

The invention relates to a device for the wire connection, in an ultrasonic-contacting manner, of switching circuits to electronic components by means of a contacting element, which element comprises a first supporting frame able to be pivoted by an electric motor drive about an axis, as well as a second supporting frame arranged thereon and formed for receiving an energy transducer, provided with a capillary, wherein the second supporting frame is mounted on a pivot point of the first supporting frame, arranged at a distance to the axis, and, with contact of the capillary with the respective electronic component is able to be moved relative to the first supporting frame.

A device for fastening connecting wires to the terminals of a semi-conductor component is known from EP-A 0 186 176, which device comprises substantially a supporting frame able to be pivoted about a first axis and a holding block pivotally mounted about a second axis with pins in the supporting frame, on which block there are arranged a bracket arm (transducer) with a capillary as well as a stop arm, wherein the stop arm arranged on the holding block is arranged between a first stop of the supporting frame and an associated second stop of a piezo-electric drive and which is pressed through the force of a spring mounted on the holding block as well as on the support arm onto the first stop, whilst when the piezo electric drive is excited, clearance for the stop arm is produced between the two stops. In this device the welding pressure acting on the connection spot of the semi-conductor component is obtained and determined by the force of the spring, wherein with the stop of the piezo electric drive it can only be established whether the stop arm is lifted from the stop (touch down).

A contact device is disclosed in US-A 4 610

387 for ultrasonic wire welding, which comprises substantially a first, a second as well as a third supporting frame formed in each case approximately like a fork. The first supporting frame arranged on a main support and operatively connected to a first motor and a correspondingly associated crank is able to be adjusted, together with the second and third supporting frame pivoted thereon about a common axis, relative to the main support approximately in the vertical direction, that is in the direction of associated electronic components (chips). The third supporting frame is operatively connected to a further second motor formed as a linear motor and the second supporting frame is formed for receiving an energy transducer provided on its front end with a capillary. On the second and third supporting frame, which are able to be moved relative to each other, there are provided in each case contacts arranged correspondingly relative to each other, which in a first phase are brought into engagement by an electric magnet acting for example on the second supporting frame.

The underlying object of the invention is to improve a device of the named generic type and to form this to the effect that for the wire connection of switching circuits to electronic components a precise adjusting movement of the two supporting frames together with the energy transducer is guaranteed, without relative movement of the supporting frame provided with the energy transducer occurring in relation to the other supporting frame when there is a mutual pivoting movement.

This object is achieved according to the invention in that the two supporting frames as well as the energy transducer are arranged in a support element so as to be able to be pivoted about the axis and have a common centre of gravity lying on the axis of

symmetry of the individual parts, and in that the centre of gravity lies within a circle oriented perpendicularly towards the axis and arranged with its centre on a straight line formed between the axis and
5 the pivot point and also oriented perpendicularly to the axis, the radius of which circle is smaller than half of the spacing between the axis and the pivot point.

In the device according to the invention the
10 acceleration moments occurring with the pivoting movement are eliminated extensively through the special arrangement of the centres of gravity and a precise so-called path accuracy of the individual elements is thus guaranteed.

15 Further features relating to the device according to the invention are found in the description, the drawing as well as the corresponding claims.

A further object of the invention is seen in
20 that a support element formed for integrating reception of the device according to the invention is provided which has a construction which is itself stable with a relatively low dead weight and, together with the device, forms a component, wherein the component, which
25 for the required movements is freely adjustable in the plane, is able to be supplied to a work station formed for producing the wire connection to the electronic components.

This object is achieved according to the
30 invention in that the support element is formed as a rigid, housing-like cell construction, formed in one piece by an upper overhead wall, a lower base as well as walls connecting these to each, in the form of a square hollow body with chambers for receiving and for
35 pivotable bearing of the contact device formed from the individual elements and of the electric motor drive

operatively connected thereto, as well as an encoder,
and in that the lower side of the support element is
formed as a vacuum prestressing air cushion bearing
which has a vacuum zone surrounded completely on the
5 circumference by a pressure zone.

Further features relating to the support
element are found in the description and the drawing.

