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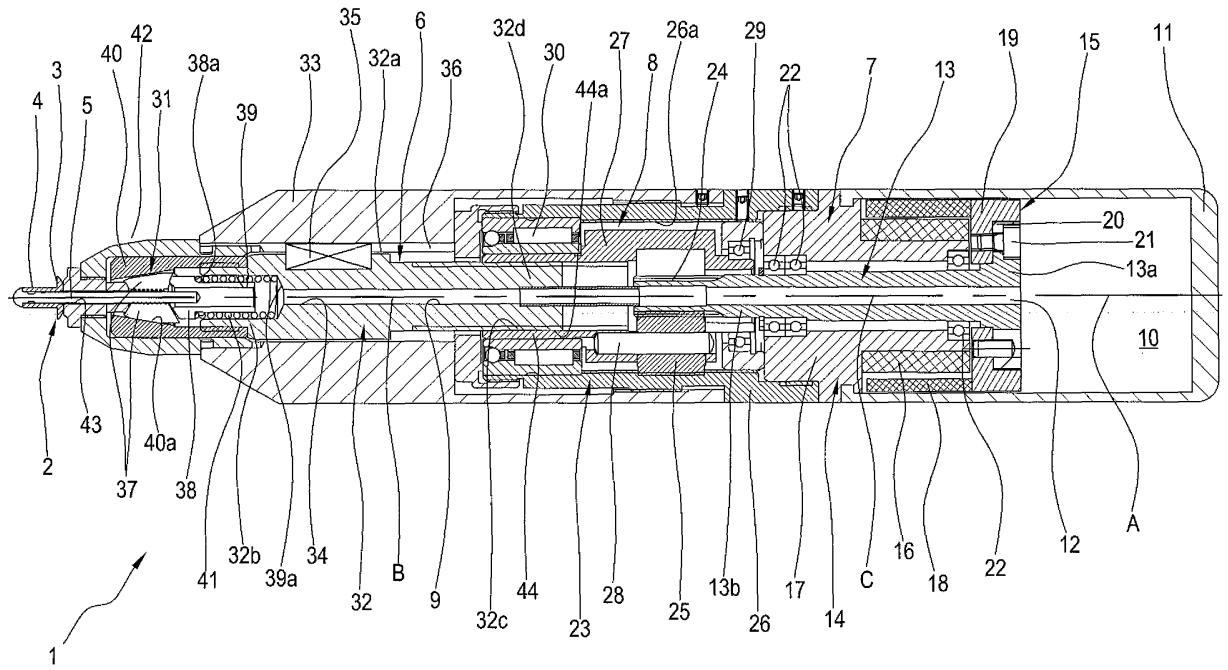
(54) Electric machine for applying fastening elements

(57) An electric riveter comprises a pulling element (6) which can be connected to a rivet (2) and can move in a pulling direction (B) to move a rivet (2) stem (5) and apply the rivet (2); an electric motor (7) connected to the pulling element (6) for moving it in the pulling direction (B); transmission means (8) positioned between the electric motor (7) and the pulling element (6); the electric riveter also having a longitudinal channel (9) for expulsion of the stem (5); the electric motor (7) having an axis of rotation (C) which is aligned with the pulling direction (B). [Figure 1]

FIG 1



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Description

[0001] The present invention relates to an electric machine for applying fastening elements such as rivets or threaded inserts whose installation involves their deformation.

[0002] Machines for applying inserts or rivets comprise pulling means intended to be associated with a corresponding fastening element so as to deform it in such a way that it is fixed in its hole.

[0003] In the case of machines for applying inserts, commonly known as "machines for inserts", the pulling means comprise a threaded male component designed to engage with the thread of the corresponding insert.

[0004] The rotary action of the male component, in the machines for inserts referred to in this description, is converted on the stationary insert into a pulling action on the threads which causes deformation of the insert, locking it in its hole.

[0005] Machines for applying rivets, commonly known as "machines for rivets" or "riveters", referred to herein without thereby limiting the scope of the invention, deform the rivet by extracting a mandrel or stem from it.

[0006] As is known, rivets comprise a pre-formed factory head, a cylindrical shank, which together form a deformable bush, and a stem located inside the bush, interfering with the shank and designed to partly deform the shank to form a shop or upset head during rivet application.

[0007] The pulling means grip the stem and extract it from the rest of the rivet, causing deformation of the shank (and formation of the shop head) and breakage of the stem.

