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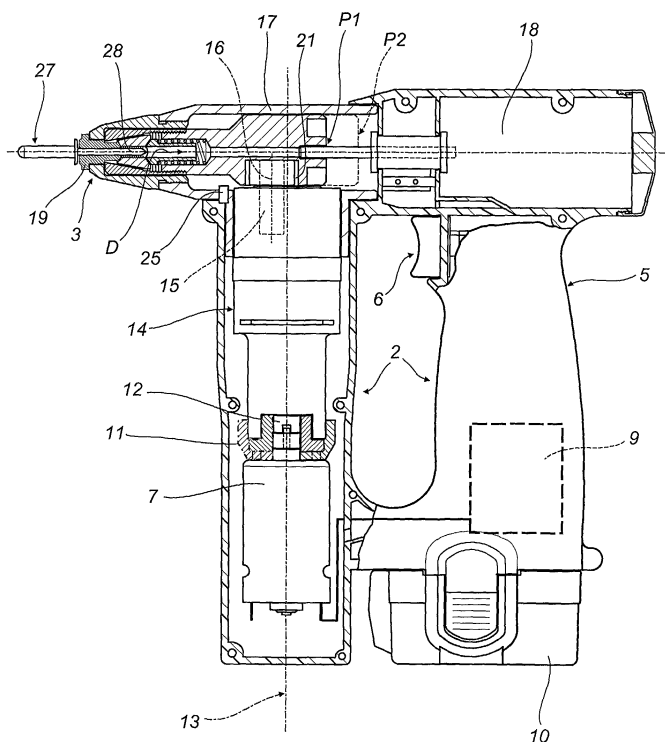
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(54) An electric riveting gun

(57) An electric riveting gun (1) is used to apply rivets of the type with break mandrels and is equipped with a gripping and pulling device (3) designed to engage and pull the mandrels, an electric motor (7) powered by a rechargeable battery (10), and a transmission element

(8) located between the motor (7) and the gripping and pulling device (3). The speed of the motor (7) is controlled by a PWM (Pulse Width Modulation) signal that drives an electronic circuit (9) designed to control the current drawn by the motor (7) during the upsetting cycle in which a mandrel is broken off a rivet.

FIG. 1



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Description

[0001] The present invention relates to an electric riveting gun.

[0002] The riveting gun according to the invention is designed to apply rivets by gripping, pulling and breaking the mandrel positioned coaxially inside each rivet, and in particular is of the type where a device for gripping and pulling the mandrel is driven, through a transmission element, by an electric motor powered by a rechargeable battery.

[0003] In known riveting guns of this type, the gripping and pulling device usually comprises: at least two jaws for clamping the mandrels; a slider or tie rod which moves in the mandrel pulling direction in a straight line and which engages with the jaws in such a way as to move them between an advanced position where they receive the mandrels and a retracted position where they clamp and pull the mandrels; and a slider sliding guide. In these guns, where the rotational motion of the electric motor's output shaft is converted into the straight-line motion of the slider through the transmission element, which in known solutions may be, for example, a rack and pinion or crank mechanism, the motor draws from the battery a current whose intensity varies according to the position of the slider during the upsetting cycle, that is, as the slider moves from the fully forward to the fully retracted position to break off a mandrel. Indeed, at several points in the upsetting cycle, the intensity of the current drawn by the motor greatly exceeds the requirement, resulting in excessive battery power consumption.

[0004] The object of the present invention is to provide an electric riveting gun whose motor, during the upsetting cycle in which the mandrel is broken off the rivet, consumes as little power as possible.

[0005] Accordingly, the present invention provides an electric riveting gun for break mandrel rivets; the riveting gun comprising gripping and pulling means for engaging and pulling up the mandrels, and means for driving the gripping and pulling means; said drive means comprising an electric motor and a transmission element located between the motor and the gripping and pulling means; the riveting gun being characterised in that the drive means comprise an electronic circuit that controls the speed of the motor and that is designed to control the current drawn by the motor during the upsetting cycle in which a mandrel is gripped and broken off. The invention will now be described with reference to the accompanying drawings which illustrate a preferred embodiment of it and in which:

- Figure 1 is a side view, with some parts in cross section, of a preferred embodiment of the hand riveting tool according to the present invention;
- Figure 2 shows, partly in cross section, an enlarged detail of the riveting gun illustrated in Figure 1;
- Figure 3 graphically represents an upsetting cycle

performed by the riveting gun of Figure 1 to break a mandrel off a rivet; and

- Figures 4 and 5 are two electric circuit diagrams of a preferred embodiment of an electronic control circuit of the riveting gun illustrated in Figure 1.