The invention will be described in the
following with the aid of the drawing:

10 Figure 1 shows a device represented in
sectional view and provided with a contacting element
for ultrasonic-contacting wire connection,

Figure 2 shows the device according to Figure
1 in plan view,

15 Figure 3 shows a first variant of a
supporting frame shown in a diagrammatic manner for the
contacting element according to Figure 1,

Figure 4 shows the supporting frame according
to Figure 3 in plan view,

20 Figure 5 shows a part represented in
sectional view of the supporting frame according to
line V-V in Figure 4,

Figure 6 shows a part represented in section
of the supporting frame in the arrow direction B in
25 Figure 4,

Figure 7 shows an adjusting device for a
second supporting frame of the contacting element
arranged in the first supporting frame, according to
Figures 1 and 2,

30 Figure 8 shows a clamping device for the
contacting element according to Figures 1 and 2,

Figure 9 shows the second supporting frame
represented in section,

Figure 10 shows the second supporting frame
35 represented in side view according to Figure 9,

Figure 11 shows an electric motor drive for

the contacting element according to Figures 1 and 2, represented in section,

Figure 12 shows a cutaway section, represented in Figure 1 by a circle denoted by A, of a contact device which is operatively connected to the two supporting frames,

Figure 13 shows a diagrammatic representation of the contacting element represented in Figure 1,

Figure 14 shows a second variant of the contacting element represented in a perspective exploded representation,

Figure 14a shows an electric current circuit represented as block diagram for the contact device according to Figure 14,

Figure 15 shows a support element represented in section for the contacting element of the device according to Figure 1,

Figure 16 shows the support element represented in plan view and section according to Figure 15,

Figure 17 shows the support element represented as a detail and in perspective view and

Figure 18 shows the base of the support element represented in section, according to Figure 15.

In order to illustrate the invention and to give a general plan of the system in Figure 1 in sectional representation and in Figure 2 in plan view there is represented a device of the semi-conductor connection technology denoted as a whole by 200, which will be described in the following in detail:

The device 200 comprises substantially a support element 290 represented in outline in Figure 1 and Figure 2 with a dot-dash line, which is formed as a rigid, housing-like cell construction with at least two useful inner chambers 225, 224 (Figure 2). The support element 290 serves to receive a contacting element

denoted as a whole by 150 or 150', an incremental encoder 260, or the like, operatively connected to the contacting element 150 or 150' and mounted in the chamber 224 of the support element 290, as well as an
5 electric motor drive 25 operatively connected to the contacting element 150 or 150'.

The contacting element 150 or 150' operatively connected to the electric motor drive on the one end comprises substantially a first supporting
10 frame 10, a second supporting frame 50, 50' formed to receive an energy transducer 175, 175', known per se, as well as a correspondingly formed clamping device 35. The contacting element 150, 150' operatively connected to the drive 25 is mounted in the support element 290
15 with the individual parts oscillating (swinging) somewhat about a common axis Z of two axle pins 265, 265', arranged approximately horizontally, by some degrees of angle in the direction of the arrow Z' (Figure 1).

20 In dependence on the pivoting movement in the direction of the arrow Z'', as represented diagrammatically in Figure 2, signals S1 which are movement-dependent on the encoder 260 are supplied to a first evaluating unit 180. The signals S1 processed
25 and evaluated correspondingly in the first evaluating unit 180 are supplied as signals S2 to a first control unit 185 and then as control or regulating signals S3 to the electric motor drive 25.

The device 200 consisting of the essential
30 parts 290 and 260 and the contacting element 150 or 150' comprising the individual parts forms a function unit closed in itself, which is formed for high-dynamic and precise adjusting movement of the transducer 175, 175' arranged on the contacting element 150, 150'
35 (Figures 1, 13) and provided with a horn 176 and a capillary 177, to a work station, i.e. to a chip

(electronic component part) denoted by 170, and represented diagrammatically.

Furthermore Figure 1 shows a diagrammatically represented wire coil 160 of a bond wire unwinding device not shown here in any more detail, from which a bond wire denoted by 178, is supplied to the clamping device 35 arranged on the contacting element 150 or 150' and from there centrally into the capillary 177. The necessary pressure force or contact force of the capillary 177 is achieved substantially through the effect or through the oscillations of the electric motor drive 25.

In a first phase corresponding contacts 71, 72 of a contact device 70 operatively connected to the first supporting frame 10 as well as to the second supporting frame 50, formed for receiving the transducer 175 (Figure 12), are closed. With force acting correspondingly on the chip 170 in a second phase the contacts 71, 72 are opened and corresponding signals are supplied to the transducer 175, with which a wire ball (not represented) melted on the wire end in a known manner is pressed onto the chip 170 by means of the capillary 177.

The device 200 is able to be adjusted approximately in the arrow direction X and Y in a freely swinging manner, by means of drives not represented further and operatively connected substantially to the support element 290, on a sliding plate correspondingly formed but not represented further, according to the coordinate system K represented in Figure 2, along two coordinates oriented in the plane at right angles relative to each other. In order to achieve the free-swinging movement of the whole device 200 on a correspondingly formed base plate (not represented) the base of the support element 200 is provided with a correspondingly formed air cushion

bearing.