[0008] The pulling means comprise gripping means for firmly gripping the stem and movement means connected to the gripping means for extracting the stem by means of a straight movement.

[0009] Prior art electric machines for applying rivets or inserts also comprise an electric motor for driving the pulling means, the motor being positioned alongside the pulling means.

[0010] More precisely, the electric motor is positioned in a compartment made in a machine handle. Suitable transmission means allow the transfer of the required torque from the electric motor to the pulling means. In prior art electric machines for rivets or inserts, the transmission means comprise a plurality of gears connected to each other.

[0011] Disadvantageously, such prior art electric machines are very large, since the electric motor must be housed in the handle compartment.

[0012] Moreover, since the motor is alongside the pulling means, the transmission means are complex and bulky.

[0013] In this context, the technical purpose of the present invention is to propose an electric machine for applying fastening elements, threaded inserts or rivets, which is free of the above-mentioned disadvantages.

[0014] In particular, the present invention has for an aim to propose an electric machine for applying fastening elements which features compact dimensions.

[0015] The present invention also has for an aim to propose an electric machine for applying fastening elements which is simple to make.

[0016] Accordingly, the present invention achieves the technical purpose and the aims described with an electric machine for applying fastening elements comprising the technical features described in one or more of the appended claims.

[0017] Further features and advantages of the present invention are more apparent in the non-limiting description below, with reference to a preferred, non-limiting embodiment of an electric riveter, as illustrated in the accompanying drawings, in which:

- Figure 1 is a side view in cross-section of an electric machine for applying rivets according to the present invention;
- Figure 2 is a side view in cross-section of an electric machine for applying threaded inserts according to the present invention.

[0018] With reference to the accompanying drawings, the numeral 1 denotes as a whole an electric machine for applying fastening elements, a machine for rivets or riveter in Figure 1 and a machine for inserts in Figure 2, according to the present invention.

[0019] With reference to Figure 1, the electric machine 1 is designed to apply rivets 2 of the pop rivet type (otherwise known as blind rivets). The latter comprise, before application, a pre-formed factory head 3 and a hollow cylindrical shank 4, which together form a deformable bush. A mandrel or stem 5 is inserted in the shank 4 and interferes with the shank in such a way that, when the stem 5 is extracted during rivet 2 application, the shank 4 is partly deformed to form a shop head (not illustrated).

[0020] The electric riveter 1 has a substantially cylindrical shape and extends along its own longitudinal axis "A". The electric riveter 1 comprises a pulling element 6 acting on the rivet 2 stem 5 to extract the stem during rivet application. The pulling element 6 can move in a pulling direction "B" extending at least parallel with the longitudinal axis "A" of the electric machine 1. In the accompanying drawing, the pulling direction "B" coincides with the longitudinal axis "A".

[0021] As explained in more detail below, the pulling element 6 is located at a first end 1a of the electric machine 1.

[0022] An electric motor 7 is connected, by transmission means 8, to the pulling element 6 so as to move it in the pulling direction "B".

[0023] In more detail, the electric motor 7 is positioned in such a way that it axis of rotation "C" is aligned with the pulling direction "B". In other words, the axis of rotation "C" of the electric motor 7 coincides with the pulling direction "B" of the pulling element 6.

[0024] Advantageously, the electric motor 7 is positioned within the cylindrical transversal dimensions of the electric riveter 1.

[0025] The electric riveter 1 of Figure 1 also has a channel 9 positioned longitudinally for allowing the expulsion of waste, that is to say, of the stem 5, or part of it, once it has been extracted and the rivet 2 has been applied.

[0026] The channel 9 extends from the pulling element 6 along the entire longitudinal axis "A" of the electric riveter 1, leading to a containment compartment 10 formed by a box-shaped body 11 positioned at a second end 1b of the electric riveter 1, opposite the first end 1a.

[0027] To allow extension of the channel 9, the electric motor 7 has a central cavity 12 positioned coaxially with the axis of rotation "C" of the electric motor 7, thus at least partly forming the channel 9 and consequently allowing waste expulsion. Advantageously, the central cavity 12 is substantially cylindrical.

[0028] In general, the electric motor 7 comprises a driving shaft 13 positioned along the longitudinal axis "A" of the electric riveter 1 in such a way that the axis of rotation "C" of the electric motor 7 is at least parallel with the longitudinal axis "A" and coincides with the pulling direction "B". The driving shaft 13 is hollow, forming the central cavity 12. In other words, the driving shaft 13 has a sleeve configuration.

