This invention relates to process for fitting strip-shaped system supports (leadframe strips) with electronic components, according to the precharacterising clause of the first claim.

The invention also relates to a device for carrying out the process.

In the automation of motional and processing procedures, particularly in connection with a device which is appropriately constructed for the transport of relatively thin (of the order of about 0.1 to about 2.0 mm), strip-like metal system supports (leadframe strips), the problem exists that the individual system supports for the application of electronic components and for the joining (for the bonding) of integrated circuits have to be fed to a processing or bonding station or the like accurately aligned and positionally stable, with tolerances in the μ range.

A bonding device for fastening electronic components to a workpiece (leadframe) is known from US-A-4 674 670; this device essentially comprises a table which can be moved in the X and Y directions in a plane and which is constructed as a support element for a bonding head, and which is disposed on a frame and is actively connected to a motor for executing the movements in the X and Y directions. In this bonding device the feed movement of the workpiece (leadframe), which is guided on rails, is effected by means of correspondingly driven conveyor belts, the position of the individual workpiece in relation to the bonding head being monitored by an optical system in the form of a TV camera. The individual system supports are placed on a conveyor belt driven in circulation and are essentially fed by the friction of the bonding head of the bonding station. In the bonding station, the individual system supports are guided by additional rails which are adjusted on to the respective system support, and are positioned and held at their lateral edges by additional rollers which can be brought into engagement therewith. This device has the disadvantage that the rails have to be reset and adjusted in each case for system supports of different construction, and the adjustment of the guide rails has to be extremely precise to prevent deformations of the highly sensitive system supports. The additional adjusting operations on the rails are time-consuming and costly.

CH-A-423 397 describes a transport apparatus on a machine for advancing a strip- or ribbon-shaped workpiece in steps to a processing location, wherein the individual workpiece is firstly fed by pneumatically or hydraulically operated clamping elements which can move back and forth and is secondly held by fixed clamping elements.

The underlying object of the present invention is to provide a process and a device for carrying out the process by means of which it is possible to achieve accurately aligned transport, for example phased transport, of system supports of different forms (types), and the feeding thereof to a processing or bonding station which is correspondingly disposed in the direction of throughput, without additional resetting and/or manipulation measures.

This object is achieved by the process according to the invention by means of the features of claim 1.

The device according to the invention for carrying out the process consists of a transport apparatus (70) which can be operated by an electric motor drive (30) and an associated processing or bonding station (75) to which system supports (1) provided with processing points and holes at a distance from each other can be fed for bonding electrical circuits and/or electronic components (3'), and further consisting of a sensor (80) by means of which the data required for controlling the electric motor drive (30) can be determined, and is characterised in that the transport apparatus (70) comprises a main support (10) oriented in the direction of transport (X') with first clamping elements (13, 14, 15, 16, 17) disposed fixed thereon at a distance from each other and a support member (20) oriented in the direction of transport and having second clamping elements (23, 24, 25, 26, 27) disposed thereon at a distance from each other, wherein the support member (20) together with the second clamping elements (23 to 27) feeding the individual system supports (1) to the processing or bonding station (75) can be moved back and forth in the direction of transport in relation to the first clamping elements (13 to 17) disposed on the main support (10) by means of the electric motor drive (30) and a guide unit (35) actively connected thereto, and the electric motor drive (30) can be controlled by an actuator (102) which can be triggered by signals generated from the data determined by the sensor (80) by means of a computer (103), and by a positional inspection and control unit (101) for determining the instantaneous

position of the second clamping elements (23 to 27) which can be adjusted in the direction of transport (X').

Other features of the invention follow from the description given below in association with the drawings, and from the other claims.