In Figure 3 a variant of the first supporting frame 10 is shown in perspective view and in Figure 4 in enlarged scale in plan view and two support arms 11 and 12 can be seen which have two front first partial pieces 11'' and 12'' arranged in parallel spacing relative to each other and connected in the central region to each other by a web 13, as well as two second partial pieces 11' and 12', combined with each other in the rear region 16. Between the two rear partial pieces 11' and 12' extending inclined relative to each other there is provided a base 15 extending from the rear region 16 to the web 13 and between the two front partial pieces 11'' and 12'' there is provided a base partial piece 14. In the perpendicular walling of the rear region 16, not shown any further, there is provided a perpendicular recess 16', formed like a groove, which is formed for receiving a magnetic body 20 arranged spaced thereto in Figure 3. The approximately sword-like magnetic body 20 operatively connected to the electric motor drive 25 (Figure 1) consists of a fastening plate 21 and two magnetic plates 22, 22' arranged thereon and is connected with means not represented, for example by sticking or the like, to the first supporting frame 10.

The support arms 11 and 12 with their partial pieces 11', 11'' and 12', 12'' have, as shown in partial section in Figure 3, an approximately [-shaped profiled cross-section. The web 13 connecting the two support arms 11 and 12 to each other is penetrated by a bore 13' oriented approximately transverse to the support arms 11 and 12. The front partial piece 11'' of the support arm 11 is, as represented in Figure 5, curved upwardly in relation to the partial piece 11' and on its front end is provided with a bearing part 18. The bearing part 18 is penetrated by a bore 19

and, as represented in Figures 1 and 2, is provided for receiving and fastening the clamping device 35.

Figure 5 shows the first supporting frame 10 in section according to line V-V in Figure 4 and the support arm 11 can be seen with the approximately horizontal partial piece 11', the partial piece 11'' upwardly curved relative thereto with the bearing part 18 penetrated by the bore 19, the web 13 with the bore 13', the base 15 with the region 16 preformed thereon in web form as well as the base partial piece 14. Provided on the lower side of the front partial piece 11'' there is a recess 24, which is formed for receiving and fastening a first spring element 34 (Figures 1, 2).

The first supporting frame 10 is represented in section in Figure 6 according to the arrow direction B shown in Figure 4 and the horizontal support arm 12, formed from the partial pieces 12', 12'' can be seen, as well as a part of the curved partial piece 11'' of the support arm 11. The front partial piece 12'' is provided with a recess 24', which is formed for receiving and fastening a second spring element 34' (Figures 1, 2). On the front partial piece 12'' of the support arm 12 there is provided a pocket 17 with an opening 17', in which pocket 17 is arranged the contact device 70 actively connected to the first and to the second supporting frame 10, 50 and described in more detailed in conjunction with Figure 12.

In Figure 8 the clamping device 35 is shown in plan view and a first clamping piece 40 as well as a second clamping piece 45 can be seen, which clamping pieces 40, 45 are operatively connected to each other at the one end substantially by means of an axle pin 36' of an electric magnet 36 and approximately in the central region by a connecting element formed as a plate spring 39. The rear end 45'' of the clamping

piece 45 is arranged between two elastic elements 48, 48' (O-rings), which, by means of discs 47, 47' are held on the axle pin 36' of the electric magnet 36. The plate spring 39 is releasably secured with a

5 correspondingly formed holding part 41 on the first clamping piece 40 and with a second holding part 44 on the second clamping piece 45 by means of fastening means (screw connection) not shown. The plate spring 39 forms substantially a pivot point, not shown any

10 further, of the two clamping pieces 40 and 45 able to be moved relative to each other in the arrow direction C from the electric magnet 36 against the restoring force of a pressure spring 46 arranged between the two clamping pieces 40, 45. On the front end 40' of the

15 clamping piece 40 and on the front end 45' of the clamping piece 45 there is provided in each case a small clamping plate 42, 43 with in each case an absolutely plane bearing surface (not shown any further) arranged corresponding to each other, between

20 which bearing surfaces the relatively thin bond wire 178 lying in the μ region is clamped (Figure 1) and released again.

Figures 9 and 10 show the second supporting frame 50, formed correspondingly for receiving the

25 transducer 175, in section represented partially broken up as well as in side section. The supporting frame 50 having a base 58 has a body 51, formed approximately like a semi-shell, which in the front region has a web-like formed clamping part 55 penetrated by a bore 51' with two parts 55', 55'' separated by a slit 54 (Figure

30 10), and in the rear region is provided with a bevel 52 and a projection 53.

