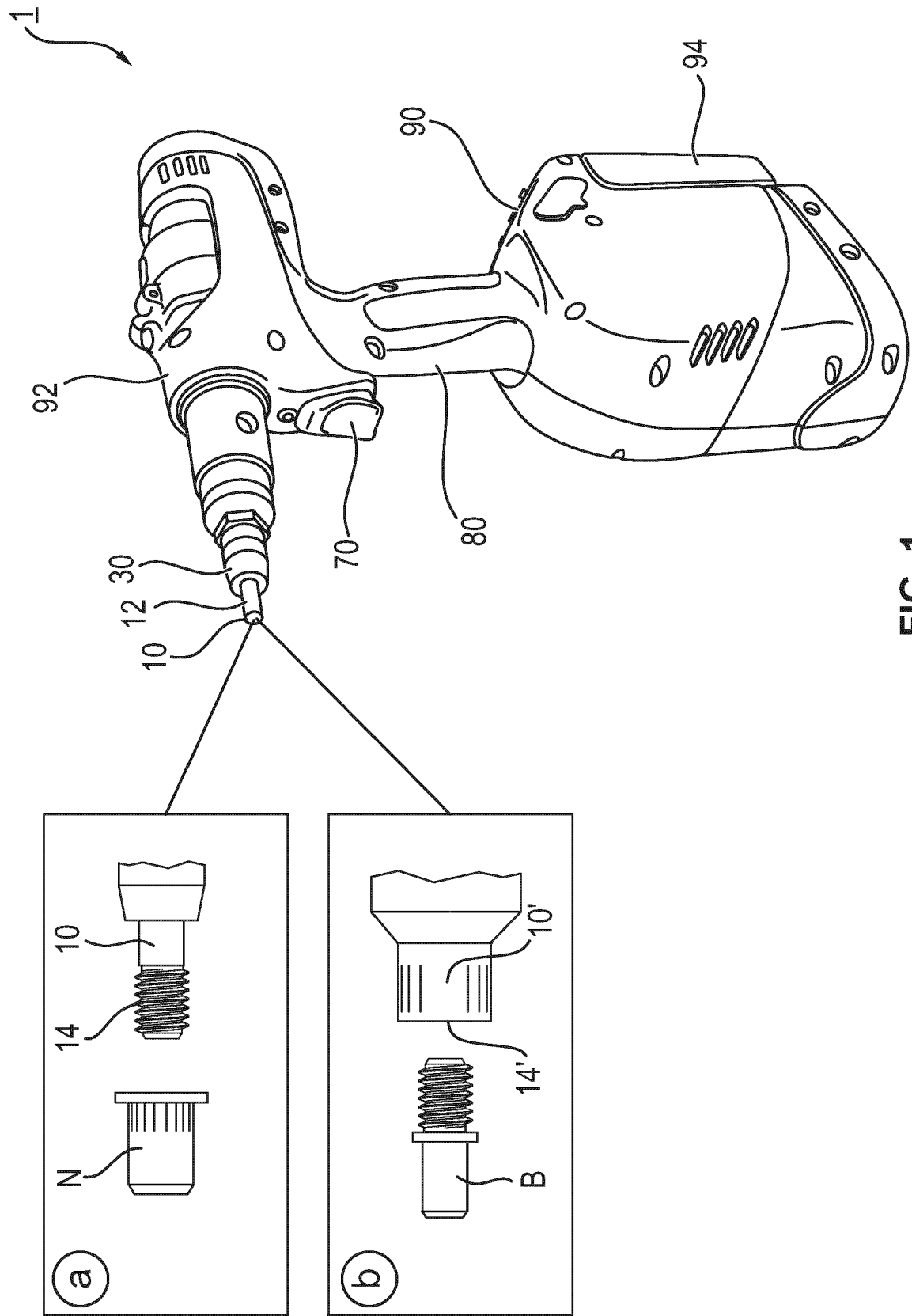


FIG. 1

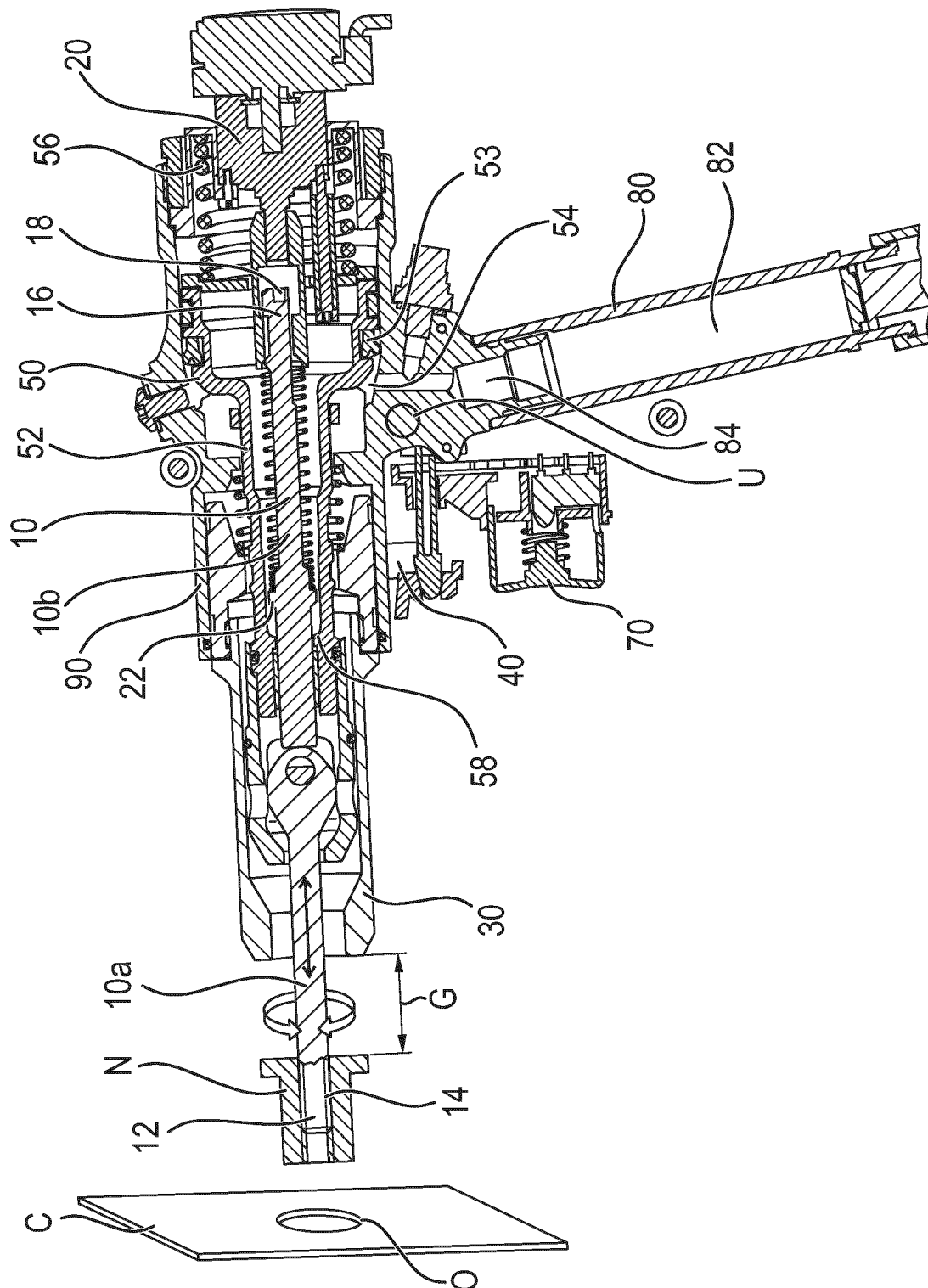