[0006] With reference to Figure 1, the numeral 1 denotes in its entirety an electric riveting gun designed to apply rivets 27 of the type with break mandrels 28.

[0007] The riveting gun 1 comprises an outer casing 2 that houses a gripping and pulling device 3 designed to engage and pull the rivet mandrels, and a unit 4 that drives the device 3.

[0008] The casing 2 comprises two moulded half shells, which, for example, are made of plastic and are substantially symmetrical, and defines a handgrip 5 close to which the casing 2 itself has pivotally mounted on it a start button 6 used to control the drive unit 4.

[0009] The unit 4 comprises a direct current motor 7, a transmission element 8 located between the motor 7 and the device 3, and an electronic circuit 9 that controls the speed of the motor 7. More specifically, the circuit 9 is designed to control the current drawn by the motor 7 during the upsetting cycle in which a rivet mandrel is broken off.

[0010] The motor 7 is powered by a rechargeable 12 Volt battery 10, which is removably housed in the casing 2 at an end opposite the end that houses the device 3.

[0011] The rotor of the motor 7 has an output shaft 11 which is coaxially connected to an input shaft 12 of the element 8 in such a way that it rotates with the shaft 12 itself in one direction about an axis 13. More specifically, the shaft 12 is the input shaft of an epicyclic speed reduction gear unit 14 with two or more stages which mounts at its output a pin 15 that is parallel to the axis 13 and that rotates eccentrically about the axis 13 itself. Looking in more detail, the pin 15 has a central axis 16 whose distance from the axis 13 is kept constant during the eccentric rotation of the pin 15 about the axis 13.

[0012] The gripping and pulling device 3 is designed to engage and pull the rivet mandrels in a direction D transversal to the axis 13 and comprises a substantially cylindrical, hollow body 17 that extends substantially symmetrically along and around the direction D. In particular, as illustrated in Figures 1 and 2, the body 17 is defined by a substantially cylindrical portion of the casing 2.

[0013] In the direction D, the body 17 is delimited on one side by a receptacle 18 for the mandrels broken off by the riveting gun 1 and, on the other side, by an interchangeable nozzle 19 designed to receive the mandrels to be broken off. The receptacle 18 is a substantially cylindrical container that is removably mounted on the casing 2.

[0014] As shown in more detail in Figure 2, the body 17 slidably houses and guides inside it a hollow slider 20 that can move lengthways in a straight line in the direction D between a first limit position P1 (shown in Fig-

ure 1 by the continuous line and in Figure 2), where the slider 20 is close to the nozzle 19, and a second limit position P2 (shown by the dashed line in Figure 1), where the slider 20 and the nozzle 19 are positioned at a defined maximum distance from each other.

[0015] The slider 20 is driven in the direction D between the aforementioned positions P1 and P2 by the eccentric pin 15 which is slidably engaged in a transversal elongated slot 21 made in the slider 20 itself.

[0016] Besides the body 17 and the slider 20, the gripping and pulling device 3 comprises two jaws 22 for gripping, clamping and pulling the mandrels.

[0017] The jaws 22 are housed at least partially inside the slider 20 and are slidably engaged with a truncated cone shaped inside wall of the slider 20. Each of the jaws 22 has a first end facing the nozzle 19 and a second end, opposite the first end, coupled with a truncated cone shaped pushing element 23 also positioned inside the slider 20. The element 23 is in turn coupled with a helical spring 24 which extends coaxially in the direction D between the element 23 itself and an end wall of the device 3, located at the end opposite the nozzle 19.

[0018] The circuit 9, which, as mentioned above, is designed to control the current drawn by the motor 7 during the rivet upsetting cycle in which the mandrel is broken off, generates a PWM (Pulse Width Modulation) signal used to control the speed of the rotor of the motor 7. More specifically, the circuit 9 powers and drives the motor 7 with a pulsed, periodic armature voltage having a fixed frequency of 20 kHz and a useful duty cycle that is variable.

[0019] The circuit diagram of the circuit 9 is illustrated in detail in Figures 4 and 5.