In the front region the clamping parts 55', 55'' for holding the transducer 175, able to be pressed

35 together with screws or the like, not represented, are provided in each case with a lateral bearing part 56,

56', in which there is formed in each case a pocket-like recess 57, 57' for receiving and fastening the spring elements 34, 34' (not represented here). The individual spring element 34, 34' is, as shown
5 diagrammatically in Figures 1 and 2, operatively connected, on the one side, to the first supporting frame 10 and, on the other side, to the second supporting frame 50 and substantially forms a pivot point Z' arranged spaced D to the axis Z, by means of
10 which the second supporting frame 50 together with the transducer 175 (ultrasonic transducer) is able to be moved relative to the first supporting frame 10 in the direction of the arrow Z'' for releasing the contacts 71, 72 (contacts are no longer in operative connection
15 with one another). The axis Z and the pivot point Z' form in each case an operative connection point of the two supporting frames 10 and 50, also known as a so-called swivel axis.

Figure 11 shows the electric motor drive 25,
20 in which the one half is represented in section and the other half in sectional view. The drive 25 comprises substantially a base plate 30 formed as a support element, two stator bodies 26, 26' arranged spaced relative to each other through a gap 27, two coil
25 bodies 33, 33' as well as a holding part 32. The two stator bodies 26, 26' formed in the profiled cross-section approximately in an E shape have recesses 28, 28' separated by a central web, 29, 29', in which recesses the coil bodies 33, 33' are arranged. The
30 stator bodies 26, 26' have lower webs 37, 37' and upper webs 38, 38'. The lower webs 37, 37' are arranged in the base plate 30 provided with corresponding recesses (not shown in any more detail) spaced relative to each other by a web 30'. The upper webs 38, 38' are
35 arranged in the holding part 32 also provided with recesses (not shown in any more detail) spaced relative

to each other by a web 32'. The base plate 30 as well as the upper holding part 32 are, as shown diagrammatically in Figure 2, provided in each case with a slit 30'' reaching up to the web 30', or with a slit 32'' reaching up the web 32' for the movement of the sword-like shaped magnetic body 20 with the magnetic plates 22, 22'. The drive 25 is detachably secured by means of screws 31 (Figure 2) to the base of the chamber 225 of the support element 290. With corresponding excitation, preferably through a controlled or regulated direct-current excitation of the coil bodies 33, 33', a vertical relative movement of the magnetic body 20 arranged on the first supporting frame 10 relative to the stator bodies 26, 26', or to the drive 25 secured on the support element 290 is produced.

Shown in Figure 7 there is a device denoted as a whole by 60, for adjusting and regulating the relative movement of the second supporting frame 50 relative to the first supporting frame 10 pivotable about the two axle pins 23, 23' by some degrees of angle. The device 60 comprises an angular piece 61, which is secured with a side part 61'' on the web 13 of the supporting frame 10 with means not represented and in a perpendicular web part 61' has a bore which is not marked, which bore is provided and formed for receiving a pressure spring 63 able to be pressed through an adjusting screw 62 from the one side against the projection 53 of the supporting frame base 58. An adjusting screw 65 arranged in the base 14 of the first supporting frame 10 and able to be adjusted with a thread has a blind hole bore 65' for receiving a pressure spring 64 acting against the other side of the projection 53. The second pressure spring 64 is preferably held in the operative position with a pin 59 arranged on the projection 53. The first adjusting

screw 62 and the second adjusting screw 65 are able to be correspondingly fixed after the actual adjustment with means not shown for securing their position. By means of the above-described device 60 formed as a
5 spring clamping system the necessary impact or the contact pressure of the capillary 176 on the chip 170 can be adjusted substantially in a precise manner according to requirements.

Figure 12 shows the contact device described
10 in the introduction in combination with the method of operating and functioning and denoted as a whole by 70 and it is possible to see a partial piece of the support element 290, a partial piece of the transducer 175 as well as the support arm 12 of the first
15 supporting frame 10 provided with the recess 17 and the opening 17'. Arranged in the recess 17, with means not shown in any more detail, there is a first, diagrammatically represented, contacting element 71, and on the second supporting frame 50 not shown in any
20 more detail here there is arranged the second contacting element 72 penetrating the opening 17'.

The second supporting frame 50 forming a component with the transducer 175, as shown diagrammatically and symbolically in Figure 13, is
25 arranged with the pivot point Z' spaced D to the axis Z. The axis Z of the supporting frame 10 is formed here substantially by the axle pins 265, 265' arranged in the first supporting frame 10 and mounted in the support element 290 and the pivot point Z' is formed by
30 the spring elements 34, 34' arranged on the first and second supporting frames 10 and 50. The two supporting frames 10 and 50 are operatively connected to one another by the spring elements 34, 34', such that the second supporting frame 50 is able to be moved in the
35 arrow direction Z'', exclusively in a fixed working phase (pressing the capillary 176 against the chip 170)

of the contacting element 150, relative to the first supporting frame 10.

