(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number : **0 445 084 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number : **91830054.2**

(51) Int. Cl.[5] : **B25B 27/00,** B25B 23/147

(22) Date of filing : **18.02.91**

(30) Priority : **02.03.90 IT 337190**

(43) Date of publication of application :
04.09.91 Bulletin 91/36

(84) Designated Contracting States :
AT BE CH DE DK ES FR GB GR LI LU NL SE

(71) Applicant : **FAR S.r.l.**
Via Marzabotto, 16
I-40127 Quarto Inferiore (Bologna) (IT)

(72) Inventor : **Cariati, Vincenzo**
Via Kharkov, 11
I-40127 Bologna (IT)
Inventor : **Lambardi, Roberto**
Via Zagabria, 14
I-40127 Bologna (IT)

(74) Representative : **Pederzini, Paolo**
c/o BUGNION S.p.A. Via dei Mille, 19
I-40121 Bologna (IT)

(54) Tool for the application of internally threaded hollow inserts.

(57) In a power screwdriver-drill for clinching hollow cylindrical inserts (50) with a flanged end (52) and an internally threaded end (53) interconnected by an collapsible centre section (54), use is made of an interchangeable bolt (7) having one end (8) threaded to match the internal thread of the insert and coupled coaxially by the remaining end (9) to a prismatic spindle (3). The motor (2) is governed by an electronic monitoring and control unit (10) wired into the power supply line (6) between the on-off switch (5) and the motor, which regulates the input voltage to a value reflecting the maximum torque requirement and comprises a transducer (13) of which the output signal, a continuous voltage proportional to the current absorbed by the motor, is used to pilot a device (14) capable of inverting the polarity of the power supply to the motor (2), and thus automatically reversing its direction of rotation, on sensing a current equal to or greater than that absorbed by the windings when sufficient power is developed to give optimum upsetting and clinching torque at the spindle (3).

EP 0 445 084 A2

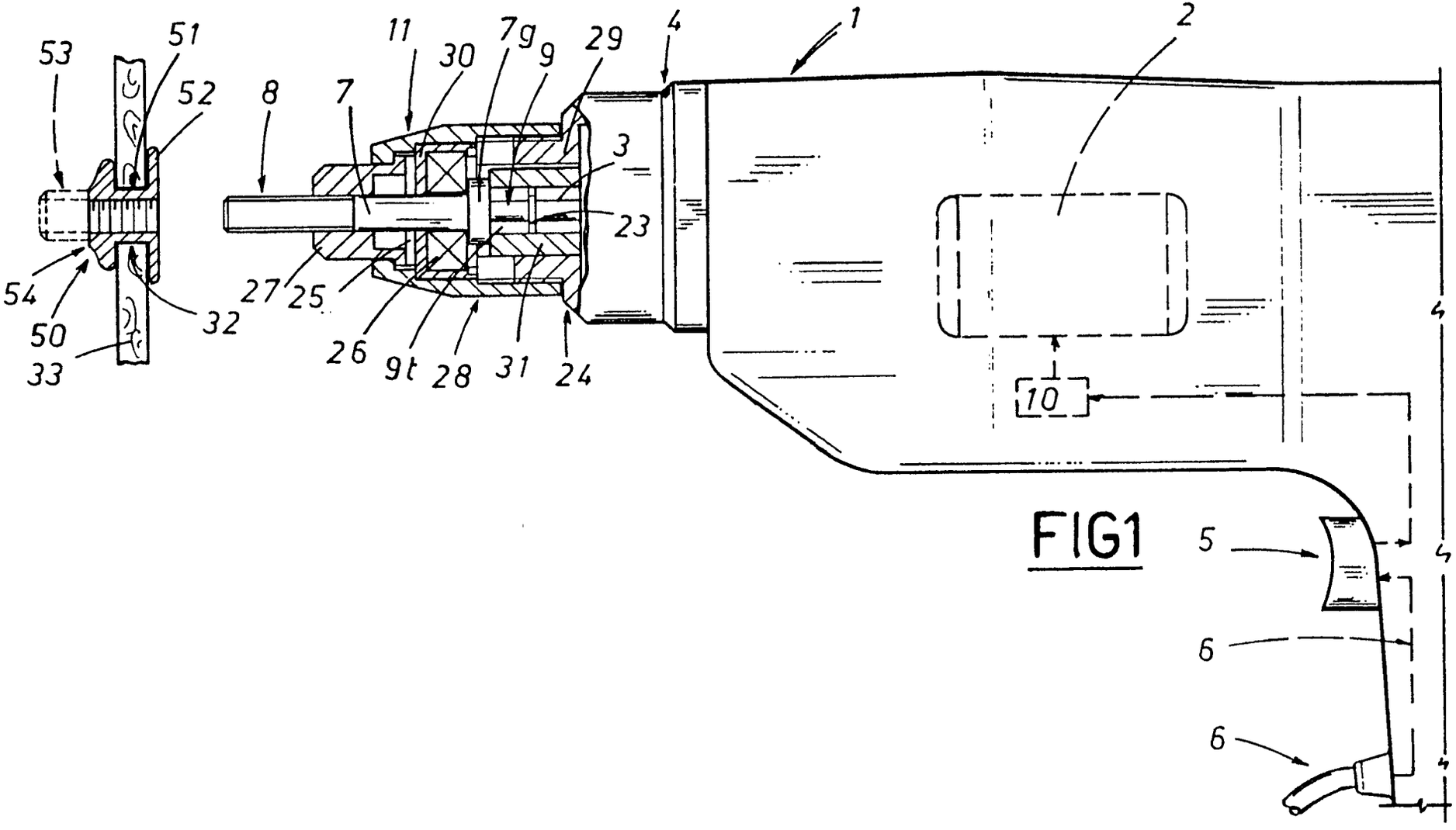
53
51
52
54
50
33
32
8
7
11
30
7g
9
29
4
1
2
3
23
27
25
26
9t
28
31
24
10
5
6
6
4
4
4