[0020] With reference to Figure 4, the start button 6 is connected on one side to the positive terminal of the battery 10 and, on the other side, to earth through a resistor R1.

[0021] Of the terminals of the button 6, the one connected to the positive battery terminal is connected to the emitter of a PNP transistor Q1, whilst the one connected to the resistor R1 is connected, through a capacitor C1, both to the collector of the transistor Q1 and to the input of a voltage stabiliser S.

[0022] The stabiliser S is a customary integrated circuit that reduces the supply voltage of the circuit 9 from the value applied to the terminals of the battery 10 to a defined lower value so as to stabilise the operation of the circuit 9 itself. In particular, the stabiliser S presents an 8 Volt positive output terminal connected through a resistor R2 to the base of a transistor Q2.

[0023] The transistor Q2 is an NPN transistor and its collector is connected through a capacitor C2 to a first input I1 of a flip-flop FF, whose output U is connected through a resistor R3 to the base of an NPN transistor Q3. The collector of the transistor Q3 is connected to the base of the transistor Q1 through a resistor R4.

[0024] The flip-flop FF is made up of two logical ports of a customary integrated circuit and, besides the first

input I1, presents a second input I2. The second input I2, like the input I1, performs an on/off function of the flip-flop FF by changing the state of the output U of the flip-flop FF from the logical «0» or negative state to the logical «1» or positive state and vice versa.

[0025] In particular, the input I2 is connected to both a section M for monitoring the voltage under load applied to the terminals of the battery 10 and to a section R for detecting the end of each rivet upsetting cycle in which a mandrel is broken off.

[0026] The main function of the monitoring section M is to break the circuit 9 when the voltage under load reaches a predetermined minimum value. The section M comprises an operational subsection M1 designed to break the circuit 9 and a signalling subsection M2 designed to warn the user that the battery 10 is low. The subsection M1 comprises two logical ports U1 and U2 connected in cascade. The input of the port U1 is connected on one side to the positive terminal of the battery 10 through a Zener diode D1 and, on the other side, to earth through a resistor R5. The input of the port U2 is connected to the output of the port U1 and its output is connected to the input I2 of the flip-flop FF through a diode D2 and a capacitor C3. The subsection M2 comprises a logical port U3 whose input is connected on one side to the positive terminal of the battery 10 through a Zener diode D3 and, on the other side, to earth through a resistor R6. The output of the port U3 is connected to earth through an indicator LED D4 and a resistor R7 in series with each other.

[0027] The function of the detecting section R is to break the circuit 9 at the end of each upsetting cycle. The section R is connected to a proximity sensor 25, forming part of the drive means 4, and, as shown in Figures 1 and 2, facing the inside of the body 17 so as to detect the presence of a protruding peripheral portion of the slider 20 when the slider 20 reaches the aforementioned limit position P1.

[0028] The output U of the flip-flop FF is connected not only to the base of the transistor Q3, as mentioned above, but also to a braking section F of the motor 7. More specifically, the output U is connected, through a diode D5 (Figure 4) and a resistor R8 (Figure 5), which are connected to each other in series, to the base of an NPN transistor Q4 forming part of the section F, illustrated in detail in Figure 5.

[0029] Besides the transistor Q4, the section F comprises an NMOS transistor Q5, designed to short circuit the motor 7, stopping the residual energy present in the choke of the motor 7, when the base of the transistor Q4 detects the motor stop command upon the slider 20 reaching the aforementioned limit position P1.

[0030] The heart of the circuit 9, that is, the section of the circuit 9 that generates the PWM (Pulse Width Modulation) signal to control the speed of the motor 7, comprises an integrated circuit 26, known by the trade name TPIC2101, made by Texas Instruments.

[0031] The integrated circuit 26 is powered by the sta-

biliser S and presents an output 27 which drives the gate of an NMOS power transistor Q6 so as to control the motor 7 by PWM. Specifically, the transistor Q6, on receiving the PWM pulses from the integrated circuit 26, becomes conductive for the duration of the positive pulses so that voltage is carried to the motor 7.

[0032] The integrated circuit 26 uses a diode D6, a capacitor C4 and three resistors R9, R10 and R11 to check the current drawn by the motor 7 from the battery 10.

[0033] The operation of the riveting gun 1 is described below, starting from the point in which the slider 20 is at the limit position P1 close to the nozzle 19. In this position, the spring 24 is at its position of minimum contraction, the element 23 is at its smallest distance from the nozzle 19 and the jaws 22 are located in a forward mandrel receiving position, where the jaws 22 themselves are as far apart as possible.