The formation of the second supporting frame 50 as well as the arrangement of the transducer 175 in the supporting frame 50 is selected such that a centre of gravity M of the parts 175 and 50 imagined and represented in Figure 13, lying on the axis of symmetry S (Figure 2) and to be determined with calculations, lies within a circle E defining approximately a plane of movement, preferably however in the upper semi-circle E' of the circle denoted by E. The circle E is arranged with its centre F in the middle of a straight line formed between the axis Z and the pivot point Z' not shown in more detail, wherein the radius R of the circle E is selected to be smaller than half the spacing D.

The above described preferred arrangement of the centre of gravity M in the region of the upper semi-circular plane E' guarantees an optimum balancing and distribution of mass of the individual elements such that during the common pivoting movement (first phase of movement) of the corresponding parts 10, 50, 175 in the direction of arrow Z'' (Figure 1) a sufficient position stability is guaranteed; that is a relative movement of the transducer 175 with the supporting frame 50 relative to the first supporting frame 10 is largely precluded in the first pivoting movement.

Figure 14 shows an exploded perspective drawing of a variant of a contacting element denoted as a whole by 150' and a partial piece of a supporting frame 10' as well as a contact device denoted as a whole by 70' can be seen. The supporting frame 10' provided with corresponding bores for the axis Z has an approximately Ω -shaped profiled cross-section and is formed on the one rear end in the same way as the

supporting frame 10 (Figures 1,2) and is provided with the magnetic body 20, which is operatively connected to the electric motor drive 25 not shown in any more detail in Figure 14. On the other front end the

5 supporting frame 10' is formed with a correspondingly formed recess 19 for the contact device 70' as well as with assembly surfaces not shown in any more detail for securing the contact device 70'. The contact device 70' has a supporting frame 50' formed for bearing the

10 transducer 175' with two bearing parts 59, 59' connected to one another through a clamping part 55 and arranged spaced relative to each other. The supporting frame 50' is formed substantially like the supporting frame 50 represented in Figure 9 and Figure 10 and

15 comprises the clamping part 55 formed from the parts 55', 55'' and the gap 54 and provided for receiving and holding the transducer 175'.

Varying from the supporting frame 50 according to Figure 9 and Figure 10 on the two bearing

20 parts 59, 59' of the supporting frame 50' there is arranged in each case a printed board 76, 76' or the like, secured with means not shown.

In the exemplary embodiment represented in Figure 14 on each printed board 76, 76' there are

25 provided two piezo elements 75, 77 or 75', 77', arranged spaced relative to each other, which elements are operatively connected in an electrical manner to the corresponding printed board 76 or 76', using means not represented. In the assembled state not

30 represented in more detail, in which the second supporting frame 50' is secured for example by a screw connection (not represented) on the first supporting frame 10', the four piezo elements 75, 75' and 77, 77' are in operative connection with the first supporting

35 frame 10' with corresponding prestressing.

The special arrangement of the centre of

gravity M within the circle E, described above in connection with Figure 13 is formed in this variant in a substantially analogous manner. The clamping part 55 of the supporting frame 50', arranged spaced
5 approximately with the same clearance between the piezo elements 75, 77 or 75', 77', arranged correspondingly relative to each other, forms here the imaginary pivot point Z' (Figure 13) for the relative movement of the second supporting frame 50' relative to the first
10 supporting frame 10'.

In this preferred exemplary embodiment when there is pivoting movement Z'' of the contacting element 150' a corresponding force is produced when the capillary 177' strikes (touch down) the chip 170. The
15 force, because of the geometric arrangement, causes the two front piezo elements 75, 75' to be correspondingly loaded in addition to the prestressing and the two rear piezo elements 77, 77', because of the mobility of the parts 175', 50', lying in the μ -region, about the
20 imaginary pivot point Z', to be released.

Also in this exemplary embodiment according to Figure 14, as in the exemplary embodiment shown in Figure 2, in the first evaluating unit 180, corresponding signals S1 are processed and supplied as
25 signals S2 to the first control unit 185 and as control or regulating signals S3 to the electric motor drive 25. In addition to this in dependence on the loading or unloading of the piezo elements 75, 75' and 77, 77', occurring with capillary contact (touch down), as shown
30 in Figure 14a in the block diagram, corresponding force-dependent signals S75, S75' and S77, S77' are supplied by way of a circuit 181 to a second evaluating unit 184, in which evaluating unit 184 for example an impedance transformation, amplification and/or
35 difference formation of the signals S75, S75' and S77, S77' occurs. The values determined thus are preferably

supplied in the form of an electric voltage by way of an output 182 to a second control unit 186 for forming corresponding control or regulating signals, which are supplied by way of an output 183 to the electric motor drive 25.