FIG1

A SCREWDRIVER-DRILL

The present invention falls within the art field of hand-held power tools and relates to an electric screwdriver-drill intended in particular for the application of internally threaded hollow inserts. Such inserts are applied, for instance, to sheet metal or similar flat material of limited thickness in order to provide anchorages for fasteners such as screws, etc..

The insert comprises a cylindrical element with a hollow cylindrical bore, of which one end affords a flange and the remaining end is internally threaded and merges with a central part of reduced thickness designed to deform radially by upsetting when force is applied to draw the threaded end back toward the flange.

As regards tools for the fitment of such inserts, the prior art embraces pneumatic drivers provided with a dual control by which a bolt, threaded at one end to match the internal thread of the insert, is screwed into and unscrewed from the cylindrical element in two distinct steps. More exactly, the bolt is inserted into the bore from the flanged end and screwed tight so as to draw the threaded end of the cylindrical element forcibly toward the flange, which remains sandwiched between a locating surface afforded by the tool and the flat surface of the material to which the insert is fixed; thereafter, the bolt is unscrewed and removed to vacate the bore and leave the insert ready for use.

From the construction standpoint, this type of tool requires a system for verifying and controlling the degree of torque transmitted to the upsetting bolt that is somewhat complex in mechanical terms.

Moreover, the direction of rotation is reversed by the operator essentially in arbitrary fashion on receipt of an indication, provided by mechanical means, that the insert is fully upset and secure.

Needless to say, it is difficult to use equipment of the type in question with any appreciable degree of precision and automatic control.

The object of the present invention is to provide a hand-held screwdriver-drill in which the direction of rotation can be reversed automatically to remove the upsetting bolt once the screwing operation is complete and the insert is secured in position.

The stated object is comprehensively realized in a screwdriver-drill as characterized in the appended claims.

The invention will now be described in detail, by way of example, with the aid of the accompanying drawings, in which:

- fig 1 provides a schematic illustration of the screwdriver-drill according to the invention, with certain parts viewed in section and others omitted better to reveal others;
- fig 2 is the block diagram of an electronic device forming part of the screwdriver-drill of fig 1.

With reference to the drawings, a screwdriver-drill according to the present invention, denoted 1 in its entirety, is intended in particular for fitting inserts 50 of the type shown in fig 1, consisting in a hollow cylindrical element 51 that affords a flange 52 at one end, and an internally threaded stretch 53 at the other end. The flange 52 and the threaded end 53 are interconnected by a central section 54 of reduced thickness which is designed to upset, spreading in the radial direction, when a contracting force is applied the insert 50 in such a way as to draw the threaded end 53 toward the flanged end 52. Applied to an insert 50 occupying a hole 32 in a panel of sheet metal 33, for example, this contracting force has the effect of tightening the cylindrical element 51 against the panel 33 on the side opposite from the flange 52.