FIG. 2

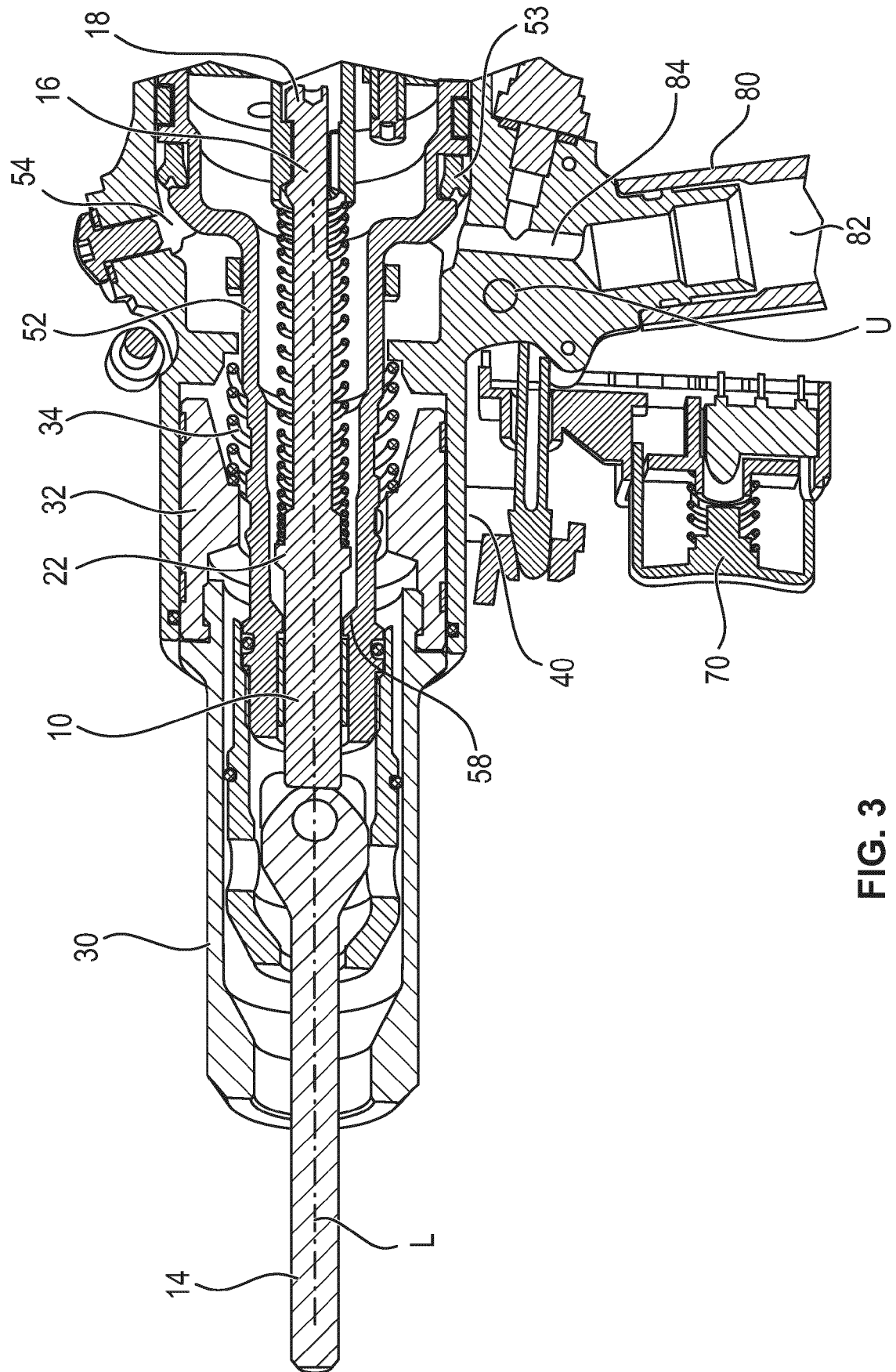


FIG. 3