The signals S75, S75' and S77, S77', determined during the bond process in this way, preferably continually, can be processed for detection of capillary contact as well as for judging the respective force characteristic and used for controlling or regulating the electric motor drive 25 and thus for controlling the bond force.

Represented in Figure 15 in sectional view and in Figure 16 in sectional plan view is the device of semi-conductor connection technology denoted as a whole by 200, which comprises substantially the contacting element 150 or 150' (Bonder), represented in outline diagrammatically in this drawing and shown with dot-dash lines, a support 300 formed like a carrier (only shown in Figure 15), with the optical scanning element 301 (sensor) arranged thereon as well as the support element 290 formed correspondingly for the parts 150 or 150' and 300. The contacting element 150 or 150', provided on the front end with the diagrammatically represented capillary 177, and formed like a rocker, as shown in Figure 16, is able to be inserted into the approximately housing-like support element 290 and is operatively connected to the electric motor drive 25 at one end. The contacting element 150 or 150' is mounted approximately in the central region by means of axle pins 265, arranged spaced to the drive 25 in a correspondingly formed bearing piece 255 and by means of a second axle pin 265, arranged corresponding to the first axle pin 265', in a wall of the support element 290 denoted by 212' (Figure 2). The bearing piece 255, provided with

recesses 256 and 257 formed in an offset manner, is penetrated by the axle pin 265. The axle pin 265 is operatively connected to the incremental encoder 260, represented diagrammatically and by means of dot-dash
5 lines. The contacting element 150 or 150' is pivotally mounted about the common axis Z in the arrow direction Z'' (Figure 1) by some degrees of angle with the one axle pin 265 in a bearing part 258 (ball bearing), arranged in the recess 257, and with the other axle pin
10 265' in a bearing part 218.

The support element 290 for the device 200 is represented in section and in plan view in Figure 16, and it is possible to see the bearing piece 255 for receiving and bearing the measuring element 260 as well
15 as for bearing the contacting element 150 or 150', formed as an insertable individual part, which piece is incorporated into the support element 290 and secured with means not represented further, for example by a screw connection, such that it can be exchanged. At
20 this point it should be pointed out that the housing-like support element 290 can be provided in this region, in a manner which is not represented, with a bearing piece 255, forming a unit with the support element 290, for receiving and bearing the parts 260,
25 265 and 150 or 150'.

The support element 290 represented in Figure 17 in perspective view is formed approximately as a square, one piece hollow body with usable cavities for receiving the essential function parts 150 or 150', 25
30 and 260 and has a lower side 210, an upper side 211 for receiving the support 300, sides 212 and 213, an end side 215 as well as a rear side 216 and is described in the following in detail:

The housing-like support element 290 is
35 formed as a rigid cell construction and has on its lower side, denoted by 210, a base 210' formed as a

horizontal plate and in parallel spacing thereto on its upper side 211 an overhead wall 211'. On the one side, denoted by 212, there is a first vertical wall 212' and on the other side opposing side, denoted by 213, there is a second vertical wall 213'. The two walls 212' and 213' connecting the base 210' to the overhead wall 211' are arranged in parallel spacing relative to each other.

For centering bearing and fastening of the insertable bearing piece 255 there is provided in the front region of the support element 290 on the inner side 210'' of the base 210' as well on the inner side 211'' of the overhead wall 211' in each case a correspondingly formed bearing and centering surface 259, 259', represented partially in Figure 17.

The second vertical wall 213' has recesses 220, 222 and 224, arranged spaced relative to each other, wherein between the recesses 220 and 222 as well as 224 there is provided in each case a rib 221, 223. Through the ribs 221 and 223 reaching from the base 210' to the overhead wall 211' and oriented approximately inwardly in the direction of the first wall 212', and through the two corner pieces 214, 214' of the wall 213', in the interior of the support element 290, as represented in Figure 16, there are formed corresponding cavities or chambers 220', 222' and 224'. The front corner piece 214 is provided for bearing the measuring element 260 with a correspondingly formed recess 224''. Provided in addition to the chambers 220', 222' and 224' is the main chamber 225. The chamber 224' serves in this connection to receive the measuring element 260 and the main chamber 225 to receive the contacting element 150 or 150', not represented in Figure 17, as well as the drive 25.

The wall 213' as well as the wall of the

5 rearside 216 which is not shown in any more detail are provided in each case with threaded bores, not shown, arranged spaced relative to each other, for securing the support part 290 to an electric motor drive, not represented, for the adjusting movement oriented according to the coordinate system K in Figure 2 in the plane in the arrow direction X and Y.