[0034] To clamp, pull and break the rivet mandrel, the user inserts the mandrel itself between the jaws 22 through the nozzle 19 and then starts the motor 7 by pressing the start button 6. Following the starting of the motor 7, the pin 15 performs one full rotation of 360° about the axis 13. This is because motors of this kind are not reversible and can rotate in one direction only.

[0035] The different positions reached by the pin 15 during a full upsetting cycle, in which a rivet mandrel is broken off, are shown in Figure 3. Looking at Figure 3, the pin 15 performs a rotation about the axis 13 in a clockwise direction starting from a position A where the slider 20 is at its position P1.

[0036] On starting, the circuit 9 generates a control signal which imparts on the motor 7 a relatively slow starting speed that becomes progressively faster. This control signal is determined by a resistor R12 and by a capacitor C5 both connected to the integrated circuit 26.

[0037] Specifically, the control signal remains active for a stage of the cycle corresponding to a first stage in the rotation of the pin 15 during which it describes a first circular arc defined by a given number of degrees about the axis 13, the number of degrees depending on the physical and geometrical characteristics of the rivet 27 and, in particular, of the mandrel 28.

[0038] In particular, the first stage comprises an initial sub-stage consisting of a very short idle stroke of the slider 20, and an equally short final sub-stage in which the jaws 22 are tightened round the mandrel to be broken off. These sub-stages, and hence the first stage, as mentioned above, vary according to the thickness and length of the mandrel 28. The thicker the mandrel 28 is, the smaller the corresponding rotation of the pin 15 (that is, the number of degrees through which it turns about the axis 13) and thus, the shorter the first circular arc described.

[0039] The first stage is followed by an intermediate stage during which the mandrel 28 is pulled and broken off and which corresponds to a further rotation of the pin 15 through a second defined circular arc.

[0040] During this stage, the current drawn from the battery 10 reaches its highest level on account of the pulling effort required. More specifically, this second, intermediate stage comprises two sub-stages, the first of which corresponds to the initial deformation of the rivet 27, while the second sub-stage corresponds to the breaking off of the mandrel 28.

[0041] Thus, these two sub-stages, and hence the intermediate pulling and breaking stage, depend on the mechanical characteristics of the rivets and the angle subtended by the second circular arc described by the pin 15 about the axis 13 is any angle between the angle of the first circular arc and 180 degrees. In some cases, for example, the second circular arc is the supplementary arc of the first arc, that is, 180 degree minus the number of degrees through which the pin 15 turns to describe the first circular arc about the axis 13.

[0042] Lastly, the intermediate stage is followed by a third stage of returning to the starting point of the cycle, that is, to position A. During the third stage, the pin 15 describes a third circular arc and passes from a position, which, for the reasons stated above, may be close to the position B diametrically opposite the starting position A or may coincide with the position B itself, at which the slider 20 is in position P2.

[0043] In a simple example, with reference to Figure 3, and considering one particular type of rivet 28, the sequence might be the following: the first stage, corresponding to the first arc, labelled f1, comprising both the initial idle stroke sub-stage of the slider 20 and the final sub-stage in which the jaws 22 are tightened around the mandrel to be broken off, are substantially the same and equal to 45 degrees; the second intermediate stage of pulling and breaking the mandrel 28, during which the pin 15 rotates through a further angle to describe a second circular arc, labelled f2, which, in this example, is the supplementary arc of the first arc and, hence, equal to 180 degrees minus the degrees through which the pin 15 rotates to describe the first circular arc f1.

[0044] The second arc f2 defines the two aforementioned sub-stages of which the first sub-stage corresponds to an arc f'2 during which the rivet 27 is initially deformed, and the second sub-stage corresponds to an arc f''2 during which the mandrel 28 is broken off.

[0045] Lastly, the pin 15 passes from position B to position A, turning through a third circular arc, labelled f3 in Figure 3 and equal to approximately 180 degrees.

[0046] When the slider 20 is in position P2, the spring 24 is at its position of maximum contraction, the element 23 is at its largest distance from the nozzle 19 and the jaws 22 are located in a retracted position where they are as close together as possible.