[0029] In particular with reference to the preferred embodiment, the electric motor 7 is of the brushless type and comprises a stator 14 and a rotor 15.

[0030] The stator 14 comprises a plurality of windings 16 (schematically illustrated in the accompanying drawing) made of copper and positioned so that they are separated from each other by equal angles on a fixed support 17.

[0031] The rotor 15 is connected to the driving shaft 13 to drive the rotation of the latter and comprises at least one permanent magnet 18. In more detail, the rotor 15 comprises a plurality of permanent magnets 18 (schematically illustrated in the accompanying drawing).

[0032] The magnets 18 are placed alongside the windings 16 and are advantageously positioned on the outside of the windings. In other words, the magnets 18 lie in a distal position relative to the axis of rotation "C" of the electric motor 7 so that the windings 16 are positioned between the magnets 18 and the axis of rotation "C".

[0033] The rotor 15 also comprises a ring 19 connecting it to the driving shaft 13. In particular, the driving shaft 13 comprises a flange 20 positioned at its first end 13a giving onto the containment compartment 10 for the extracted stems 5.

[0034] The ring 19 is fixed to the permanent magnets 18 and is connected to the driving shaft 13. More precisely, the ring 19 is connected to the driving shaft 13 flange 20 by screws 21 positioned in such a way that they are separated by equal angles.

[0035] The driving shaft 13 is rotatably connected to the stator 14 support 17 by a plurality of ball bearings 22.

[0036] Suitable electronic control means (not illustrated in the accompanying drawing) allow electricity to be supplied to the windings 16 so that they generate a rotary magnetic field, that is to say, the control means allow the electric machine 1 to be operated.

[0037] The magnetic field moves the rotor 15 permanent magnets 18, rotating the rotor and, with it, the driving shaft 13.

[0038] It should be noticed that the electric motor 7 configuration described avoids, in the riveter of Figure 1, interference with the waste extracted.

[0039] When the waste is moved away along the channel 9 (for example, by gravity by tilting the electric riveter 1) and passes through the central cavity 12, the magnetic field generated by the motor has no effect at all whether the motor is switched on or off. Moreover, since the rotor 15 permanent magnets 18 are far from the axis of rotation, the magnetic field they generate does not interfere with waste transit.

[0040] In the machine 1 according to the present invention, the electric riveter 1 transmission means 8 comprise a device 23 for reducing the speed which is interposed between the electric motor 7 and the pulling element 6.

[0041] In the example described, the reduction device 23 is single - stage and of the type with an epicyclic train and comprises a central (or sun) gear 24 directly connected to electric motor 7.

[0042] In the riveter shown in Figure 1, the sun gear 24 is hollow so that in combination with the central cavity 12 of the electric motor 7 it at least partly forms the channel 9 for moving away the extracted stems 5.

[0043] In more detail, the hollow sun gear 24 is coaxial with the driving shaft 13 and is fixed to a second end 13b, opposite the first end, of the driving shaft 13 and is made in one piece with the latter.

[0044] The reduction device 23 also comprises at least one planet gear 25 meshing with the sun gear 24 and able to rotate about the latter. In the embodiment described, the reduction device 23 comprises three planet gears 25 spaced at equal angular intervals of 120° from each other. In that way, during electric riveter 1 operation, the planet gears 25 are balanced and do not induce vibrations.

[0045] The planet gears 25 also mesh with a fixed ring gear 26 coaxial with the pulling direction "B". As shown in the accompanying drawing, the ring gear 26 has a toothed surface 26a facing inwards.

[0046] The planet gears 25 are supported by a carrier 27 by means of respective pins 28. The carrier 27, connected to the pulling element 6 so as to move the latter, is rotatably supported by ball bearings 29 and/or combined bearings 30.

[0047] During operation, the carrier 27 is rotationally driven by the sun gear 24 by means of the planet gears 25. It should be noticed that the ratio of the angular speed of the carrier 27 to the angular speed of the driving shaft 13 is determined by the ratio of the number of teeth on the central sun gear 24, the planet gears 25, the ring gear

26 and the carrier 27.

[0048] As is more apparent below, in the riveter 1 the transmission means 8 are connected to the pulling element 6 by a screw connection, so as to transmit and convert a rotary motion from the electric motor 7 into a linear motion by the pulling element 6.