The invention is described blow with reference to the drawings, where:

Figure 1 a schematic plan view of a device for feeding strip-like workpieces to a processing or bonding station, in a first position;

Figure 2 shows the device illustrated in plan view in Figure 1, in a second position;

Figure 3 is a schematic perspective view of a portion of the device shown in Figure 1;

Figure 4 is a section through the device along the line IV-IV in Figure 1;

Figure 5 is a section through a portion of the device along the line V-V in Figure 1;

Figure 6 is a section through the device along the line VI-VI in Figure 1;

Figure 7 illustrates a portion of the strip-like workpiece;

Figure 8 illustrates, on an enlarged scale, a clamping element of a first group of clamping elements for the device shown in Figure 1;

Figure 9 is a section through an area, which is marked by the circle D, of the front region of the clamping element shown in Figure 8;

Figure 10 is a section, on an enlarged scale, through a clamping element of a second group of clamping elements for the device shown in Figure 1;

Figure 11 is a section through the positioning apparatus associated with the individual clamping element shown in Figure 10;

Figure 12 is a view, in the direction of arrow B in Figure 11, of the positioning apparatus for the clamping element shown in Figure 10;

Figure 13 is a plan view, on a reduced scale, of the positioning apparatus shown in Figure 11; and

Figure 14 is a front view, in the direction of arrow C in Figure 10, of a modified embodiment, with the clamping faces of the clamping elements correspondingly disposed in relation to each other.

A plan view of a device which is denoted in its entirety by 100 is illustrated in Figures 1 and 2 as a general view in order to clarify the invention. The device 100, which amongst other components comprises an appropriately constructed and associated transport apparatus 70, is designed for feeding strip-like workpieces to at least one associated processing or bonding station 75 corresponding to the apparatus 70. The station 75 is provided with a measuring element, for example an optical sensor 80 which is schematically illustrated.

During the feed movement, the individual workpiece is fed to the processing or bonding station 75 or to the optical sensor in a phased manner and approximately in the arrowed direction X of a schematically illustrated system of coordinates K (Figure 3) in a first phase, and is fed in a second phase along the coordinate denoted by arrowed direction X'. In a preferred embodiment, the workpiece can also be aligned in a third phase along a coordinate marked by arrowed direction Y, wherein the coordinate Y is oriented approximately at right angles to the coordinate X' in the plane. The means for effecting the feed movement in arrowed direction X' and the alignment movement in arrowed direction Y will now be described in detail.

The portion of the workpiece which is schematically illustrated in Figure 7 is, for example, a so-called system support (leadframe strip) known in the art. This has a surface structure 2, which is of multicontact construction for example, and a plurality of support surfaces 3 or cut-outs (processing points) for the automatic fixation and contacting of electronic components such as chips or the like, which are not shown, or for the formation of integrated circuits. The holes 4,5 or 4',5' which are provided at the side edges 6,6' during the manufacture of system supports 1 of this type and which are disposed at defined periodic spacings A from each other are at a defined distance, denoted by A', from the support surface 3. The holes 4,5 or 4',5' are utilised, in association with the device according to the invention 100, as the reference geometry during the feed movement to the processing or bonding station 75 in arrowed direction X'.

The system support 1 illustrated in Figure 7 is an example, and the use of other forms of support with corresponding reference geometries is also possible. The actual positioning

function of the system support is described later in connection with the mode of operation and mode of action of the device 100 as a whole.

The device 100 shown in schematic plan view in Figure 1 essentially comprises, as seen in the direction of throughput and in arrowed direction X,X' (Figure 3), a delivery apparatus 95 disposed at one end for the bare workpieces or system supports 1, a receiving apparatus 90 at the other end for the system supports 1 fitted with electronic components, which are not illustrated in Figure 1, and also comprises the transport apparatus 70 disposed approximately between the two apparatuses 95 and 90. The two schematically illustrated delivery and receiving apparatuses 95 and 90 are of magazine-like construction, and are constructed in a manner which is not illustrated for receiving the individual system supports 1 situated one on top of another. Other forms of the delivery and receiving apparatuses 95,90 are also possible, but are not a subject of this invention and are therefore not described in detail.