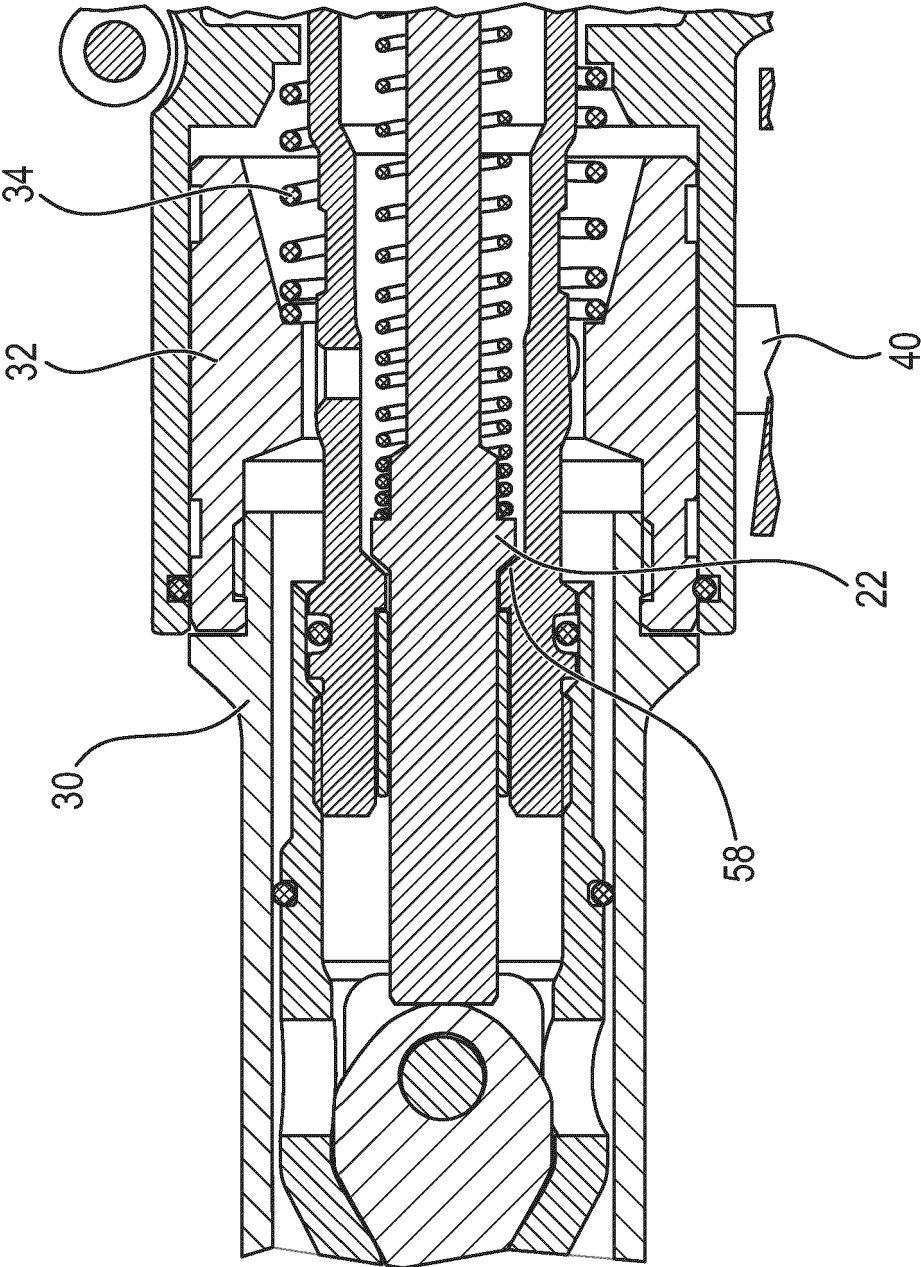


FIG. 4

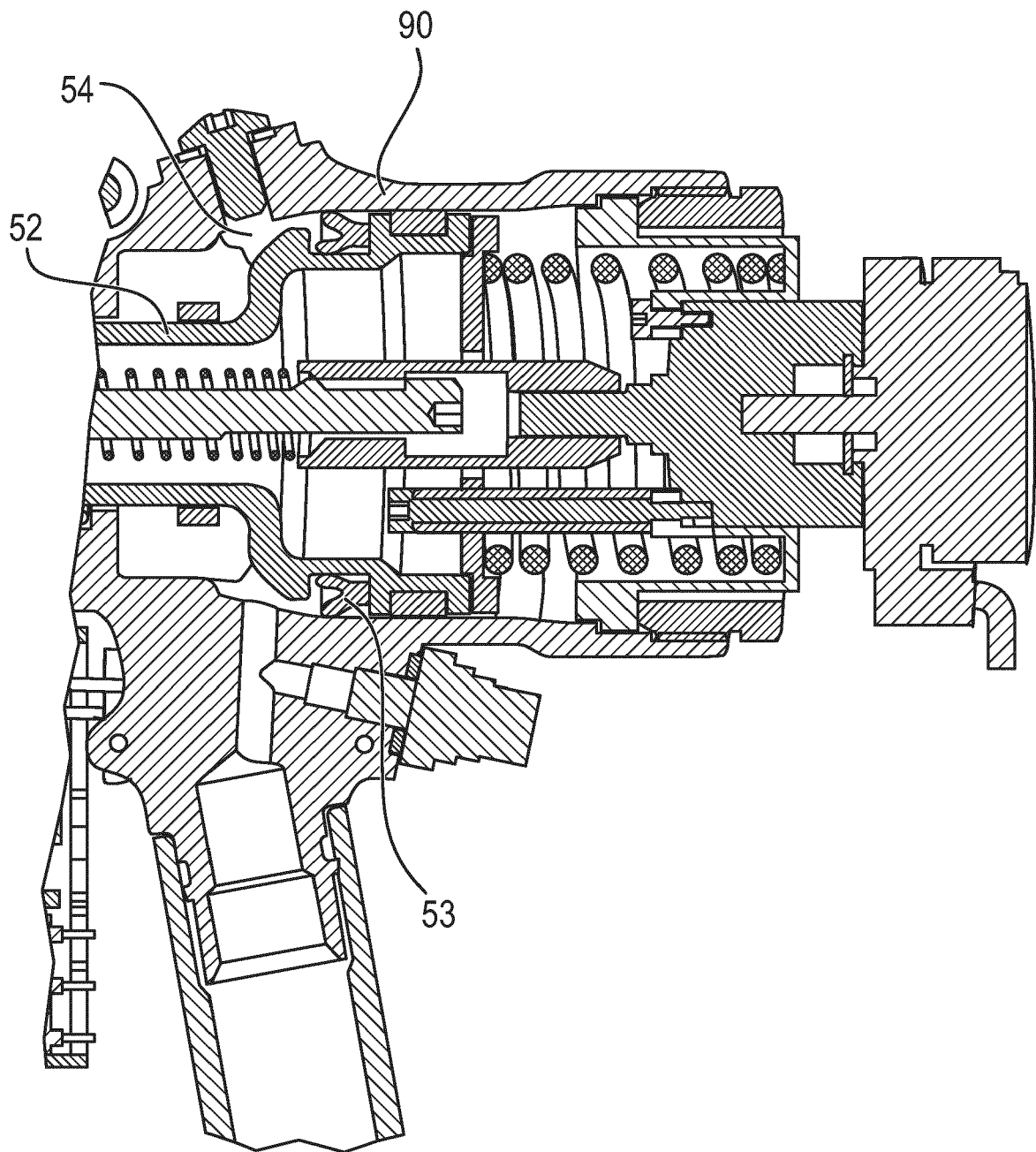


