

Clamp

Field of the invention

[0001] The present invention concerns an electrical test clamp comprising a plurality of fingers, and in particular, but not exclusively, a clamp which is configured to be actuated to clamp a component by means of applying a force
5 to the component to be clamped.

Description of related art

[0002] Component processing assemblies typically comprise a number of processing and testing stations which process and test components e.g. electronic components. Usually components are transported between the
10 processing and testing stations by means of a rotatable turret which comprises a plurality of component handling means. The component handling means typically have a pick up head which can pick a component from a processing or testing station, and hold the component, by means of vacuum; the pick up head is operable to release a held component by removing the vacuum.

15 [0003] Certain processing and testing stations require the component to be held securely, in a fixed position, while it is being processed or tested. Electrical or pneumatic clamps are provided at these particular processing and testing stations to hold the component securely in the required fixed position. Often, those clamps also need to establish an electrical contact with leads (including
20 pads or feet) of the component under test.

[0004] These actuated clamps are susceptible to electrical or pneumatic faults which can occur in the electrical or pneumatic components of the clamps; when a fault occurs in a clamp which is used in a component processing assembly, the operation of the component processing assembly must be
25 interrupted so that the clamp can be repaired. This increases the "down-time" of the component processing assembly.

[0005] Additionally, electrical or pneumatic clamps are often expensive and have a complex structure. This is particularly the case when the clamp is required to be able to synchronize its clamping operation with a component handling means which delivers the component to the clamp.

- 5 [0006] A further problem with existing clamps is that they are slow in their operation. To clamp a component using existing clamps two consecutive steps are required; firstly the component which is to be clamped must be positioned in the clamp, secondly, only after the component has been positioned in the clamp can the component be clamped and then tested. As two consecutive steps are
10 required, the clamping operation is slow.

- [0007] EP1111724 discloses a socket which includes an adaptor which has a seating surface for an IC and which has a plurality of contact member receiving holes in the seating surface. The tips of a plurality of contact members are received through the contact member receiving holes of the adaptor, with
15 contact established with each respective terminal of the IC that has been placed on the seating surface. The IC on the seating surface is held by means of rotary latches. The latches have an opened position for placement of the IC on the seating surface of the adaptor and a closed position for holding the IC from above it, rotating about a shaft fixed to the base. A cover is movable between
20 first and second positions and a links connected to the cover open the latches when the cover is at a first position and close the latches when the cover is at a second position.

- [0008] US5718595 discloses a socket for removably mounting an electric part such as an IC package has a cover which when pushed down from a
25 raised at rest position causes a drive shaft fixed to the cover to move down rotating a first lever and actuating a second lever. Upon such rotation a latch moves to a retracted position which is obliquely above a plurality of contact elements and, at the same time, vertically movable arms rise to a selected vertical position from a cavity. The IC package is then received on the vertically
30 movable arms. When the downward force on the cover is removed, cover and the drive shaft rise, first lever and second lever start moving in an opposite direction and the vertically movable arms move down carrying the IC package,

with a result that each terminal lead of the IC package engages and rides on a contact portion of each contact element corresponding thereto and the latch engages the terminal leads disposed on the contact portions in such a fashion as to sandwich the leads and apply an additional contact force to the leads.

- 5 [0009] The disadvantage of the devices in EP1111724 and US5718595 is that clamping within the socket cannot be activated by a component handling head which delivers a component to the socket.

[0010] It is an aim of the present invention to mitigate, or obviate, at least some of the above-mentioned disadvantages.

10 Brief summary of the invention

- [0011] According to the invention, this aim is achieved by means of a clamp, suitable for clamping a component so that the component is held in a fixed position while being processed, the clamp comprising, a first finger which is pivotally mounted at a first pivot point and the second finger which is pivotally
- 15 mounted at a second pivot point, so that the first finger and a second finger can each pivot towards a central plane; wherein the first finger and a second finger each comprise a surface suitable for cooperating with a component to be clamped, wherein the first finger and a second finger each comprise a stop means which is suitable for cooperating with a component to be clamped to
- 20 restrict movement of the component with respect to the respective finger, so that applying a force to a component which cooperates with the stop means will cause the first and second fingers to clamp the component.