The drill 1 is conventional in basic embodiment, comprising a case 4 that houses and supports a power mechanism including an electric motor 2 and a prismatic shank or spindle 3 for the connection of attachments or chucking devices (not illustrated).

The case 4 affords an integrally moulded hand grip enabling an operator to lay hold on the tool, and an on-off switch 5 controlling the electrical power supply line 6 to the electric motor 2.

The drill 1 according to the invention comprises an interchangeable upsetting bolt 7 of which one end 8 is threaded to match the internally threaded end 53 of the insert 50 and the opposite end 9 is embodied as a shank coupled positively and coaxially to the prismatic spindle 3.

11 denotes retaining and support means associated with and removable from the case 4, which serve both as a depth gauge designed to locate against the flange 52 of the insert 50, and as a means of disallowing axial movement of the bolt 7 relative to the flange 52 when the bolt 7 is introduced into the insert 50 from the flanged end, engaged with the internally threaded end 53 of the cylindrical element 51 and set in rotation by the prismatic spindle 3 to apply the upsetting force.

The drill 1 further comprises an electronic unit 10 for monitoring and controlling the operation of the electric motor 2, connected to the electrical power supply line 6 between the on-off switch 5 and the motor 2; the unit 10 in question comprises at least one voltage regulator 12 wired on the input side to the switch 5, hence to the power supply 6, and able to generate output voltage of a predetermined value that is a function of the maximum rated torque of the motor 2. The output of the voltage regulator 12 is connected to the input of an absorbed current transducer 13, the output of which is a continuous voltage proportional to the current absorbed by the motor 2; this is used to pilot a device 14 capable of inverting the polarity of the

power supply to the electric motor 2, hence reversing its direction of rotation, whenever the current input to the transducer 13 becomes equal to or greater than a predetermined value corresponding, in practice, to the current absorbed by the motor 2 in developing a degree of power such as will torque the spindle 3 sufficiently to clinch the insert 50, drawing the threaded end 53 further toward the flange 52 at the moment in which the central section 54 has been fully upset by the action of the bolt 7 and thus securing it to best possible effect.

The voltage regulator 12 and the absorbed current transducer 13 are interlocked to means 15 by which to control the value of the input voltage to the inverter 14; these same means 15 also control the maximum absorbed current value, determined on the basis of the mechanical deformation properties of the insert 50, which triggers the activation of the inverter 14.

Such control means 15 might consist in a regulator calibrated in discrete steps, with a continuous regulator to give fine adjustment.

The output from the absorbed current transducer 13 to the inverter 14 is taken off additionally to an electronic monitoring and control loop 16 capable of limiting the threshold current values beyond which the inverter is triggered into operation.

The monitoring and control loop 16 comprises a filter 17 serving to eliminate mains interference and limit the peak voltage at the output of the absorbed current transducer 13 when the motor 2 is started up, a threshold circuit 18 of which the output signal is dependent on a predetermined input value, and a corrective delay network 19 serving both to effect an additional filtering action in respect of the voltage signal from the absorbed current transducer 13 by eliminating the residual peak value when the motor is started, and to delay the activation of the inverter 14 for a selectable interval sufficient, in practical terms, to ensure that the insert 50 is fully upset and clinched.

Such a delay is indispensable should it happen, as the insert 50 begins to deform, that greater power is required from the electric motor 2 in order to generate a torque capable of overcoming resistance offered by a particularly rigid or tough insert 50; higher power in turn dictates proportionally higher values of absorbed current, and earlier activation of the inverter device 14 by the transducer 13.

Accordingly, in this instance, the corrective delay network 19 will retard the inversion signal for a duration sufficient to allow the motor 2 to clinch the insert 50 fully.

The corrective network 19 is adjustable, in that its delay time constant in respect of the input signal can be increased or decreased.

The output of the corrective network 19 is directed into a memory circuit 20 by which the correction signal is retained so as to avoid any unwarranted interruption of the inversion signal, and emission of a further inversion signal, in the event of a momentary break in the power supply 6 occasioned by accidental release of the switch 5, for example.

The inverter 14 is also wired direct to the power supply input 6 by way of an auxiliary circuit 6a and activated at the moment when this same circuit is activated.

The threshold circuit 18 is interlocked likewise to the control means 15, and its threshold value thus regulated according to the mechanical deformation properties of the insert 50.