FIG. 5

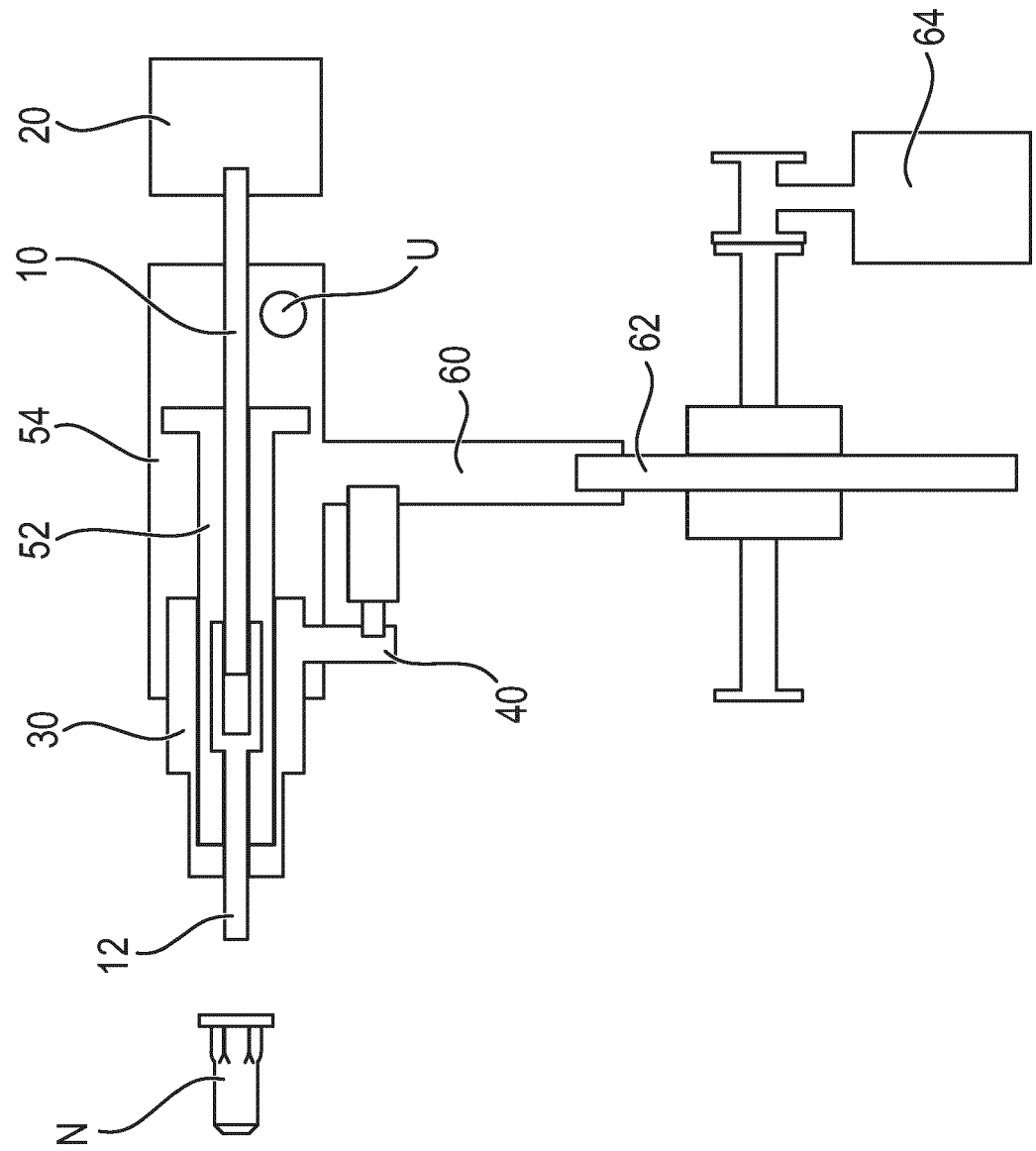


FIG. 6

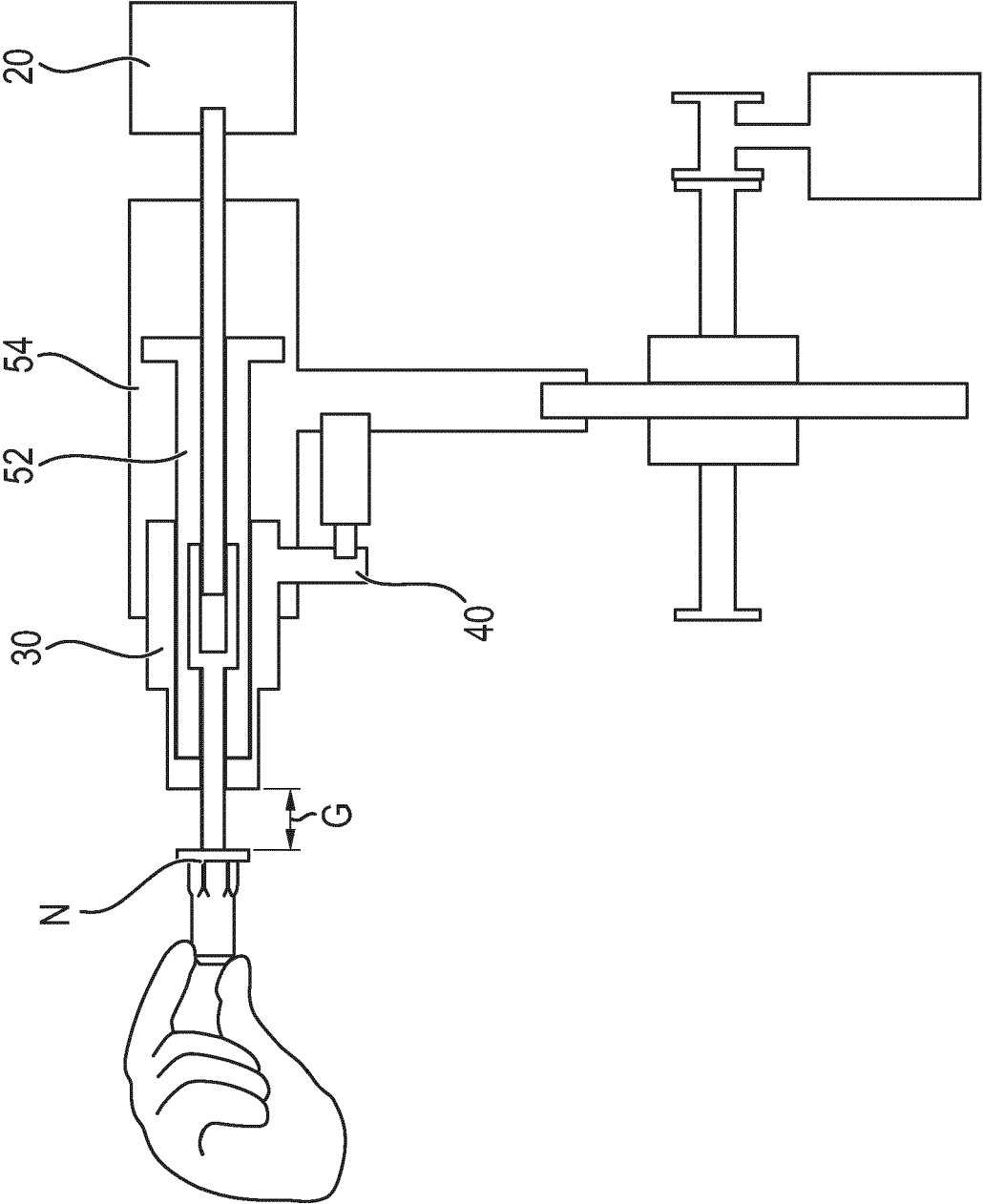