[0047] As the slider 20 passes from position P1 to position P2, that is, as pin 15 rotates from position A to position B, the motion of the slider 20 in the direction D causes the jaws 22 to slide relative to the truncated cone-shaped inside wall of the slider 20 itself against the opposing force of the spring 24. As a result of this

sliding motion, the jaws 22 move closer to each other and, at the same time, away from the nozzle 19.

[0048] During the different stages of the upsetting cycle, equivalent to the aforementioned circular arcs f1, f2, and f3 described by the pin 15 as it rotates about the axis 13, the integrated circuit 26, through the diode D6, the capacitor C4 and the resistors R9, R10, R11, controls the current drawn by the motor 7. More specifically, the first, second and third stages of rotation, corresponding to the first, second and third stages of the cycle and equivalent to the first, second and third arcs f1, f2, f3, are marked by respective values of current drawn by the motor 7. The current drawn during the first and third stages of the cycle is considerably lower than the current drawn during the second stage. Even during the second stage (arc f2), the current draw differs between the two sub-stages equivalent to the arcs f'2 and f''2. It follows, therefore, that the current drawn by the motor 7 and controlled by the circuit 9 depends on the geometrical and mechanical characteristics of the rivet and of its mandrel 28.

[0049] The invention will now be described in detail with reference to the operation of the circuit 9 from the moment the start button 6 is pressed to the moment the upsetting cycle ends.

[0050] Before the button 6 is pressed, the logical state of the output U of the flip-flop FF is «0», that is to say, the flip-flop FF is off, the transistors Q1, Q2, Q3, Q4 and Q6 are in the non-conductive state and the stabiliser S is not powered. When the button 6 is pressed, it carries the positive voltage of the battery 10, for a short instant through the capacitor C1 connected in series with the button 6 itself, both to the input of the stabiliser S, which supplies an output of 8 Volts, and to the collector of the transistor Q1, which remains in the non-conductive state.

[0051] The output voltage of the stabiliser S is applied to the base of the transistor Q2 through the resistor R2, thus making the transistor Q2 conductive. On becoming conductive, the transistor Q2 activates the flip-flop FF by sending a negative pulse to the input I1 of the flip-flop FF itself through the capacitor C2.

[0052] The output U of the flip-flop FF thus switches to the logical state «1», that is to say, the flip-flop FF switches on, and carries a positive voltage to the base of the transistor Q3, which switches to the conductive state. Then, through the resistor R4, the transistor Q3, carries the positive voltage to the base of the transistor Q1, which also switches to the conductive state.

[0053] The transistor Q1, being connected in parallel with the start button 6, keeps the stabiliser S, and thus the entire circuit 9, powered as long as the output U of the flip-flop FF remains in the logical state «1».

[0054] When the output U of the flip-flop FF switches to the logical state «1», the transistor Q4 of the braking section F switches to the conductive state, carrying a negative voltage to the base of the NMOS transistor Q5. In this condition, the transistor NMOS Q5 is de-ener-

gised and remains in this state until the flip-flop FF changes state, that is to say, until its output U switches to the logical state «0» again. For this to occur, a negative pulse must be applied to the input I2 of the flip-flop FF. This negative pulse may come from the detecting section R when the proximity sensor 25 detects the slider 20 at the aforementioned limit position P1, or from the section M that monitors the voltage at the terminals of the battery 10 under load. Through the Zener diode D1 and the resistor R5, the section M normally keeps a predetermined positive operating voltage at the input of the logical port U1, with output at logical state «1» from the logical port U2. When the voltage applied to the input of the port U1 falls below the preset value on account of the lowered state of charge of the battery 10, the output of the port U2 changes to logical state «0» and, through the diode D2 and the capacitor C3, switches the flip-flop FF by changing the logical state of its output U to «0». When the voltage applied to the input of the port U1 falls below the preset value on account of the lowered state of charge of the battery 10, the voltage applied to the input of the logical port U3 also falls below the preset value. This switches on the indicator LED D4 to warn the user of this condition.

[0055] During the whole time that the logical state of the flip-flop FF output U remains at «1», the stabiliser S powers the integrated circuit 26. The latter can thus perform its PWM control function on the motor 7 by using the positive pulse applied to the output 27 to drive the NMOS transistor Q6, which is conductive during the positive pulses, thus allowing voltage to be carried to the motor 7. In the operation of the circuit 26, a capacitor C6 and a resistor R13 determine the aforementioned 20 kHz operating frequency of the circuit 9. The two resistors R9 and R11, on the other hand, determine the over-current threshold.