- [0012] "Processing" includes carrying out any processing on a component; processing included, but is not limited to "testing" (in particular Kelvin testing),
- 25 "inspecting" of a component and/or "carrying out one or more manufacturing steps".

[0013] Advantageously the clamp of the present invention does not require integral electronic or pneumatic components to actuate the clamp and effect clamping of the component; rather a force applied to the component actuates the clamp. Thus, the clamp is not susceptible to electrical or pneumatic faults; and has a simple structure which can be manufactured at low cost. Furthermore, when used in a component handling assembly, it is possible to use the component handling means to apply the necessary force to the component to actuate the clamp.

[0014] Additionally, the clamp of the present invention can operate faster than existing clamps, as the clamping operation can take place simultaneously with the step of positioning the component in the clamp.

[0015] The force may be a force which is substantially parallel to the central plane. The force may be a force which is parallel to the central plane. The force may be a vertical force. The vertical force may be a force applied along the vertical normal.

[0016] The force may be applied by a component handling means. The component handling means may be configured to be movable linearly. Preferably, the component handling means is configured to be movable in the direction which is the same as the direction of the force required to be applied to a component which cooperates with the stop means, to cause the first and second fingers to clamp the component. The component handling means may comprise a component handling head. The component handling head may hold the component by means of a vacuum. The component handling means may be provided on a turret.

[0017] Each stop means may comprise a projection on a finger. The projection may be configured to provide a planar surface. The planar surface may be arranged to be substantially perpendicular to the central plane when a component is clamped.

[0018] Each stop means may comprise a gripping means. A gripping means may be provided on a surface of each finger. The surface may be the surface

which suitable for cooperating with a component. The gripping means may be configured such that it is suitable for preventing movement of a component relative to a respective finger. The gripping means may be a grip surface. The gripping means may be the surface suitable for cooperating with a component
5 which is configured to be roughened.

[0019] The clamp may be configured such that the distance between the first pivot point and second pivot point is adjustable. This will enable the clamp to be adjusted so that it can clamp components of different sizes.

10 [0020] The clamp may be configured such that it can receive a component from a component handling means. Each of the first and second fingers may comprise a tapered portion which is adjacent to the surface suitable for cooperating with a component to be clamped; this will allow the component to be clamped to be more easily received into the clamp.

15 [0021] The clamp may be configured such that when a component is clamped, a gap is defined between the first and second fingers, which exposes at least part of a surface of the clamped component. The clamp may be configured such that when a component is clamped, a gap is defined between the first and second fingers, which exposes an at least part a lower surface of the clamped component. The clamp may be configured such that when a
20 component is clamped, a gap is defined between the first and second fingers, which exposes an at least part a upper surface of the clamped component. The first and second fingers may be configured so that when a component is clamped, a gap is defined between the first and second fingers, which exposes at least both an upper surface and lower surface of clamped component. The
25 exposed surface(s) of the component can be processed while the component is clamped. When both the upper and lower surfaces of the clamped component are exposed, this obviates the need to rotate the component in the clamp to process both the upper and lower surfaces of the component.

30 [0022] The clamp may be configured such that the gap is aligned with a processing device. The processing device may be a sensor such as optical

sensor, magnetic sensor or signal generator such as photo emitter or magnetic field generator but not limited to such list.

[0023] Each finger may be cut from a flat plate. Each finger may be disposed in a vertical plane, and move in this plane when the component is clamped.

[0024] The clamp may comprise a one or more additional fingers. Some or all of the one or more additional fingers may have some or all of the features of the above-mentioned first and second fingers. For example, the clamp may comprise four fingers; this will enable a component to be clamped at four sides of the component.

[0025] The clamp may also comprise more than one finger at at least one side of the component. For example, the clamp may comprise one row of parallel mounted fingers at one side of the component under test, and another row of parallel mounted fingers at the opposite side of this component. All fingers in each row may be mounted so as to rotate simultaneously around a same axis when the component is clamped.

[0026] At least one finger can be used for contacting one lead of the component, in order to test this component. The finger may be made of an electrically conductive metal.