10 The overhead wall 211' is, as represented in Figure 17, also penetrated by recesses 227, 227', 227'', 228, 229, 229' and 229'', arranged spaced relative to each other. The outer surface of the overhead wall 211', not shown any further, is formed for receiving the support 300 (Figure 15), which is releasably secured on the support element 290 with
15 securing means not shown.

20 The recesses 220, 222, 224 and 227, 227', 227'', 228, 229, 229', 229'' provided in the vertical wall 213 as well as in the overhead wall 211', assist assembly and operability of the individual essential parts 150 or 150', 25 and 260 and guarantees furthermore, while maintaining stability, a substantial reduction in weight of the support element 290 which is advantageous for the free-swinging adjustability.

25 The first wall 212' opposite the second wall 213' is provided on the inner side 212'' with a recess 217 formed in an offset manner (Figure 16), in which is arranged the bearing part 218 for the axle pin 265' of the contacting element 150 or 150'. The outer surface of the first wall 212', not denoted any further is
30 formed to be an absolutely plane, preferably ground surface and serves as a so-called air bearing support surface of a slide part not shown, operatively connected to the support element 290 and activated by means not shown.

35 In Figure 18 the base 210' of the support element 290, facing the sliding plate which is not

shown, is represented, which base 210', vacuum prestressed preferably with a so-called air cushion bearing, is operatively connected to the sliding plate, not shown, and is able to be moved approximately in the horizontal plane in a freely swinging manner. The base 210' has a completely circumferential pressure zone 230 and is provided with a first recess 231, directed inwardly into the base wall in relation to the pressure zone 230, and with a second recess 232, directed inwardly relative to the first recess 231. Approximately in the central region of the second recess 232 there is provided a support part 233. The recess 231 serves to receive a plate-like measuring element not represented and not defined in any more detail, for example a glass measure gauge, known per se, with correspondingly arranged and oriented strip units.

Arranged in the region of the pressure zone 230 in the base wall 210', as represented in plan view in Figure 18, there is a channel system formed from channels 235, 235' and 236, 236' as well as several bores 237 (only shown once), arranged spaced relative to each other. The bores emanating from the outer surface of the pressure zone 230 open into the respective channels 235, 235' or 236, 236' provided on the outer side with connections not shown or defined in any more detail. At this point it should be pointed out that the sliding movement of the support element 290, forming a constructional unit with the parts 260, 25, 150 or 150' and 300, occurs substantially by means of drives, acting on the sides 212, 213 and 216 and which are not shown, approximately according to the coordinate system K in Figures 2, 16 in the arrow direction X and Y. The special embodiment of the support element 290 in combination with the arrangement and the bearing of the contacting element 150 or 150'

formed substantially as a so-called rocker in the interior of the support element 290, of the correspondingly formed side walls 212, 213, operatively connected to electric motor drives (not shown) or to a
5 slide part able to be operated by corresponding means and the rear side 216 as well as in connection with the base 210, operatively connected to a sliding plate (not shown) in a vacuum prestressing manner, guarantees the drive of the complete device 200 in the centre of
10 gravity of the mass to be moved such that no tilting moments on the actual support element 290 occur and a high dynamic adjusting movement of the device 220 to a working station (not shown) is guaranteed.



Claims

1. A device for the wire connection, in an ultrasonic-contacting manner, of switching circuits to electronic components by means of a contacting element (150; 150'), which element comprises a first supporting frame (10; 10') able to be pivoted by an electric motor drive (25) about an axis (Z), as well as a second supporting frame (50; 50') arranged thereon and formed for receiving an energy transducer (175; 175'),
5 provided with a capillary, wherein the second supporting frame (50; 50') is mounted on a pivot point (Z') of the first supporting frame, arranged at a distance (D) to the axis (Z), and, with contact of the capillary (177; 177') with the respective electronic
15 component (170) is able to be moved relative to the first supporting frame (10; 10'), characterised in that the two supporting frames (10, 50; 10', 50') as well as the energy transducer (175; 175') are arranged in a support element (290) so as to be pivoted about the
20 axis (Z) and have a common centre of gravity (M) lying on the axis of symmetry (S) of the individual parts, and in that the centre of gravity (M) lies within a circle (E) oriented perpendicularly towards the axis (Z) and arranged with its centre (F) on a straight line
25 formed between the axis (Z) and the pivot point (Z') and also oriented perpendicularly to the axis (Z), the radius (R) of which circle is smaller than half ($R < D/2$) of the spacing (D) between the axis (Z) and the pivot point (Z').

30 2. A device according to claim 1, characterised in that arranged in each case on the supporting frame (10, 50; 10', 50') there is a contact device (70; 70') which is designed to form signals, which are dependent on movement and force, for the
35 energy transducer (175; 175').