[0056] The circuit 9 illustrated in Figures 4 and 5 may be modified and adapted in several ways, which are not described, without thereby departing from the scope of the inventive concept. These modifications and adaptations will be obvious to an expert in the trade in the light of the above description and of the teachings of prior art relating to PWM control of motors.

[0057] On the other hand, it is worth emphasising that the motor 7 and the transmission element 8 are arranged in line, that is to say, with the output shaft 11 of the motor 7 parallel to the output pin 15 of the reduction unit 14 and aligned with the input shaft 12 of the reduction unit 14 itself. This arrangement optimises the overall dimensions of the motor 7 and transmission element 8, allowing both of them to be housed in the handgrip 5. The riveting gun 1 is thus compact and easy to handle. The compactness and handiness of the riveting gun 1 are further improved by the T-shaped configuration of the gripping and pulling device 3 relative to the assembly formed by the motor 7 and the transmission element 8. This derives from the fact that the axis 13 of rotation of the shafts 11 and 12 is at right angles to the mandrel

pulling direction D.

[0058] Lastly, it should be emphasised that the speed reduction unit 14 in the transmission element 8 performs a double function since it not only reduces the speed of rotation between input and output but is also used to connect the output shaft 11 of the motor 7 to the gripping and pulling device 3. In other words, the transmission element 8 described above is very compact and thus contributes significantly to the reduced size and handiness of the riveting gun 1.

Claims

1. An electric riveting gun for break mandrel rivets; the riveting gun (1) comprising gripping and pulling means (3) for engaging and pulling up the mandrels (28), and means (4) for driving the gripping and pulling means (3); said drive means (4) comprising an electric motor (7) and a transmission element (8) located between the motor (7) and the gripping and pulling means (3); the riveting gun (1) being **characterised in that** the drive means (4) comprise an electronic circuit (9) that controls the speed of the motor (7) and that is designed to control the current drawn by the motor (7) during the upsetting cycle in which a mandrel (28) is gripped and broken off a rivet (27).
2. The riveting gun according to claim 1, **characterised in that** the electronic circuit (9) generates a PWM (Pulse Width Modulation) signal used to control the speed of the motor (7).
3. The riveting gun according to claim 1 or 2, **characterised in that** the electronic circuit (9) generates a control signal which imparts on the motor (7) a relatively slow starting speed within the upsetting cycle.
4. The riveting gun according to any of the foregoing claims from 1 to 3, **characterised in that** the motor (7) is a direct current motor.
5. The riveting gun according to claim 4, **characterised in that** the motor (7) is powered by the electronic circuit (9) with a pulsed, periodic armature voltage having a fixed frequency of 20 kHz.
6. The riveting gun according to any of the foregoing claims from 1 to 5, **characterised in that** it comprises power supply means (10) for the motor (7).
7. The riveting gun according to claim 6, **characterised in that** the power supply means (10) comprise a rechargeable battery (10).
8. The riveting gun according to claim 7, **characterised in that** the electronic circuit (9) comprises a section (M) for monitoring the voltage under load applied to the terminals of the battery (10); the monitoring section (M) being designed to break the circuit (9) when the voltage under load reaches a pre-determined minimum value.
9. The riveting gun according to any of the foregoing claims from 1 to 8, **characterised in that** the drive means (4) comprise means (25) for detecting the end of each upsetting cycle; the detecting means (25) being connected to the electronic circuit (9) in order to break the circuit (9) itself at the end of each upsetting cycle.
10. The riveting gun according to claim 9, **characterised in that** the detecting means (25) comprise a proximity sensor (25).
11. The riveting gun according to claim 9 or 10, **characterised in that** the electronic circuit (9) comprises a section (F) for braking the motor (7); the braking section (F) being designed to short circuit the residual voltage present in the choke of the motor (7) each time the detecting means (25) detect the end of the upsetting cycle.
12. The riveting gun according to any of the foregoing claims from 1 to 11, **characterised in that** the upsetting cycle, starting from a point (A), comprises at least a first initial stage of gripping and retaining a mandrel, a second intermediate stage of pulling and breaking the mandrel and a third final stage of returning to the starting point (A).
13. The riveting gun according to claim 12, **characterised in that** the first, second and third stages are each marked by a respective value of current drawn by the motor (7).
14. The riveting gun according to claim 13, **characterised in that** the durations of the first, second and third stages depend on the geometrical and mechanical characteristics of the rivets (27) and of the related mandrels (28).
15. The riveting gun according to claim 13 or 14, **characterised in that** less current is drawn by the motor (7) during the first and third stages than during the second stage.
16. The riveting gun according to claim 12, **characterised in that** the first stage comprises an initial sub-stage consisting of an idle stroke and a second sub-stage of gripping the mandrel (28) of the rivet (27); these sub-stages varying according to the size of the mandrel (28).