[0027] The clamp may comprise at least one finger arranged for contacting each of the leads of the component. Different fingers may be separated by insulating spacers.

[0028] The clamp may be configured to have two fingers contacting one lead of the component. The clamp may be configured to have two fingers contacting each lead of the component. The two fingers which contact a same lead may be separated by an insulating spacer. This arrangement gives better electrical contact and precision Kelvin measurement.

[0029] Each surface suitable for cooperating with a component to be clamped may be provided at an end of each respective finger. The end may be the free end of the finger. The first and second fingers may be pivotally mounted at the other, opposite, end.

- 5 [0030] The first finger at one side of the component and the second second finger at the opposite side of the component may be arranged substantially perpendicular to one another. Preferably, the first finger and second finger are arranged such that they are perpendicular to one another when the component is clamped. The first finger and second finger may be arranged such that when
10 the component is clamped, the smallest angle between the first finger and second finger is greater than 90°.

- [0031] The first finger at one side of the component may comprise a tapered body. The second finger at the opposite side of the component may comprise a tapered body. The first finger may comprise a concave surface. The second
15 finger may comprise a concave surface. The first finger and second finger may each comprise a body which has a concave surface.

- [0032] Any of the above-mentioned clamps may be used for testing LED, power QFN, MOSFET, IGBT; and/or a power regulator. Any of the above mentioned clamps may be used for testing any one of those devices which may
20 be encapsulated into QFN package, PQFN packages, J lead packages or any suitable packages.

- [0033] Any of the above-mentioned clamps may be used for Kelvin testing of the component, using the fingers to contact the leads of the component. Any of the above-mentioned clamps may be used for optical testing of the
25 component, using the clamp to center the component at the right distance in front of the optical testing apparatus.

- [0034] The clamp may be associated or include an air purge vent for cleaning the fingers and/or the leads of the component. The clamp may be associated or include an air purge vent at each side of the component, for
30 cleaning the fingers and/or the leads at each side of the component.

[0035] Any of the above-mentioned clamps may be used to centre a component. Any of the above-mentioned clamps may be used to centre a component above a processing means.

5 [0036] According to a further aspect of the present invention there is provided a processing station comprising a processing means suitable for processing a component, and a clamp according to any one of the above-mentioned clamps.

10 [0037] The processing mean may comprise an optical sensor. The processing means may be a component testing means, a component inspection means and/or a means for carrying out a manufacturing step.

15 [0038] According to a further aspect of the present invention there is provided a method of clamping component, comprising the steps of, using a component handling means to deliver a component to a clamp according to any one of the above-mentioned clamps, wherein the component handling means delivers the component to the clamp such that the component cooperates with the stop means of the first finger and a second finger which restricts movement of the component with respect to the fingers; using the component handling means to apply a force to the component to cause the first and second fingers to clamp the component.

20 [0039] According to a further aspect of the present invention there is provided a method of processing a component at a processing station which comprises a clamp according to any one of the above-mentioned clamps and a component processing means suitable for processing a component, comprising the step of clamping the component using the above-mentioned method;
25 processing the component using the component processing means; releasing the clamp by removing the component from the clamp using the component handling means.

[0040] "Releasing the clamp", includes, but is not restricted to, opening the clamp and/or adjusting the clamp so that it no longer clamps the component.

[0041] Releasing the clamp by removing the component from the clamp using the component handling means, may comprise retracting the component handling means which holds the component which is clamped by the clamp. The component handling means may hold the component by means of vacuum.

5 Releasing the clamp by removing the component from the clamp using the component handling means, may comprise lifting the component out of the clamp in a direction which is parallel to the central plane. Preferably, releasing the clamp by removing the component from the clamp using the component handling means, may comprise the step of lifting vertically the component out of

10 clamp using the component handling means.

Brief Description of the Drawings

[0042] The invention will be better understood with the aid of the description of an embodiment, which is given by way of example only, and illustrated by:

15 Fig. 1 which shows a perspective view of a processing station which comprises a clamp according to the present invention.

Fig. 2 which shows another perspective view of the processing station.