FIG. 7

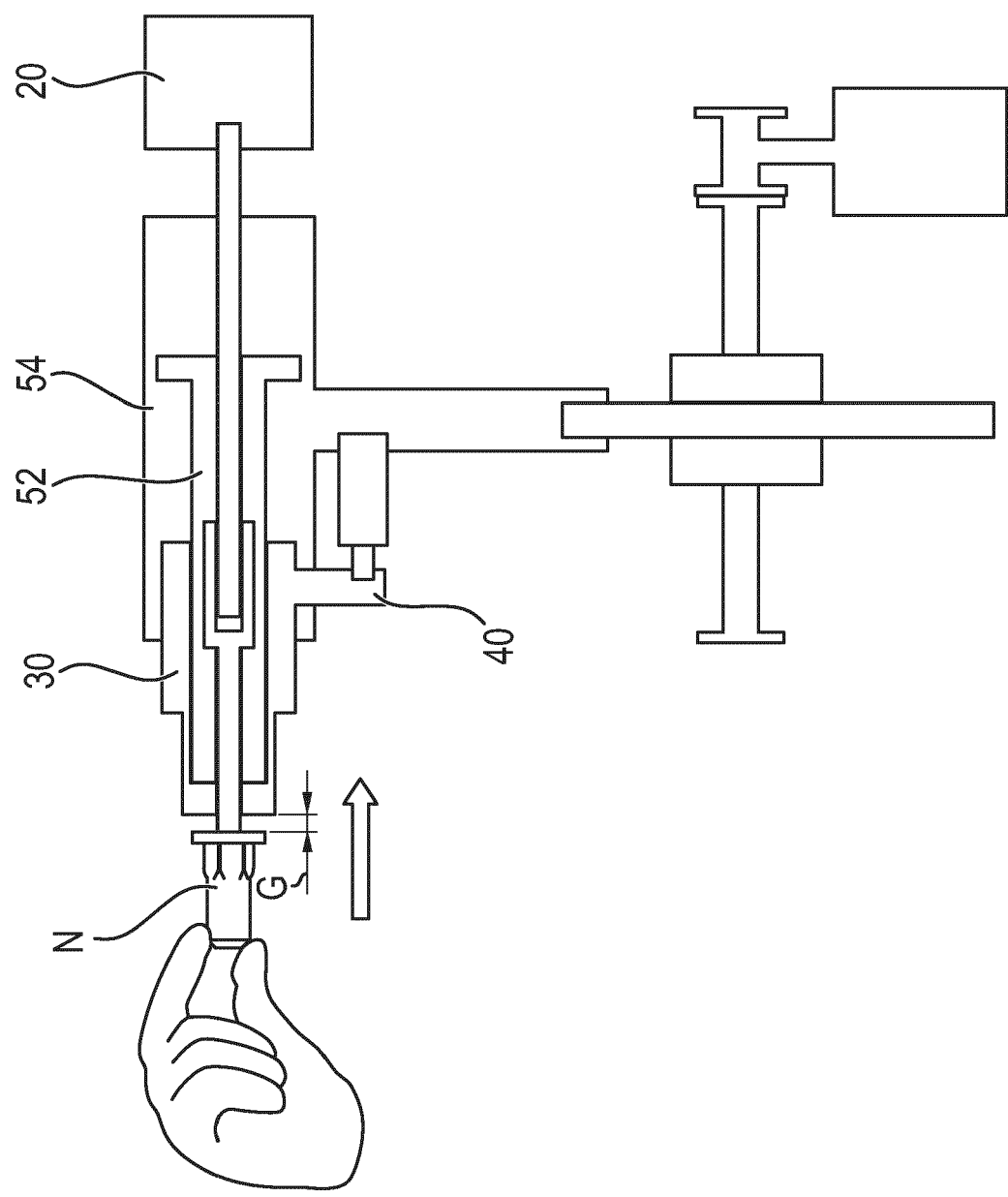


FIG. 8