The inverter 14 is connected further to means 14a for reversing the direction of rotation manually.

The memory circuit 20 is interlocked to a relative reset/reset-delay circuit 21 wired directly in its turn to the on-off switch 5, by means of which the memory reset can be retarded. This is of particular importance in preventing parasitic oscillations or unwanted reverse manoeuvres; in effect, time must be allowed for the motor 2 to stand still before a further cycle can be commenced in order to avoid inversions of rotation with the motor still in movement, and the electrotechnical problems that would ensue from such an event.

Reverting now to the mechanical features of the screwdriver-drill according to the invention, the upsetting bolt 7 (fig 1) exhibits an intermediate boss, denoted 7g, whilst the shank end 9 coupled with the prismatic spindle 3 affords a socket 23 matched to and accommodating the profile of the spindle 3. In the preferred embodiment of fig 1, this end 9 of the bolt 7 is fashioned in two parts: a prismatic shank 9t integral with the bolt 7, and a sleeve 31 which positively ensheaths both the prismatic spindle 3 and the prismatic shank 9t of the bolt 7.

The retaining and support means 11 consist in an axially hollow shroud 24, an interchangeable stop collar 27, and a locking cap 28.

The shroud 24, which can be fastened to and removed from the case 4, freely encompasses the end 9 of the bolt 7 associated with the prismatic spindle 3 and affords a seating 25 in which to accommodate dynamic restraint means 26 breasted frontally with the boss 7g of the bolt 7 and serving to keep the shank 9 stably in association with the spindle 3.

The stop collar 27 can be fastened to and removed from the shroud 24, and is designed to register with the flange 52 of the insert 50; when fitted, the collar is disallowed angular movement about the axis of rotation of the spindle 3. To advantage, a screw fit between the cap 28 and the shroud 24 permits of securing the collar 27 and allows its removal and replacement according to the external diameter of the insert 50, thereby achieving the interchangeability aforementioned.

The shroud 24 is embodied in two coaxial parts 29 and 30, the first 29 fastened permanently to the case

4 and the second 30 associated with the first by fitment of the locking cap 28; accordingly, the second part 30 can be made interchangeable to suit the external diameter of the insert 50. The two parts 29 and 30 of the shroud 24 thus provide the seating 25 for the dynamic restraint means 26, which can take the form of conventional thrust bearings.

It will be clear enough that a drill structured in the manner described above can be utilized to fit different sizes of inserts 50 simply by changing the upsetting bolt 7, the stop collar 27 and the removable part 30 of the shroud 24 together with the thrust bearing, and effecting the appropriate adjustment of the current transducer 13 and the threshold circuit 18.

In a screwdriver-drill according to the invention, the drawbacks stated at the outset are overcome by expedients affording simplicity, precision and compactness, and in particular, enabling the use of a reliable electric motor with limited servicing requirements.

Moreover, the precision of the control afforded is notable.

Claims

1) A screwdriver-drill (1), comprising a case (4) espectively housing and supporting an electric motor (2) and a prismatic spindle (3) to which attachments or chucking devices can be connected, and incorporating an on-off switch (5) wired into the electrical supply line (2) to the motor (2), intended in particular for applying inserts (50) of the type consisting in a hollow cylindrical element (51) affording a flange (52) at one end and an internal thread at the opposite end (53) merging with a central section (54) of reduced thickness that is designed to upset by spreading radially when a contracting force is applied to draw the threaded end (53) toward the flange (52), characterized

in that it comprises:

– an interchangeable upsetting bolt (7) of which one end (8) is threaded to match the threaded end (53) of the insert (50) and the remaining end is coupled coaxially to the prismatic spindle (3);

– retaining and support means (11) associated with and removable from the case (4), serving to provide a locating element offered to the flanged end (52) of the insert (50) and to disallow axial movement of the upsetting bolt (7) in relation to the flange when the bolt (7) is introduced into the axial bore of the insert (50) by way of the flanged end (52), screwed into the threaded end (53) of the insert and set in rotation by the prismatic spindle (3) to apply the contracting force;