Detailed Description of possible embodiments of the Invention

[0043] Figure 1 shows a perspective view of a processing station (100) in which a component (3) is processed. The processing station (100) comprises a clamp (1) according to the present invention. The processing station (100) is one of a plurality of processing stations in a component processing line (not shown). Each of the processing stations in the component processing line may process the component (3) in a different manner; for example some processing

20 stations may inspect the component (3); others may carry out manufacturing steps; while others may carry out testing of components (3). A rotatable turret (not shown) rotates to transport components (3) between the processing stations in the component processing line. The rotatable turret comprises a plurality of component handling means (19) (only one component handling

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means shown) each of which is configured to hold a component (3) by means of a vacuum. Each component handling means (19) comprises a component handling head (45) which can cooperate with a component (3). The component handling means (19) can rotate with the turret; furthermore, they can move
5 relative to the turret to enable the component handling means (19) to pick components (3) from and deliver components (3) to the processing stations in the component processing line.

[0044] In addition to the clamp (1) the processing station (100) comprises a processing means in the form of an optical sensor (29). The optical sensor (29)
10 is operable to process a component (3) to determine if the component (3) has any defect(s) (27); it achieves this by sensing light emission from the surface (27) of the component (3) and measuring scattered light emitted by the surface (27).

[0045] The processing means may also use the fingers (5, 7) of the clamp
15 for contacting leads (30) of the component under test (3) and for electrical testing this component. Figure 2 shows an embodiment where each lead of the component is contacted by two fingers as part of the processing means in order to test the component. Electrical testing may be performed simultaneously at the same station than optical testing.

20 [0046] It will be understood that the processing means could take any other suitable form and may process the component (3) in any other way. For example, the processing means could alternatively be configured to carry out a manufacturing step on the component (3); to carry out testing of the component (3) and/or to carry out inspection of the component (3).

25 [0047] The clamp (1) is suitable for clamping the component (3) so that the component (3) is held in a fixed position while being processed by the optical sensor (29). The clamp (1) comprises at least one first finger (5) at one side of the component under test, and at least one second finger (7) at the opposite side of this component. As shown on Figure 2, the clamp preferably comprises
30 a first row of first fingers (5) at one side of the component, and a second row of second fingers (7) at the opposite side of the component.

[0048] The first finger (5) and second finger (7) each comprise a body (33) which has a concave surface (35). The first finger (5) is pivotally mounted at a first pivot point (9) and the second finger (7) is pivotally mounted at a second pivot point (11). The first finger (5) and the second finger (7) may each pivot
 5 about the first pivot point (9) and second pivot point (11) respectively, so that they can each pivot towards a central plane (13). If a first row with a plurality of first fingers 5 and a second row with a plurality of second fingers 7 are provided, each first finger of the first row and each second finger of the second row may pivot simultaneously about the same first pivot (9) and second pivot (11)
 10 respectively.

[0049] The first finger (5) and a second finger (7) each comprise a surface (15) suitable for cooperating with a component (3) to be clamped. Each surface (15) is provided at a free end (31) of each respective finger (5,7); the first and second fingers (5,7) are pivotally mounted at the first pivot point (9) and second
 15 pivot point (11) respectively, at the other, opposite, end (41) of the fingers (5,7).

[0050] The first finger (5) and a second finger (7) each comprise a stop means (17) which is suitable for cooperating with the component (3) to be clamped. In this particular example each stop means (17) comprises a projection (17). Each projection (17) defines a planar surface (21) which is
 20 substantially perpendicular to the central plane (13) when the component (3) is clamped. The projections (17) are operable to restrict movement of the component (3) with respect to the respective finger (5,7); this is achieved by means of the planar surfaces (21) which cooperate with the component (3) to restrict movement of the component (3) with respect to the respective finger
 25 (5,7). Applying a force to a component (3) which is in cooperation with the planar surfaces (21) of the projections (17), will cause the first and second fingers (5,7) to clamp the component (3).

[0051] In this particular example, when a force, which is parallel to the central plane (13), in the vertical direction, is applied to the component (3) which
 30 cooperates with the planar surfaces (21) of the projections (17), the first and second fingers (5,7) are caused to clamp the component (3). This force is applied by a component handling means (19). As can be seen from figure 1 the

clamp (1) is configured so that the first finger (5) and second finger (7) are arranged substantially perpendicular to one another when the component (3) is clamped.