An apparatus 85, which is provided with suitable electric motor drives 83,83' and 83'' and which is schematically illustrated in Figure 1, may be associated with the device 100. The apparatus 85 is designed for effecting the feed movement of a bonding head 84, which is disposed on a supporting component 82 and which is schematically illustrated in part, to the system support 1 which is fed by means of the transport apparatus 70 to the processing or bonding station 75. The feed movement of the support component 82 is essentially executed according to the system of coordinates K'' which is schematically illustrated in Figure 1, in arrowed direction X'' and in arrowed direction Y'', the feed movement of the partially illustrated bonding head 84 being executed in arrowed direction Y'' and orthogonally thereto in arrowed direction Z''.

As shown schematically in plan view in Figures 1 and 2 and as a perspective view on an enlarged scale in Figure 3, the transport apparatus 70 comprises a main support 10, which is oriented in the longitudinal direction which substantially corresponds to the direction of transport, a support element 20, a guide unit 35, and an electric motor drive 30 which is actively connected to the guide unit 35. The elements 10,20,30 and 35 are described in detail below.

The main support 10, which is denoted in its entirety by 10, essentially consists of a base plate 11 and a rib 12. As seen in the longitudinal direction, and as is illustrated more clearly in Figure 3, the base plate 11 is provided with a central part 11′ of wider construction, for example, with portions 11″ adjoining both ends of the latter as seen in the longitudinal direction. The rib 12, which is disposed at right angles on the base plate 11 and is secured by means which are not illustrated, extends in the region of the central part 11′. A number of fixed clamping elements, 13,14,15,16,17 and 18, for example, are disposed at a distance from each other on the rib 12. The main support 10, which is constructed from the base plate 11 and the rib 12 and which has a substantially ⊥-shaped profile cross-section, may also be of one-piece construction.

The support element 20 which is actively connected to the guide unit 35 has an approximately U-shaped profile cross-section, for example, with two flanges 21 and 22 disposed parallel to each other and a vertical web 22′ (Figures 5, 6) joining the flanges 21,22 to each other. Clamping elements 23,24,25,26 and 27, which are adjustable or displaceable in relation to the clamping elements 13 to 18 which are disposed fixed in relation to the rib 12, and in relation to the support element 20, are disposed on the upper flange 22 at a distance from each other, as is schematically illustrated in Figures 1 and 2. The support element 20, with the clamping elements 23 to 27 which are fixed thereon or thereto, is adjustable or displaceable at an extremely acute angle laterally and in the plane in relation to the coordinate marked by arrowed direction X, as indicated in Figure 3 by arrowed direction X′ (direction of transport) in the system of coordinates in Figure 3, the clamping elements 13 to 18 which are disposed fixed on the rib 12 of the main support 10 being provided along the coordinate marked by arrowed direction X.

The clamping elements 23 to 27 which are actively connected to the support element 20 are hereinafter called the first group of clamping elements, and the clamping elements 13 to 18 disposed fixed to the rib 12 of the main support 10 are hereinafter called the second group of clamping elements. The number of clamping elements of both clamping element groups is variable and can be correspondingly adapted to the requirements imposed by the device 100 as a whole. The individual clamping elements 23 to 27 of the first group and the

clamping elements 13 to 18 of the second group can be operated hydraulically, pneumatically or electromagnetically by an appropriate associated energy source.

The special course of movement of the first group of clamping elements 23 to 27 in relation to the second group of clamping elements 13 to 18 is described below in connection with the mode of operation of the device 100 as a whole.

Figure 5 is a sectional view along line V-V of Figure 1 through a portion of the transport apparatus 70, showing the rib 12, the two flanges 21,22, the support element 20 comprising the web 22', and clamping element 23 of the first group of clamping elements 23 to 27, which is fixed to the flange 22 by means which are not illustrated. As is shown in Figure 5 as an example, a sufficient gap 28 is provided between the rib 12 and the lower face, which faces the rib 12, of the individual clamping element 23 to 27 for the free (contactless), linear transport movement, which is oriented in arrowed direction X', of the first group of clamping elements 23 to 27.

Figure 6 is a sectional view along line VI-VI of Figure 1 of the transport apparatus 70, showing the main support 10 with the base plate 11 and the rib 12, the support element 20 disposed with a lateral gap 19 from the rib 12, and the clamping element 15 of the second group of clamping elements 13 to 18, which is disposed at this location on the rib 12 and is fixed by means which are not illustrated. A gap 29 is provided in each case between the fixed clamping elements 13 to 18 and the support element 20 for the linear movement of the support element 20, which is oriented in arrowed direction X'.