[0049] In the example described, the pulling element 6 comprises gripping means 31, needed to firmly grip the rivet 2 stem 5 and a slider 32 connected to the gripping means 31 and able to move to and fro in the pulling direction "B" to move the gripping means 31.

[0050] The slider 32 has a substantially cylindrical shape and is housed in a hollow containment body 33. The slider 32 comprises a central longitudinal hole 34 extending in the pulling direction "B" so that it partly forms the channel 9 for expulsion of the extracted stems 5.

[0051] The slider 32 comprises a tab 35 extending longitudinally on its side surface 32a. The tab 35 is housed in a straight guide 36 made in the containment body 33 in such a way that the slider 32 can only move with a straight to and fro motion in the containment body 33.

[0052] The gripping means 31 are connected to the slider 32 at its first end 32b positioned close to the first end 1a of the electric riveter 1.

[0053] In the example illustrated, the gripping means 31 comprise at least two jaws 37 designed to engage directly with the rivet 2 stem 5 and a supporting body 38 connected to the jaws 37. The supporting body 38 is substantially cylindrical and hollow, forming the expulsion channel 9. The supporting body 38 is slidably housed in a socket 39 made in the first end 32b of the slider 32.

[0054] The jaws 37 are held in contact with a hollow closing element 40 screwed onto the slider 32. In more detail, the jaws 37 are in contact with tapered inner surfaces 40a of the hollow closing element 40.

[0055] A spring 41 is positioned in the socket 39, between the slider 32 and the gripping means 31 supporting body 38. More precisely, the spring 41 acts between a base 39a of the socket 39 and a shoulder 38a of the supporting body 38. The spring 41 guarantees that the gripping means 31 are held in position and, in particular, guarantees that the jaws 37 are in contact with the hollow closing element 40.

[0056] The containment body 33 comprises an end portion 42 positioned at the first end 1a of the electric riveter 1. Said end portion 42 is hollow and at least partly houses the gripping means 31 and the hollow closing element 40.

[0057] The end portion 42 has a hole 43, allowing insertion of the stem 5 of the rivet 2 to be applied, until it reaches the gripping means 31.

[0058] As already indicated, the transmission means 8 are connected to the pulling element 6 by a screw connection.

[0059] In detail, the carrier 27 is connected by threading to the slider 32. The carrier 27 comprises a sleeve 44, coaxial with the pulling direction "B", having a threaded portion 44a meshing with a corresponding threaded portion 32c of the slider 32 at a second end 32d of the slider.

[0060] The rotation of the carrier 27 and, therefore, of the sleeve 44 is transmitted to the slider 32. However, it should be noticed that the latter is connected in such a way that it can only translate. In that way, the rotary motion of the carrier 27 is converted into the linear to and fro motion of the slider 32.

[0061] In an alternative embodiment, the transmission means 8 do not comprise any reduction device.

[0062] In that case, the transmission means comprise a sleeve fixed to the driving shaft 13 and connected in a similar way to the slider 32.

[0063] With reference to Figure 2, showing a machine for applying inserts, it should be noticed that the machine 1 is substantially similar to the riveter of Figure 1.

[0064] In the embodiment illustrated, the machine 1 for inserts does not have the longitudinal cavity for waste expulsion, there being no waste, and it differs from the machine 1 for rivets because of its different pulling element.

[0065] In alternative embodiments not illustrated, the machine 1 for inserts also has the longitudinal cavity 9 although it remains unused.

[0066] In the machine 1 for inserts, the pulling element 6 is, similarly, rotationally driven by the electric motor 7 using the transmission means 8.

[0067] In particular, the pulling element 6 comprises a rotary body 50 and a threaded male component 51 connected to the body 50 and designed to engage in a corresponding threaded insert 52.

[0068] The rotary body 50 can rotate inside the hollow containment body 33 and, in the preferred embodiment illustrated by way of example it is formed by the carrier 27 to which the male component 51 is connected.

[0069] The insert 52 has a portion 53 with inner threading and a deformable portion 54. The pulling action is obtained, in the substantially known way, by rotation of the male component 51 which is translated into a translating motion by the portion 53 against the portion 54 which yields, becoming deformed and guarantees insert 52 fixing in the corresponding hole. In alternative embodiments not illustrated, the electric machine 1 for applying fastening elements according to the present invention comprises a handle extending transversally to the longitudinal axis "A".