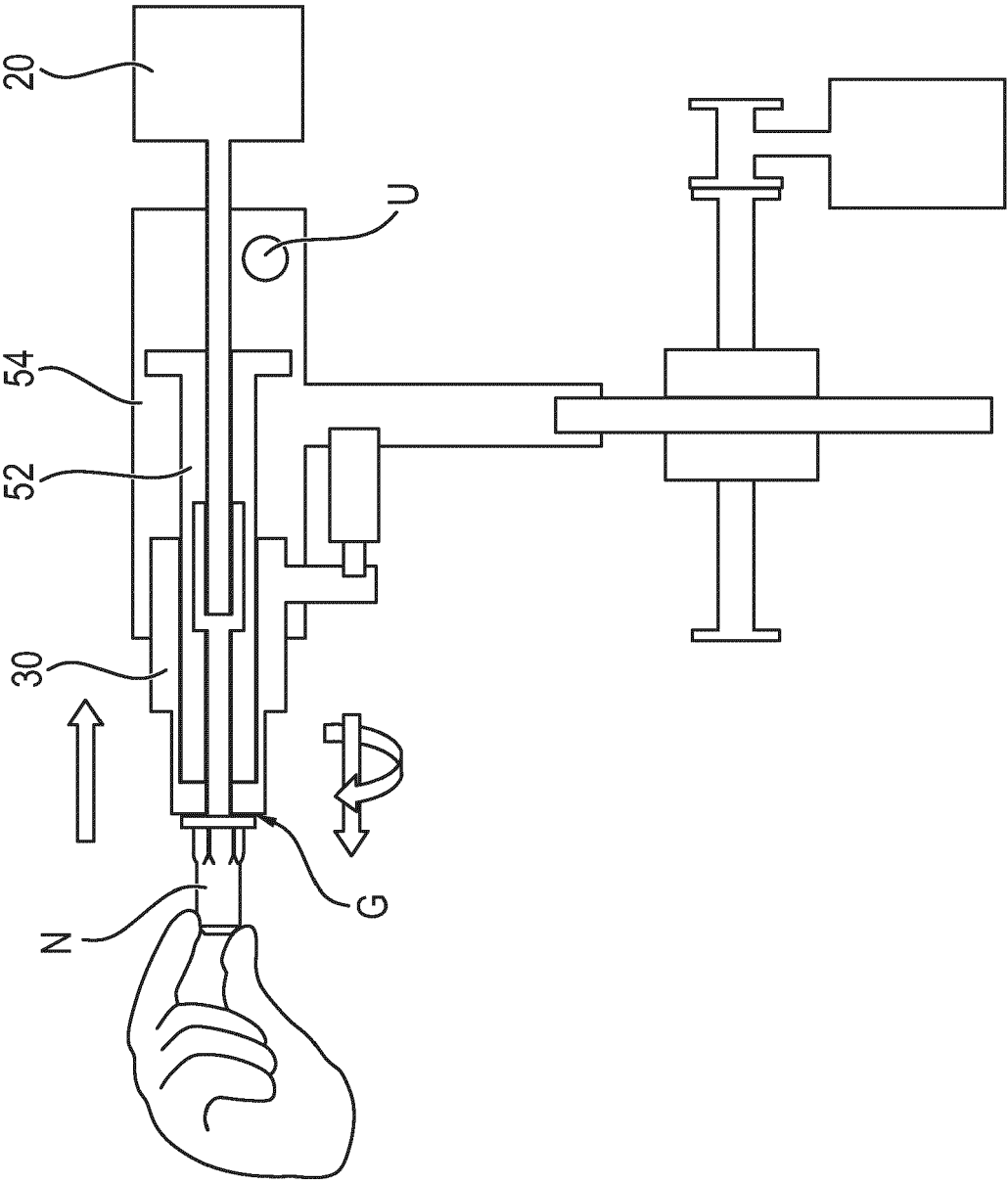


FIG. 9

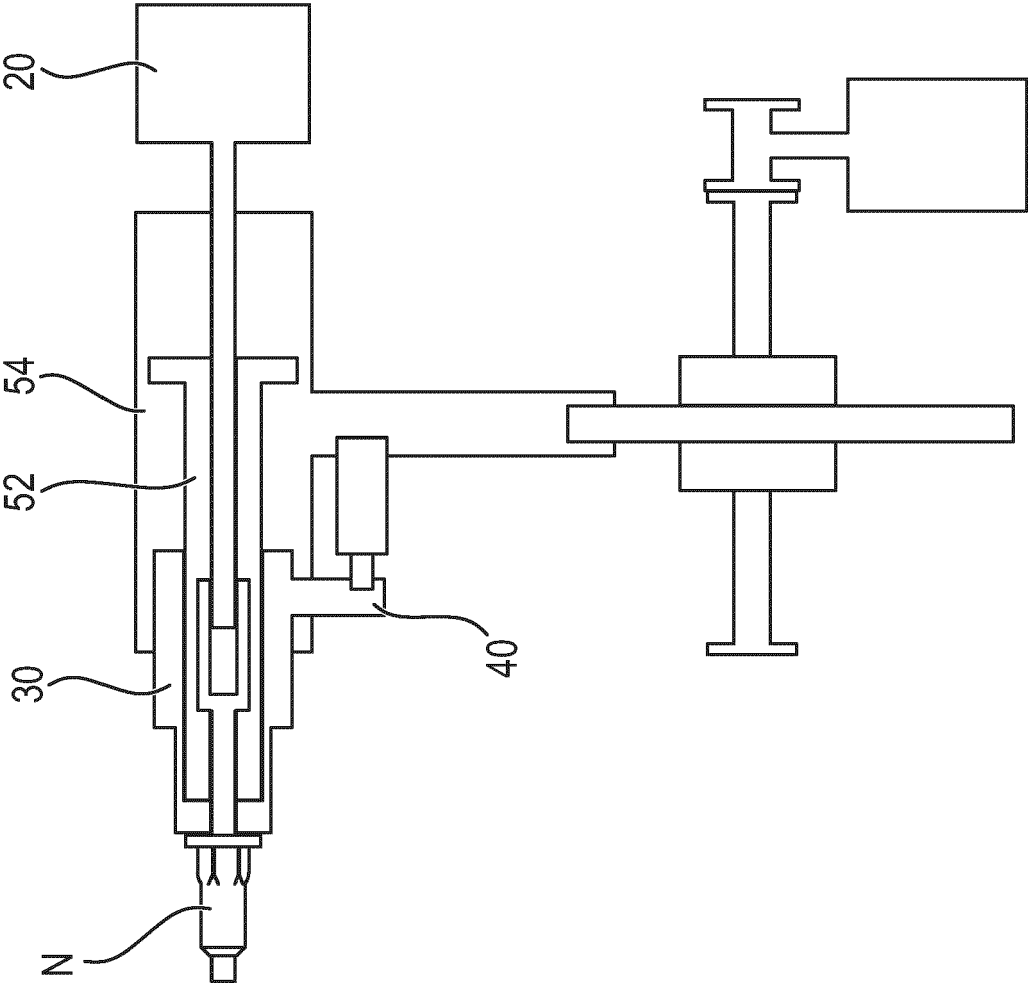