Figure 6 also shows a bearing element 40 which is detachably fixed to the rib 12 by means which are not illustrated, and the drive 30 which is disposed on the other side and which is indicated in part in this Figure by the dash-dot lines.

As shown in part as a perspective view in Figure 3, the electric motor drive 30 comprises a stator body 32 with an approximately E-shaped profile cross-section, which is fixed to the central part 11' of the base plate 11 of the main support 10 by means which are not illustrated, and correspondingly disposed magnet parts 34,34' (only magnet part 34 is visible

here), and also a coil body 31 which is guided in the stator body 32 and which is fixed to a fastening plate 33 actively connected to the guide unit 35 by means which are not illustrated. The individual parts 31,32 and 34,34' of the drive 30 are constructed and disposed in relation to each other so that movement of the coil body 31 with the fastening plate in arrowed direction X is effected by a corresponding energisation, preferably by a controlled or regulated DC energisation, of the coil body 31. In addition, movement approximately in arrowed direction Y is also possible due to the special construction of the parts 31,32.

Figure 4 is a section along line IV-IV in Figure 1, showing the guide unit denoted in its entirety by 35, the electric motor drive 30 essentially formed by the parts 31,32 and 34,34', the support element 20, the main support 10 with the bearing element 40 disposed thereon at the side and fixed to the rib 12 by fixing means which are not illustrated, and the clamping element 14 of the second, fixed group of clamping elements 13 to 18, which is disposed at this location and is fixed to the rib 12. The bearing element 40 is disposed on and fixed to the rib 12 of the main support 10 so that the system support 1 held by the clamping element 14 is disposed at a distance in the μ range from the surface, denoted by 40', of the bearing element 40. The bearing element 40 serves, particularly in the region of the bonding station, as a thrust bearing for the system support 1, during bonding for example.

The guide unit 35 comprises a first bearing element 36 and a second bearing element 37 disposed at a distance therefrom. Corresponding sliding elements 38,38' and 39,39', for example rolling bearings known in the art and installed in what is termed a cage, are disposed between the two bearing elements 36,37 of plate-like construction. The first bearing element 36 is fixed to the rib 12 of the main support 10 by means which are not illustrated, and the support element 20 and the fastening plate 33 which is actively connected to the coil body 31 of the electric motor drive 30 are fixed to the second bearing element 37.

In order to effect the feed movement, denoted by arrowed direction X', of the support element 20 with the first group of clamping elements 13 to 18 disposed thereon, one bearing element 36 may be disposed, for example, by means which are not illustrated, at the extremely acute angle α on the rib 12 of the main support 10. In another variant, the rolling

bearing track, which is not illustrated, of the bearing element 36 may be disposed at a corresponding angle α. In this respect it is essential that the guide unit 35 is constructed in order to effect the feed movement oriented in arrowed direction X', which permits the relative movement, laterally and in the same plane in relation to the coordinate denoted by arrowed direction X, and thus the substantially horizontal relative movement, of the bearing element 37 with the support element 20 and the first group of clamping elements 13 to 18 in relation to the second group of clamping elements 24 to 27 disposed on the rib 12.

An appropriately constructed measuring apparatus 50, which is schematically illustrated in Figure 4, is provided in the region of the guide unit 35 for determining the instantaneous position of the parts 37,33 and 31, and can be adjusted in relation to the rib 12 of the fixed main support 10 in arrowed direction X' by means of the drive 30. By means of this measuring apparatus the electric motor drive is actuated, by a DC energisation pulse for example, in accordance with a result, for example the result of a comparison. The measuring apparatus 50 comprises two correspondingly disposed measuring elements 51,52 with measuring heads, which are not illustrated, and correspondingly disposed glass scales which are provided with marker line units oriented in the X' direction. By means of the measuring heads, which operate opto-electronically for example, position-dependent data are determined and are converted into signals which are fed to the electric motor drive or to a corresponding controller (not illustrated).