17. The riveting gun according to claim 12, **characterised in that** the second intermediate stage comprises two sub-stages of which the first sub-stage corresponds to the initial deforming of the rivet (27), and the second sub-stage corresponds to the breaking of the mandrel (28); these sub-stages depending on the mechanical characteristics of the rivets (27) and of the related mandrels (28). 5
18. The riveting gun according to any of the foregoing claims from 15 to 17, **characterised in that** the current drawn by the motor and controlled by the electronic circuit (9) depends on the sub-stages of the first and second stages. 10 15
19. The riveting gun according to any of the foregoing claims from 1 to 18, **characterised in that** the transmission element (8) comprises a speed reduction unit (14). 20
20. The riveting gun according to claim 19, **characterised in that** the speed reduction unit (14) is an epicyclic reduction gear unit.
21. The riveting gun according to claim 19 or 20, **characterised in that** the speed reduction unit (14) itself constitutes a connecting element between the motor (7) and the gripping and pulling means (3). 25
22. The riveting gun according to any of the foregoing claims from 1 to 21, **characterised in that** the motor (7) presents an output shaft (11) whose axis of rotation (13) is transversal to the direction (D) in which the mandrels are pulled by the gripping and pulling means (3). 30 35
23. The riveting gun according to any of the foregoing claims from 1 to 22, **characterised in that** the motor (7) and the transmission element (8) are arranged in line, with respective input and/or output elements (11, 12, 15) that are aligned with and/or parallel to each other. 40 45 50 55