– an electronic unit (10) monitoring and controlling the operation of the electric motor (2), wired into the electrical power supply line (6) between the on-off switch (5) and the motor and comprising: at least one voltage regulator (12) connected on the input side to the part of the power supply line (6) controlled by the on-off switch (5) and delivering an output voltage of predetermined value that is a function of the maximum torque developed by the motor; an absorbed current transducer (13) driven by the voltage regulator (12), of which the output is a continuous voltage proportional to the current absorbed by the motor; and a device (14), piloted by the absorbed current transducer (13) and capable of inverting the polarity of the electrical power supply to the electric motor (2) hence of reversing its direction of rotation, at the moment in which the transducer (13) senses a current value equal to or greater than the value of the current absorbed by the motor (2) in developing power sufficient to produce torque at the prismatic spindle (3) such as will draw the threaded end (53) of the insert (50) closer to the flange (52) once the central section (54) of the insert has been fully upset by the action of the bolt (7), and thus secure the insert to best possible effect.

2) A screwdriver-drill as in claim 1, wherein the voltage regulator (12) and the absorbed current transducer (13) are interlocked to means (15) by which to control the values of the output voltage supplied to the inverter device (14) and of the absorbed current limit that triggers activation of the inverter device (14), respectively, according to the mechanical deformation properties of the insert (50).

3) A screwdriver-drill as in claim 1, wherein the output signal directed from the absorbed current transducer (13) into the inverter device (14) is taken off additionally to an electronic monitoring and control loop (16) capable of limiting the threshold values of absorbed current beyond which the activation of the inverter device (14) is triggered.

4) A screwdriver-drill as in claim 3, wherein the monitoring and control loop (16) comprises, in sequence:

– a filter (17), connected to the absorbed current transducer (13), capable of eliminating mains interference and limiting the voltage peak which registers at the output of the absorbed current transducer (13) when the motor (2) is started;

– a threshold circuit (18) capable of generating an output signal dependent upon a given input signal value;

– a corrective delay network (19) designed to eliminate residual peak starting voltage and able to retard the activation of the inverter device (14) for a selectable duration sufficient to ensure that the insert (50) is fully upset and secured;

– a memory circuit (20) by which the signal from the corrective network (19) is retained to the end of avoiding any interruption of the inversion sig-

nal, and emission of a further inversion signal, caused as the result of a momentary break in the power supply line (6).

5) A screwdriver-drill as in claim 1, wherein the inverter device (14) is also connected directly to the power supply line (6) by way of an auxiliary circuit (6a) and activated at the moment of activating the circuit.

6) A screwdriver-drill as in claim 4, wherein the voltage regulator (12), the absorbed current transducer (13) and the threshold circuit (18) are interlocked to means (15) by which to control the values of the voltage supplied to the inverter device (14), of the absorbed current limit which triggers activation of the inverter device (14) and of the maximum threshold, respectively, according to the mechanical deformation properties of the insert (50).

7) A screwdriver-drill as in claim 1, wherein the inverter device (14) is connected to means (14a) by which inversion can be controlled manually.

8) A screwdriver-drill as in claim 4, wherein the memory circuit (20) is interlocked to a relative reset/reset-delay circuit (21) connected directly to the on-off switch (5) and capable of delaying reset of the memory.

9) A screwdriver-drill as in claim 1, comprising an upsetting bolt (7) embodied with an intermediate boss (7g), and a socket (23) at the end (9) coupled coaxially with the prismatic spindle (3) by which the spindle (3) is accommodated in its entirety, wherein retaining and support means (11) comprise:

- an axially hollow shroud (24) freely accommodating the end (8) of the upsetting bolt (7) coupled with the prismatic spindle (3), associated removably with the case (4) and affording a seating (25) to accommodate dynamic restraint means (26) by which the bolt (7) is kept in positive association with the prismatic spindle (3);
- a stop collar (27) designed to register against the flange (52) of the insert (50), associated with the shroud (24) removably and in such a way as to remain incapable of angular movement about the axis of rotation of the prismatic spindle (3) when in use;
- a locking cap (28) serving to secure the stop collar (27) to the shroud (24), and removable to permit of replacing the collar (27) according to the external diameter of a given insert (50).

10) A screwdriver-drill as in claim 9, wherein the shroud (24) is embodied in two coaxial parts, of which a first part (29) is associated permanently with the case (4) and a second part (30) is secured to and removable from the first by means of the locking cap (28) in such a way as to be rendered interchangeable in respect of the external diameter of the insert (50), and of which the encompassed space affords the seating (25) for the dynamic restraint means (26).