In a modified embodiment of the transport apparatus 70, an appropriately constructed positioning element 150 is associated with at least one of the fixed clamping elements 13 to 18 for the alignment of the system support 1, as illustrated in Figures 11 to 13. By means of the positioning element 150, an alignment movement oriented approximately transversely to the direction of transport X', as illustrated schematically by arrowed direction Y in the system of coordinates K in Figure 3, is effected simultaneously with the feeding of the system support 1 to the processing or bonding station 75 or to further processing stations disposed before or after the bonding station 75 in the direction of throughput. To obtain optimum alignment of the system support 1, a positioning element 150 is associated with each fixed clamping element 13 to 18.

The special constructional design of the individual clamping elements is described below with reference to Figures 8 to 10.

Figure 10 is a sectional view on an enlarged scale of the clamping element 15, as an example of an embodiment of the fixed clamping elements 13 to 18. The first housing part 110 can be seen; this has a housing wall 113, on the inside of which, which faces one clamping body 130, a recess 112 of substantially pocket-like construction is provided for a transition piece 115. An appropriately constructed opening 111 is provided at one end of the housing part 110 for connecting a line which conveys medium.

The transition piece 115 disposed in the recess 112 of the housing part 110 has a hole 116' passing through the transition piece 115 and a channel 116 which communicates with the opening 11 via a bore 111' provided in the housing part 110. A first diaphragm part 118 is disposed on the side of the transition piece 115 facing the clamping body 130. The diaphragm part 118 is disposed in a recess or indentation, which is not illustrated, in the transition piece 115 and is held by means which are not illustrated.

A second housing part 220 of the clamping element 15 has a base 220' in which a first recess or indentation 223 and a second recess or indentation 222 are disposed. A second transition piece 225, which is provided with a channel 26 and a hole 226', is disposed in the second recess 222 of pocket-like construction. The channel 226 communicates via a bore 221' provided on one side in the housing part 220 with a correspondingly associated opening 221. The opening 221 is constructed for the connection of a line which conveys medium, as is the opening 111 in the housing part 110. On the other side of the housing part 220, which is the opposite side to the opening 221, a stay 224 is provided which is constructed on its face facing the clamping body 130 as a clamping face 224', which is schematically illustrated here. A second diaphragm part 219 is associated with the transition piece 225 on the side of the latter facing the clamping body 130. This diaphragm part 219 is likewise disposed in a recess or indentation which is provided in the transition piece 225 but which is not marked, and is held by means which are not illustrated.

The clamping body 130 disposed between the two housing parts 110 and 120 has a first limb 128 resting on the surface 223′ of the base 220′, an approximately vertical stay 129 integrally formed on one end of the limb 128, and a second limb 128′′ integrally formed on the stay 129. The front region of the second limb 128′′ is provided with a second clamping face 128′, which is not illustrated in detail here but which corresponds to the first clamping face 224′ disposed on the stay 224. A spring element 127, for example an elastic metal strip or the like, is disposed at the other end of the limb 128 and is fixed to the limb 128 in a manner which is not illustrated. The free end of the spring element 127 rests on a portion 220′′ of the housing part 220 and is clamped by means of an associated clamping part 114 between the two housing parts 110 and 220, which are fixedly attached by a screwed connection which is not illustrated.

By the use of suitable means, for example by means of the parts 118,219 of diaphragm-like construction or by means of pressure means of bellows-like construction which are not illustrated, the clamping body 130 is clamped against the restoring force of the spring element 127 between the two housing parts 110 and 220, the front regions of which are disposed at a distance from each other or with a gap S between them, so that it can be moved and raised freely in the direction of clamping. This means that the two clamping faces 224′ and 128′ can be pressed together to hold the metal system support 1 or pushed apart to release the system support 1 by a corresponding pneumatic or hydraulic actuation of the clamping body 130.