FIG. 1

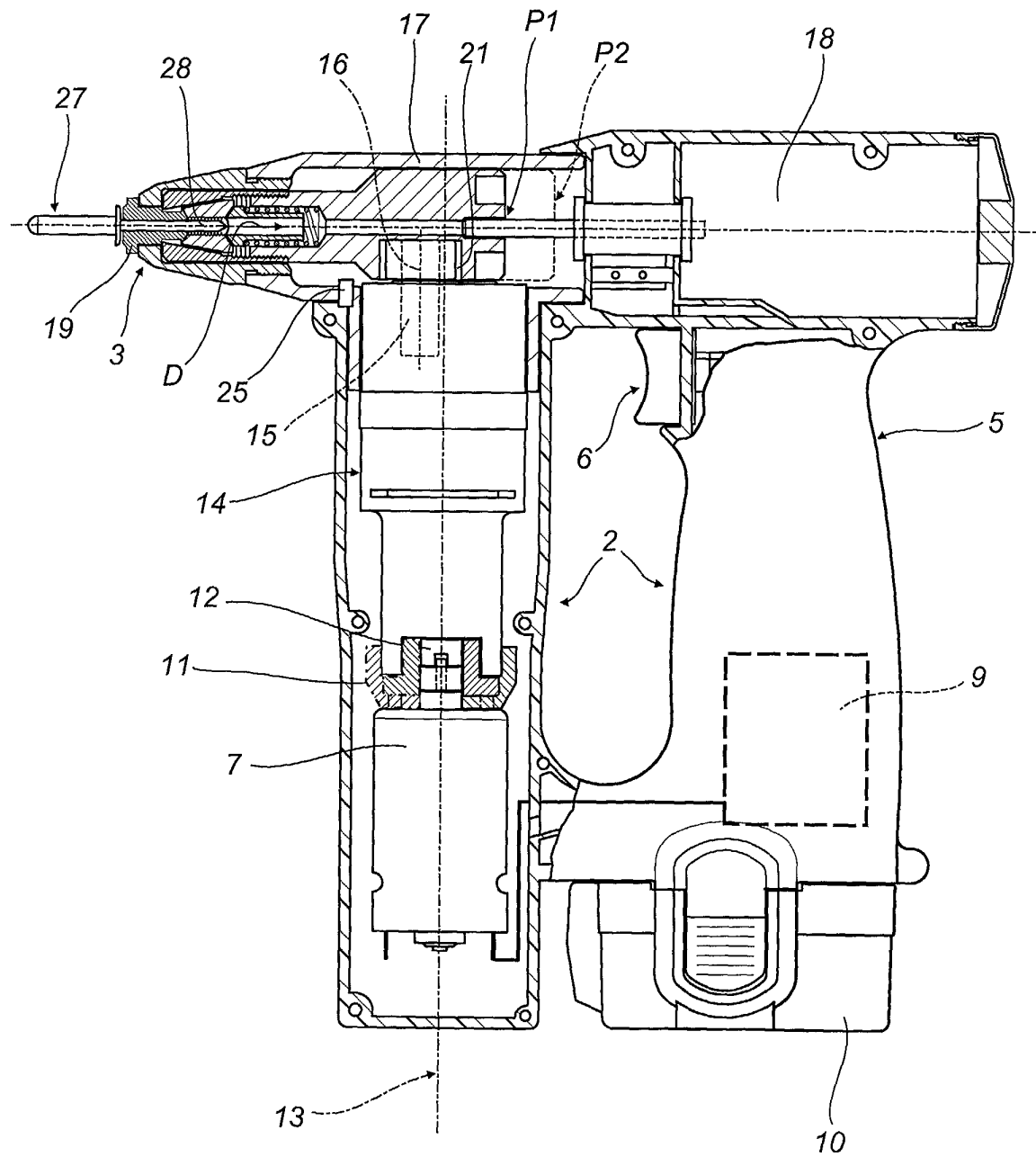


FIG. 2

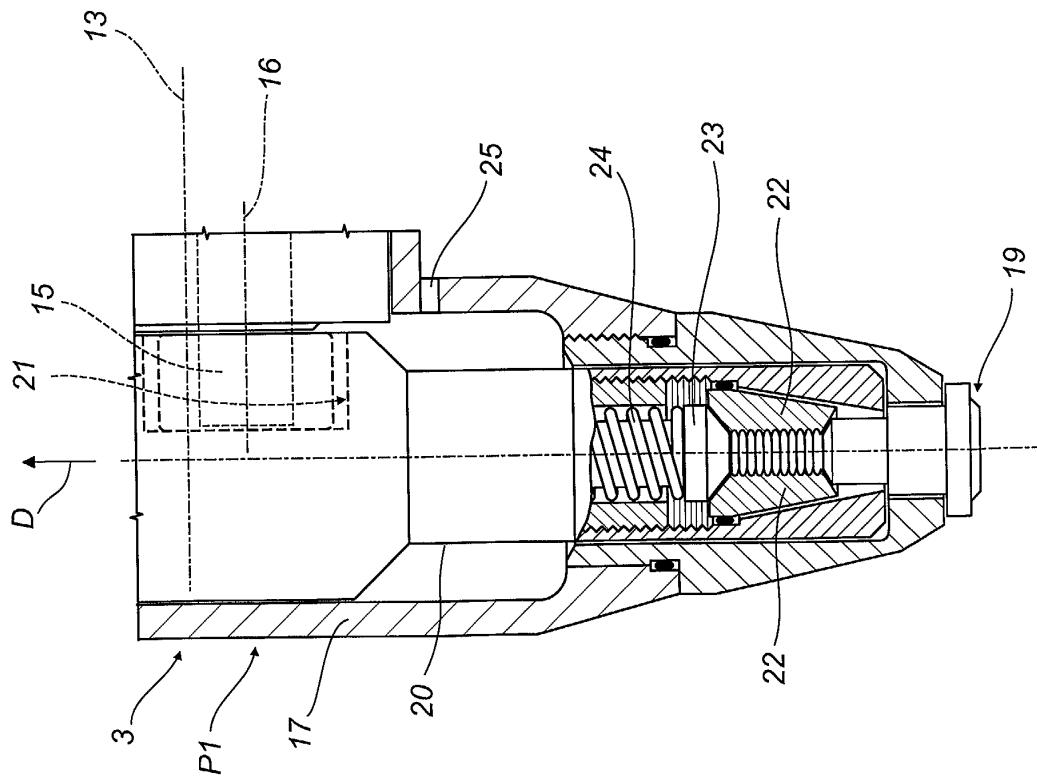


FIG. 3