[0052] It should be understood that the stop means (17) is not limited to being a projection (17) on each finger (5,7). It will be understood that other stop means could be provided; for example, as an alternative to projections (17), the stop means could comprise a gripping means, such as a grip layer, which is provided on the surfaces (15) which are suitable for cooperating with a component (3); or the stop means (17) could be the surfaces (15) which are configured to be roughened so to allow frictional gripping of the component (3) so as to prevent movement of the component (3) relative to a respective finger (5,7).

[0053] The clamp (1) is configured such that it can receive a component (3) from the component handling means (19) on a turret (not shown). Each of the first and second fingers (5,7) comprise a tapered portion (37) which is adjacent to the surface (15). The tapered portion (37) will allow the component (3) to be more easily received between the first and second fingers (5,7) when the component handling means (19) is delivering the component to the clamp (1).

[0054] The clamp (1) is configured such that when the component (3) is clamped, a gap (25) is defined between the first and second fingers (5,7), which exposes at least part of the surface (27) of the clamped component (3) to the optical sensor (29). As can be seen in Figure 1 the clamp (1) is configured such that the gap (25) is aligned with the optical sensor (29). Thus, the clamp (1) does not obstruct the optical sensor (29) when the component (3) is clamped; accordingly, the optical sensor (29) can process the component (3) when the component (3) is clamped.

[0055] During use the turret rotates so that the component handling means (19), which holds the component (3) at its component handling head (45), is aligned over the clamp 1, between the first finger (5) and the second finger (7). The component handling means (19) is then extended from the turret to deliver the component (3) to the clamp (1).

[0056] As the component handling means (19) is extended the component (3) which is held at the component handling head (45), will eventually engage the projections (17) on each of the fingers (5,7) by cooperating with the planar surfaces (21). The projection (17) on each finger (5,7) will act to prevent the component (3) from moving relative to the fingers (5,7).

[0057] As the component handling means (19) is extended further, since the component (3) is restricted from moving further by the projections (17), the component handling means (19) applies a force to the component (3), which is parallel to the central plane (13) and in the vertical direction. The force applied to the component (3) is transmitted to the fingers (5,7) via the projections (17), causing the fingers (5,7) to pivot further towards the central plane (13), and effecting clamping of the component (3). Once clamped the component's position is held fixed by the clamp (1).

[0058] The force applied to the component (3) by the component handling means (19) is maintained while processing of the component (3) by the optical sensor (29) and/or while electrical testing through the contact fingers (5, 7) is carried out. Accordingly the component (3) remains clamped while it is being processed.

[0059] Once the optical sensor (29) and/or the electrical test station has completed processing of the component (3), the component handling means (19) is retracted. As the component handling means (19) is retracted the force applied to the component (3) by the component handling means (19) is removed; thus the clamping force applied by the fingers (5,7) to the component (3) is removed. Accordingly, the component (3), which is held at the component handling head (45) of the component handling means (19) by vacuum, can be easily picked from the clamp (1). Once the component (3) has been picked from the clamp (1), the turret can rotate to transport the component to the next processing station in the component processing line.

[0060] Figure 2 shows a preferred embodiment where the clamp comprises a first row of first fingers (5) at one side of the component, and a second row of second fingers (7) at the other side of the component (3). Each finger in each

row is identical to the other fingers of the same row, and arranged in a plane which is parallel to the plane of the other fingers. In this embodiment, the fingers are arranged so that each lead (30) is in electrical contact with two adjacent fingers of the clamp when the component (3) is clamped; this allows for Kelvin
5 testing of the component by an electric test station (not shown) connected to each finger. Adjacent fingers are separated by insulating spacers (36), which preferably pivot with the fingers about the same pivot. In this embodiment, the fingers are thus part of the means used for processing and testing the component under test (3).

10 [0061] An air purge vent (33) may be provided near one side of the component for cleaning the fingers (5, 7) of the clamp and the leads of the component under test. Two air purge vents may be provided, the first vent being used for cleaning one first row of fingers with the corresponding leads, while the
15 second vent is used for cleaning the second row of fingers with the corresponding leads. The air purge vents may be controlled so as to blow a short air pulse when the component is tested; continuous blowing is also possible, although this will require more air.