11) A screwdriver-drill as in claim 9, wherein the end (9) of the upsetting bolt (7) coupled with the prismatic spindle (3) is embodied in two parts, consisting in a prismatic shank (9t) integral with the bolt and an axial sleeve (31) by which both the prismatic spindle (3) and the prismatic shank (9t) are positively ensheathed.

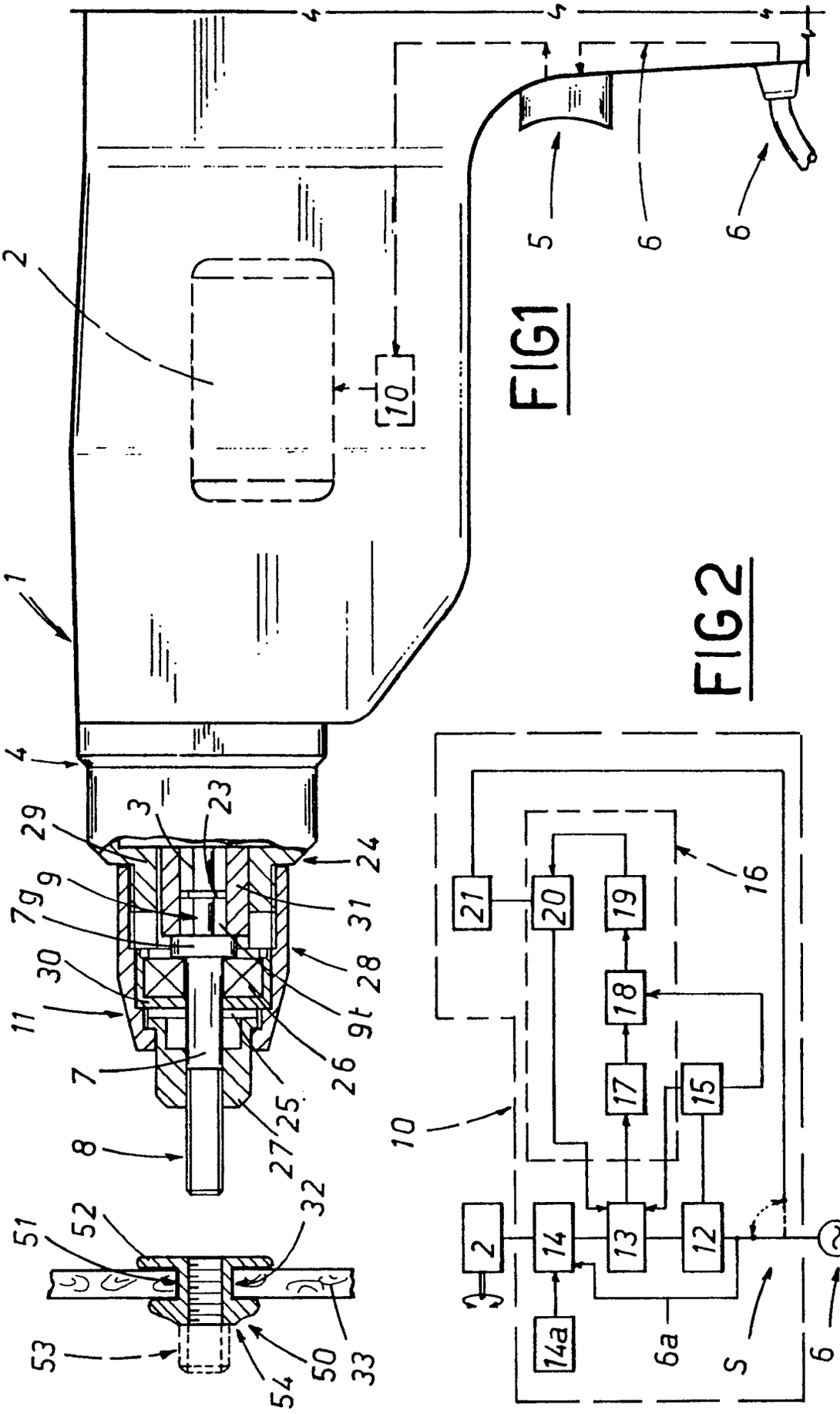
4
4
4
5
6
6
2
10
1
4
3
23
29
24
9
7g
31
30
28
11
9t
26
7
25
27
8
32
51
52
53
54
50
33

FIG1

FIG2

16
21
20
19
18
17
15
10
2
14
13
12
14a
6a
S
6