[0070] Advantageously, in that configuration, the handle houses the electronic control means.

[0071] The invention fulfils the proposed aims and achieves important advantages.

[0072] Since the electric motor is positioned so that it is aligned with the pulling direction of the pulling element, the dimensions of the electric riveter are definitely contained. Also, special compartments for housing the electric motor are not necessary.

[0073] Even the transmission between the electric motor and the pulling element is simpler, with consequent simplification of the entire electric machine.

[0074] It should also be noticed that, in the machine for rivets, the configuration of the electric motor simplifies waste expulsion. As already indicated, there is no magnetic interference along the expulsion channel.

Claims

1. A machine for applying fastening elements comprising:

   - a pulling element (6) which can be connected to a fastening element (2, 52) to pull it in a pulling direction (B) so as to deform and apply the fastening element (2, 52);
   - an electric motor (7) for driving the pulling element (6);
   - motion transmission means (8) acting between the electric motor (7) and the pulling element (6);

   the machine being **characterised in that** the electric motor (7) has an axis of rotation (C) which is aligned with the pulling direction (B).

2. The machine according to claim 1, **characterised in that** the pulling element (6) comprises a threaded male component (51) which can be connected to a threaded insert (52) forming the fastening element (2), the pulling element (6) deforming the threaded insert (52) by means of the pulling action caused by engagement between the thread of the male component (51) and a threaded portion (53) of the threaded insert (52).

3. The machine according to claim 1**, characterised in that** the pulling element (6) can be connected to a rivet (2) forming the fastening element (2), the pulling element (6) being able to move in the pulling direction (B) so as to move a rivet (2) stem (5) and apply the rivet (2).

4. The machine according to claim 3, **characterised in that** it comprises a longitudinal channel (9) for waste expulsion.

5. The machine according to claim 4, **characterised in that** the electric motor (7) comprises a central cavity (12) coaxial with the axis of rotation (C), at least partly forming the expulsion channel (9).

6. The machine according to claim 5, **characterised in that** the electric motor (7) comprises a hollow driving shaft (13) coaxial with the axis of rotation (C); the hollow driving shaft (13) forming the central cavity (12).

7. The machine according to any of the foregoing claims, **characterised in that** the electric motor (7) is of the brushless type.

8. The machine according to claim 7, **characterised in that** the electric motor (7) comprises a stator (14) having a plurality of windings (16) and a rotor (15), connected to a driving shaft (13) of the electric motor (7), having at least one magnet (18); the magnet (18) being positioned on the outside of the windings (16).

9. The machine according to claim 8, **characterised in that** the electric motor (7) comprises a ring (19) for connecting the rotor (15) to the driving shaft (13).

10. The machine according to claim 9, **characterised in that** the ring (19) is connected to the magnet (18) of the rotor (15) and to the driving shaft (13).

11. The machine according to any of the foregoing claims, **characterised in that** the transmission means (8) comprise a speed reduction device (23) for connecting the electric motor (7) to the pulling element (6).

12. The machine according to claim 11, **characterised in that** the reduction device (23) is of the type with an epicyclic train and comprises a sun gear (24) connected to the electric motor (7); the sun gear (24) being hollow, thus at least partly forming the channel (9) for waste expulsion.

13. The machine according to claim 12, **characterised in that** the sun gear (24) is coaxial with a hollow driving shaft (7) of the electric motor (7) and is made in one piece with said shaft.

14. The machine according to claim 12 or 13, **characterised in that** the reduction device (23) comprises a carrier (27) rotationally driven by the sun gear (24), the carrier being connected to the pulling element (6) so as to transfer motion to the latter.

15. The machine according to claim 14, **characterised in that** the reduction device (23) comprises a fixed ring gear (26) and at least one planet gear (25) positioned between the ring gear (26) and the sun gear (24); the planet gear (25) being connected to the carrier (27) so as to drive the movement of the carrier.

16. The machine according to claim 3, **characterised in that** the transmission means (8) are connected to the pulling element (6) by a screw connection for converting a rotary motion from the electric motor (7) into a linear motion by the pulling element (6).