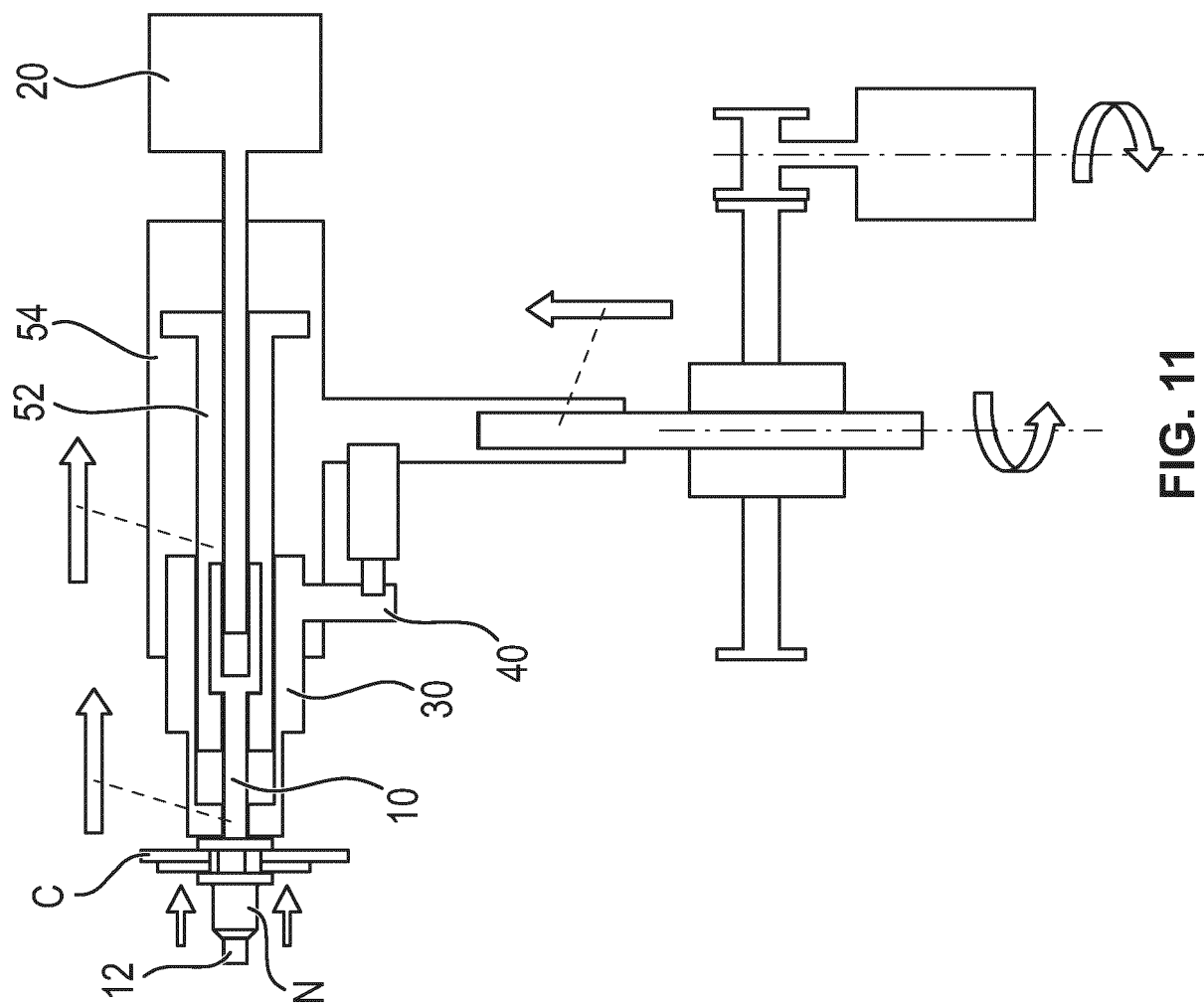
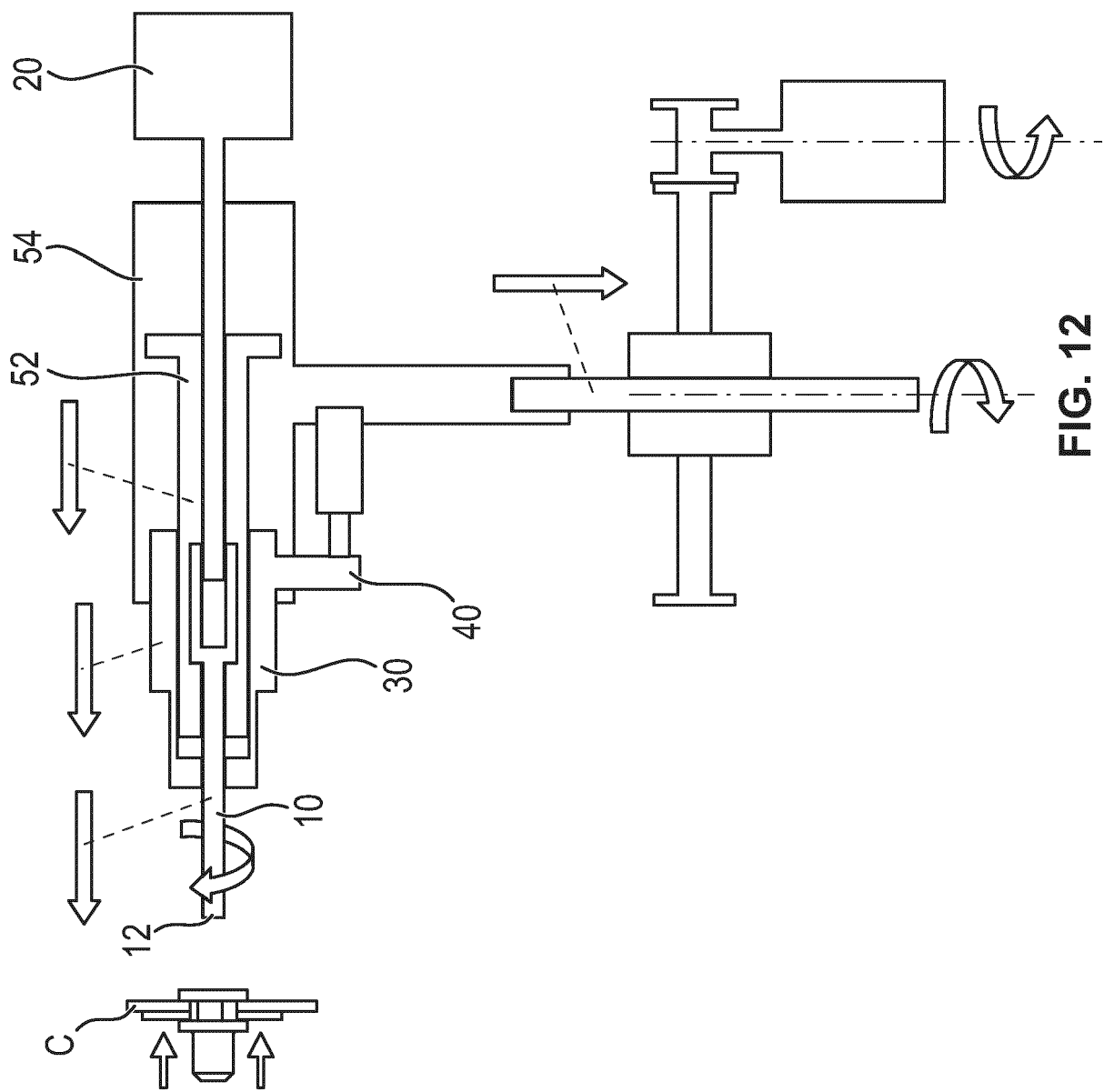