[0062] Various modifications and variations to the described embodiments of the invention will be apparent to those skilled in the art without departing from
20 the scope of the invention as defined in the appended claims. Although the invention has been described in connection with specific preferred embodiments, it should be understood that the invention as claimed should not be unduly limited to such specific embodiment

Claims

1. A clamp (1), suitable for clamping a component (3) so that the component (3) is held in a fixed position while being processed, the clamp (1) comprising,
at least one first finger (5) which is pivotally mounted at a first
5 pivot point (9) and at least one second finger (7) which is pivotally mounted at a second pivot point (11), so that the first finger (5) and a second finger (7) can each pivot towards a central plane (13);
wherein the first finger (5) and a second finger (7) each
comprise a surface (15) suitable for cooperating with the component (3) to
10 be clamped,
characterised in that, the first finger (5) and a second finger (7) each comprise a stop means (17) which is suitable for cooperating with the component (3) to be clamped to restrict movement of the component (3) with respect to a respective finger (5,7), so that applying a force to the
15 component (3) which cooperates with the stop means will cause the first and second fingers (5,7) to clamp the component (3).
2. A clamp (1) according to claim 1, wherein the force is a force which is parallel to the central plane.
3. A clamp (1) according to claim 1 or 2 wherein the force is
20 applied by a component handling means (19).
4. A clamp (1) according to any one of the preceding claims, wherein each stop means comprises a projection (17).
5. A clamp (1) according to any one of claims 1-3, wherein each stop means comprises a gripping means which is provided on the surface
25 (15) suitable for cooperating with the component.
6. A clamp (1) according to any one of the preceding claims, wherein the clamp (1) is configured such that it can receive the component from a component handling means (19).

7. A clamp (1) according to any one of the preceding claims, wherein the clamp (1) is configured such that when the component (3) is clamped, a gap (25) is defined between the first and second fingers (5,7), which exposes at least part of a surface (27) of the clamped component (3).
- 5 8. A clamp (1) according to claim 7, wherein the clamp (1) is configured such that the gap (25) is aligned with a processing device (29).
9. A clamp (1) according to any one of the preceding claims, wherein each surface (15) suitable for cooperating with the component (3) to be clamped is provided at an end (31) of each respective finger (5,7).
- 10 10. A clamp (1) according to any one of the preceding claims, wherein the clamp (1) is configured such that the distance between the first pivot point (9) and second pivot point (11) can be adjusted so that the clamp (1) can be configured to clamp components of different sizes.
11. A clamp (1) according to any one of the preceding claims,
15 wherein the first finger (5) and second finger (7) each comprise a body (33) which has an electrical contact surface (35).
12. A clamp according to any one of the preceding claims,
comprising a first row of first fingers (5) and a second row of second fingers (7),
20 each finger in each row being parallel to all other fingers of the same row,
wherein the first fingers are arranged so as to establish an electrical contact with leads (30) at a first side of the component under test,
and wherein the second fingers are arranged so as to establish
25 an electrical contact with leads (30) at a second side of the component under test.
13. A clamp according to claim 12, comprising insulating spacers (36) between adjacent fingers in each row.

14. A clamp according to any of the claims 12 or 13, wherein the first and second fingers are arranged so that each lead of the component (3) is in electrical contact with two adjacent, mutually insulated fingers.

15. A processing station (100) comprising a processing means (29) suitable for processing a component (3), characterised in that the processing station further comprises a clamp (1) according to any one of the preceding claims for clamping the component (3) which is to be processed by the processing means (29).

16. A processing station (100) according to claim 15 further comprising a component handling means (19) which can move vertically to deliver the component (3) to the clamp (1) and to apply a force to the component (3) to actuate the clamp (1).

17. A processing station according to one of the claims 15 or 16, further comprising a test station electrically connected to said fingers for performing Kelvin testing of said component (3).

18. A processing station according to one of the claims 15-17, further comprising at least one air purge vent for cleaning said fingers.