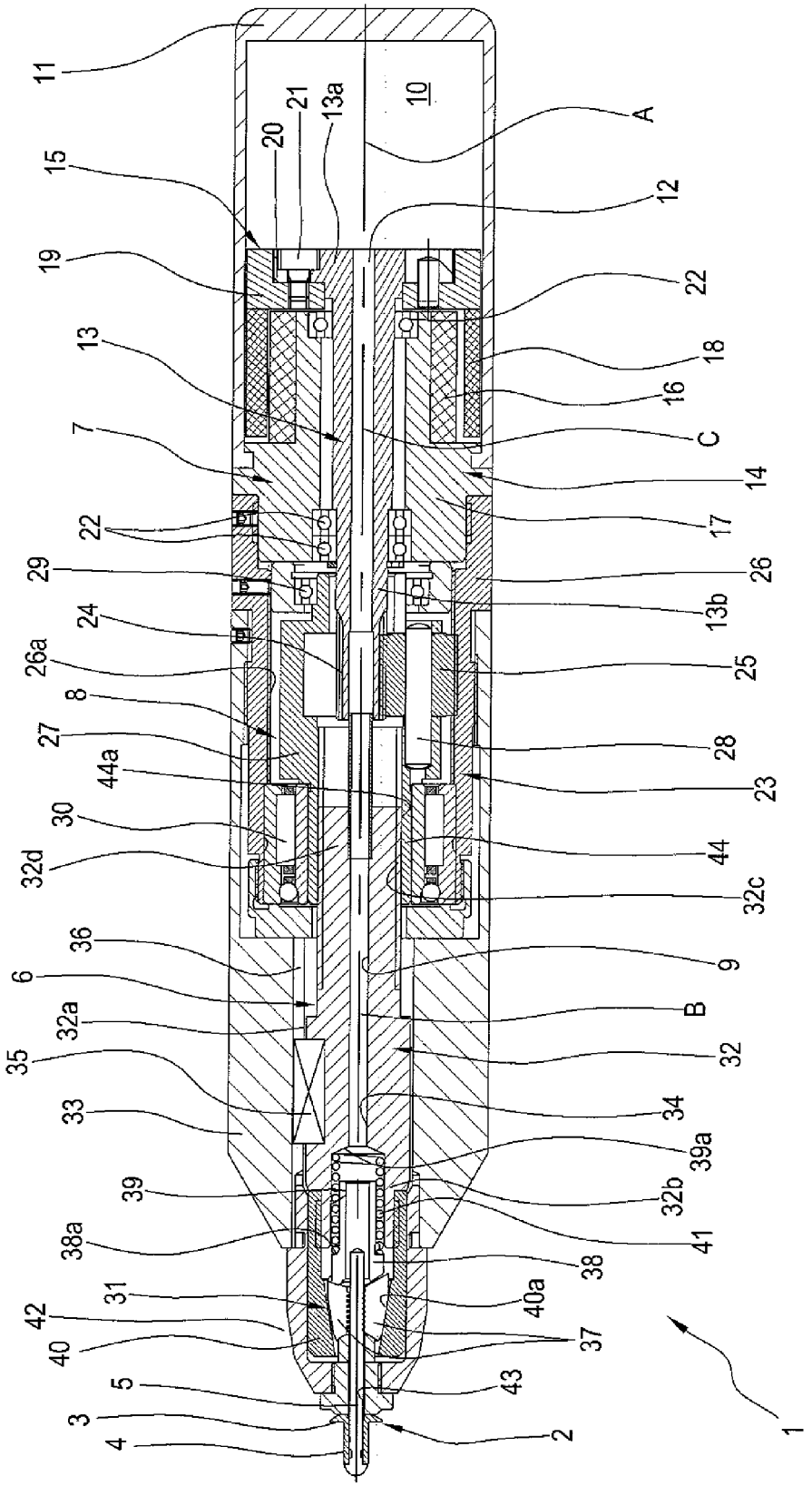
17. The machine according to claim 3, **characterised in that** the pulling element (6) comprises gripping means (31) for gripping the stem (5) and a slider (32) connected to the gripping means (31) and able to translate in the pulling direction (B) to pull the gripping means (31).

18. The machine according to claim 17, **characterised in that** the slider (32) can slide in a containment body (33) and comprises a tab (35) inserted in a guide (36) made in the containment body (33).

19. The machine according to claims 12 and 16, **characterised in that** the carrier (27) is connected by screwing to the slider (32) so as to move the latter in the pulling direction (B).