Figure 8 is a view of clamping element 23 as an example of an embodiment of the first movable group of clamping elements 23 to 27, and shows a first housing part denoted by 310, a second housing part denoted by 320, and a clamping body 330. The clamping element 23 differs from the clamping element 15 described above in that it is detachably fastened to the support element 20, which is displaceable in arrowed direction X′, by means which are not illustrated.

The constructional design of the clamping element 23 shown in Figure 8 substantially corresponds to the constructional design of the clamping element 15 which was described above in detail with reference to Figure 10, so that only the constructional differences in the

front region of the clamping element 23 in relation to the clamping element 15 will be described at this point.

Figure 9 is a section, on an enlarged scale, through the front region of the clamping element 23, which is marked by the circle D in Figure 8, and shows the first housing part 310 with the transition piece 115 and the associated diaphragm part 118 disposed therein, the second housing part 320 with the transition piece 225 and the associated diaphragm part 219 disposed therein, and the clamping body 130, which is disposed between the two housing parts 310,320, which are joined to each other by a screwed connection which is not illustrated. As distinct from the clamping element 15, in this example of an embodiment the limb 328'' of the clamping body 330, and correspondingly the base 320' of the housing part 320, are of shorter construction. Figure 9 also shows the stay 324 with the clamping face 324' of the housing part 320, and the clamping face 328' which is disposed corresponding thereto on the limb 328'' of the clamping body 330.

The essential difference in arrangement as regards the mode of operation and mode of action which is provided in the front region of the first group of clamping elements 23 to 27 in relation to the second group of clamping elements 13 to 18 is that the system support 1 is deliberately and intentionally fed to the fixed clamping elements 13 to 18 from the mobile clamping elements 23 to 27 in a slanting position which is displaced laterally and in the same plane by a slight angle α in the μ range along arrowed direction X', and has to be aligned by means of the positioning apparatus 150 which is associated with the fixed clamping elements 13 to 18 in each case and is of corresponding construction.

In a preferred embodiment, the positioning apparatus which is denoted in its entirety by 150 is associated with each of the fixed clamping elements 13 to 18. The positioning apparatus is described below with reference to Figures 11 to 13.

Figure 11 is a sectional view of the positioning apparatus 150, showing the clamping element 15 which is detachably fastened to the rib 12 of the main support 10 by means of a screwed connection which is not illustrated, with the two housing parts 110,120 which are illustrated in part, and the clamping body 130.

The positioning apparatus 150 essentially comprises a positioning element 140, a holding part 155, a transition piece 135 with an associated diaphragm part 138, a spring element 137 and a holding piece 133. The pressure element 138 which is illustrated in Figure 11 and which is constructed in the form of a diaphragm, for instance, may also be of bellows-like construction in a manner which is not illustrated.

The positioning element 140 has a portion 142 of plate-like construction, at one end of which the spring element 137, which consists of a spring-acting metal strip or the like, for example, is disposed and fixed by means which are not illustrated. The spring element 137, which is seated against a correspondingly associated transition piece 134 (Figure 11) and which is actively connected to the positioning element 140, is detachably fastened to the rib 12 of the main support 10 by means of the holding piece 133 and a screwed connection which is not illustrated. At the other end of the positioning element 140, which is of approximately fork-like construction, two limbs 141,141′ are provided at a distance from each other, between which the clamping element 15 is disposed as illustrated in Figure 12. In the upper region, a sliding surface 139 is provided on the limb 141 and a sliding surface 139′ is provided on the limb 141′, the two sliding surfaces being constructed in the shape of runners.

The holding part 155, which is of approximately [-shaped construction in profile cross-section and in plan view (Figure 13), has a front plate 156, two ribs 158,158′ disposed at a distance from each other, and a recess 157 provided between the two ribs 158,158′. The front view in the direction of the arrow B in Figure 11, which is shown partially broken away in Figure 12, illustrates the portion 142 of the positioning element 140 which is disposed between the ribs 158,158′ in the recess 157, and also shows the spring element 137 and the holding piece 133. A pressure spring 144 is disposed on the inner face of the front plate 156 and is held by means which are not illustrated. The pressure spring 144 is disposed at its free end in a recess 143 in the portion 142 and essentially acts on the positioning element 140. The holding part 155 is preferably of one-piece construction and is detachably fastened to the rib 12 of the main support 10 by means of a screwed connection which is not illustrated.