FIG. 10

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G.
F.



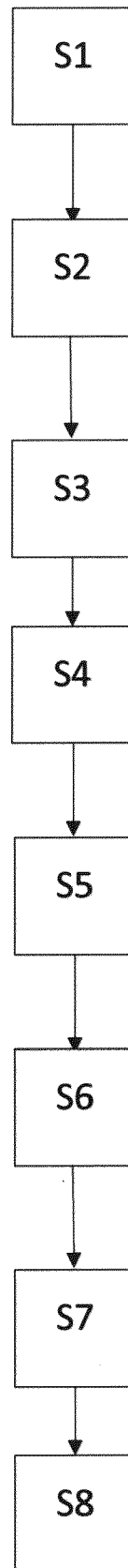


FIG. 13



EUROPEAN SEARCH REPORT

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Y	* column 5, line 16 - column 6, line 38;	4, 6-8	B21J15/04
A	figures *	3, 9-11	B21J15/10
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			B21J15/20
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Y	* column 2, line 39 - column 4, line 33;	4, 6-8	B21J15/26
A	figures *	3, 9-11	B21J15/28
	-----		B25B27/00
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	* figures *		

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Place of search		Date of completion of the search	Examiner
Munich		27 April 2023	Charvet, Pierre
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P : intermediate document			
		& : member of the same patent family, corresponding document	

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