20. The machine according to any of the claims from 16 to 18, **characterised in that** the slider (32) comprises a longitudinal hole (34) positioned along the pulling direction (B), at least partly forming the expulsion channel (9).

FIG 1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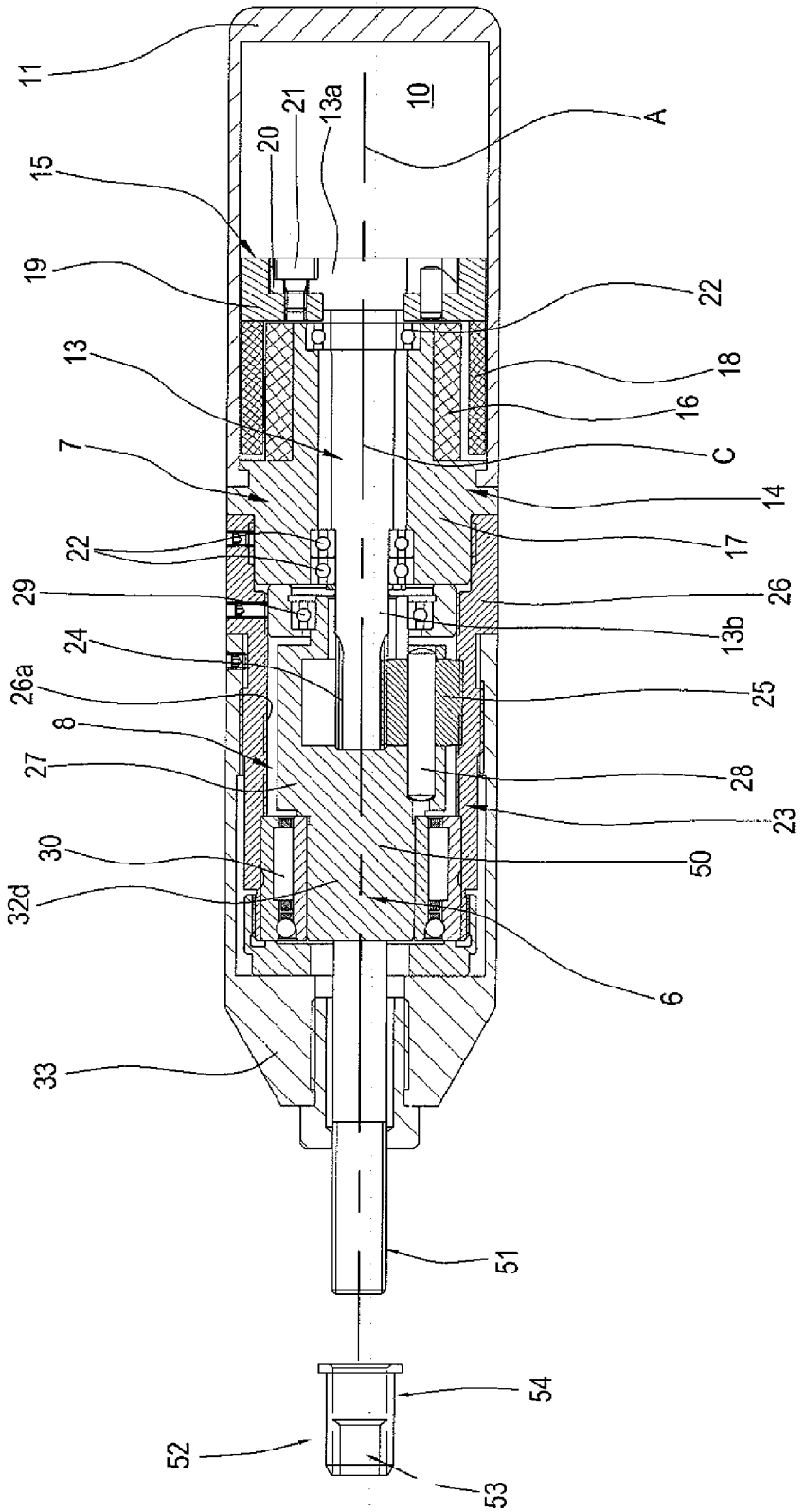
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FIG 2

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EUROPEAN SEARCH REPORT

Application Number
EP 09 15 9215

DOCUMENTS CONSIDERED TO BE RELEVANT

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	28 July 2009	Augé, Marc

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EPO FORM 1503 03.82 (P04C01)

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