3. A device according to claims 1 and 2,



characterised in that a first evaluating unit (180) for detecting and processing movement-dependent signals (S1) of the energy transducer (175), as well as a first regulating unit (185) for forming dependent electric
5 signals (S3) for the activation of the electric motor drive (25) are associated with the contacting element (150).

4. A device according to claims 1 to 3,
characterised in that the first evaluating unit (180)
10 for the movement-dependent signals (S1) of the energy transducer (175'), and the first regulating unit (185) for the electric signals (S3) as well as a second evaluating unit (184) for detecting and processing
15 force-dependent signals (S75, S75'; S77, S77') of the energy transducer (175'), and a second regulating unit (186) for forming further electric signals for the activation of the electric motor drive (25) are associated with the contacting element (150').

5. A device according to claim 2,
20 characterised in that the contact device (70') for the contacting element (150') has at both sides of the energy transducer (175') in each case at least one piezo-element (75, 75') arranged on the supporting
25 frame (50') and electrically connected to a printed board (76, 76'), with which force-dependent signals are able to be detected when there is pivoting movement of the energy transducer oriented in the direction of the arrow (Z").

6. A device according to claims 2 and 5,
30 characterised in that the contact device (70') has at both sides of the longitudinal axis or axis of symmetry (S) of the transducer (175') a respective printed board (76, 76') and in that the individual printed board (76, 76') secured to bearing parts (59, 59') of the
35 supporting frame (50') is formed in each case for receiving and for electrical connection of two piezo-



elements (75, 77; 75', 77'), wherein the piezo-elements (75, 77; 75', 77') are arranged spaced from each other, relative to the pivot point (Z') formed substantially by a clamping part (55) arranged on the supporting
5 frame (50').

7. A device according to claim 6, characterised in that the piezo-elements (75, 77; 75', 77') are arranged and secured on the printed boards (76, 76') symmetrically relative to each other and
10 relative to the longitudinal axis or axis of symmetry (S) of the energy transducer (175'), as well as relative to the pivot point (Z').

8. A device according to claim 1, characterised in that the centre of gravity (M) of the
15 two supporting frames (10, 50; 10', 50') and of the energy transducer (175; 175'), arranged thereon, which centre of gravity lies on the axis of symmetry (S) and is to be determined arithmetically with corresponding means, is arranged within the upper semi-circle (E') of
20 the circle (E).

9. A device according to claim 1, characterised in that the first supporting frame (10; 10') is formed in its front region for receiving and securing a wire-clamping device (35), which has two
25 clamping pieces (40, 45) which are operatively connected to each other at a pivot point, formed approximately of a plate spring (39), and able to be activated, against the restoring force of a spring (46), by an associated electric magnet (36), and
30 provided in the front region with small clamping plates (42, 43).

10. A device according to claim 1, characterised in that the relative motion of the second supporting frame (50) is able to be adjusted relative
35 to the first supporting frame (10) by an adjusting device (60), and in that the adjusting device (60) has



compression springs acting on both sides of the second supporting frame (50), which are able to be adjusted in their spring tension.

11. A device according to claim 1,
5 characterised in that the first supporting frame (10, 10'), formed on the one end for pivotable bearing of the second supporting frame (50; 50'), has on the other end a magnetic body (20), which is arranged in a gap (27) of the electric motor drive (25) formed by two
10 stator bodies (26, 26') and coil bodies (33, 33'), arranged spaced from each other, and the magnetic body (20) is able to be pivoted by some degrees of angle with the supporting frame (10; 10') about the axis (Z), oriented transverse to the direction of motion (Z"),
15 upwards and downwards in a limited manner.

12. A device according to claim 1,
characterised in that the contacting element (150; 150'), which comprises substantially the first
supporting frame (10; 10') with the magnetic body (20),
20 the electric motor drive (25), the clamping device (35) and the second supporting frame (50; 50') with the energy transducer (175; 175'), is formed as a function unit able to be incorporated into the support element (290) and able to be freely adjustable in the plane.

25 13. A device according to claim 1 and 12, characterised in that the support element (290) is formed as a rigid, housing-like cell construction, formed in one piece by an upper overhead wall (211'), a lower base (210') as well as walls (212', 213')
30 connecting these to each other, in the form of a square hollow body with chambers (225, 224), for receiving and for pivotable bearing of the contacting element (150; 150') formed from the individual elements and of the electric motor drive (25) operatively connected
35 thereto, as well as an encoder (260), and in that the lower side (210) of the support element (290) is formed



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as a vacuum-prestressing air cushion bearing which has a vacuum zone (231, 232) surrounded completely on the circumference by a pressure zone (230).