19. Use of the clamp (1) according to any one of claims 1-14 for testing at least one of the following components: LED, power QFN; MOSFET; a IGBT; a power regulator.

20. A method of clamping component, comprising the steps of, using a component handling means (19) to deliver a component (3) to a clamp (1) according to any one of claims 1-14, wherein the component handling means (19) delivers the component (3) to a clamp (1) such that the component (3) cooperates with the stop means (17) of the first finger (3) and a second finger (5) which restricts movement of the component (3) with respect to the fingers (5,7);
using the component handling means (19) to apply a force to

the component (3) to cause the first and second fingers (5,7) to clamp the component (3).

21. A method of processing a component (3) at a processing station (100) which comprises a clamp (1) according to any one of claims 1-14 and a component processing means (29) suitable for processing a component (3), comprising the steps of,
- 5 clamping the component (3) using the method according to claim 20;
- processing the component (3) using the component
- 10 processing means (29);
- releasing the clamp by removing the component (3) from the clamp (1) using the component handling means (29).

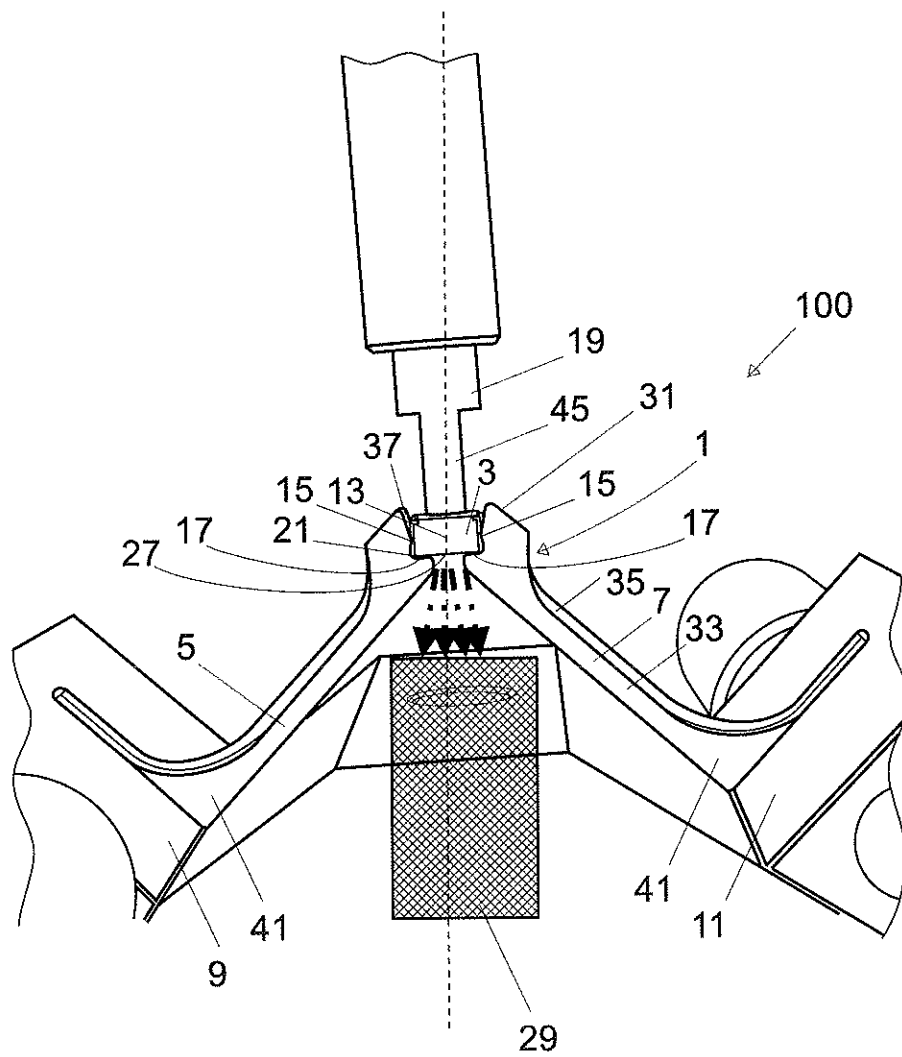


Fig. 1