As illustrated in Figure 11, a pocket-like recess 152 is provided in the rib 12. The transition piece 135, which is provided with a channel 136 and a hole 136′, is disposed in this recess.

The channel 136 communicates with a bore provided in the rib 12, the bore 151 being constructed for the connection of a line which conveys medium, which is not illustrated. The diaphragm part 138 is disposed on the side facing the portion 142 in a recess of the transition piece 135 which is not illustrated, and is held by means which are not illustrated.

Figure 12 is a view of the positioning apparatus 150, shown partially broken away, in the direction of arrow B (Figure 11), and essentially shows the clamping element 15 disposed between the two ribs 141,141', the portion 142 of the positioning element 140 disposed between the two ribs 158,158' of the holding part 155 in the recess 157, and the holding piece 133, which is fixed to the rib 12 of the main support 10 by means which are not illustrated.

Figure 13 illustrates the positioning apparatus 150 on a reduced scale and in plan view, and shows the holding part 155, the rib 12 with the clamping element 15 disposed thereon, which clamping element is disposed with the clamping body 130 between the two ribs 141,141', which are of runner-shaped construction, of the positioning element 150. As illustrated in Figure 13, the clamping face 128' of the clamping body 130 and the corresponding clamping face 224' of the housing part 220 have approximately the same width as seen in the direction of transport X' as the external dimension of the two ribs 141,141' of the positioning element 140, which are disposed at a distance from each other and are provided with the sliding faces 139,139'.

Figure 14 is a front view, in the direction of the arrow C in Figure 10, of a modified form of construction, and shows the clamping face 224',324' which is provided on the stay 224,324 of the housing part 220,320 and which is provided with integrally formed sliding surfaces 132,132' on both sides, as well as the corresponding clamping face of the clamping body 130,330. In this variant, the clamping face 128',328' is subdivided as seen in the direction of transport into two portions 128'',328'' by a recess 131'' and has integrally formed sliding runners 131,131' on both sides.

At this point it should be mentioned that the pressure elements 118,219 and 138 of the clamping elements 23 to 27 and 13 to 18 and of the positioning apparatus 150, which

pressure elements are of diaphragm-like construction and are preferably operated pneumatically or hydraulically, may also be replaced by electromagnetic coil bodies, which are not illustrated, with the housing parts being formed correspondingly.

The mode of operation of the device 100 in association with a controller 101 (POSITION CONTROLLER), an actuator 102, a computer 103, corresponding lines L1,L2,L3,L4,L5 and L6, the transport apparatus 70 and the receiving apparatus 90 for the individual system supports 1 which are to be fitted with electronic components for example, is described below.

In a first phase the system supports 1, which are disposed in the delivery device 95 schematically illustrated in Figures 1 and 2, for example situated one on top of another in a manner which is not illustrated, are ejected or pushed out individually from the delivery device 95, under phased control for example, by plungers or the like which are not illustrated, and are preferably substantially aligned by suitable means which are not illustrated for the advance movement in arrowed direction X to the first, movable clamping element 23 of the first group of clamping elements 23 to 27.

The system support 1 which is clamped and held by the first clamping element 23 is then fed to the second group of clamping elements 13 to 18, in a phased manner and substantially by means of the guide unit 35 described in detail above, in arrowed direction X', namely displaced laterally and in the same plane by the angle α in arrowed direction X' in relation to arrowed direction X in which the fixed clamping elements 13 to 18 are disposed.

During the phased feed movement of the system support 1 in arrowed direction X', the individual groups of clamping elements are correspondingly closed and opened again in succession in order to clamp and release the successive system supports 1 which are to be transported in the direction of transport and the arrowed direction X'.

The advance movement of the support element 20, which is actively connected to the electric motor drive 30, and of the first group of clamping elements 23 to 27 which is actively connected to the support element, is thereby directly related to the distances from hole 4 to hole 5 or hole 4' to hole 5' denoted by A and to the distances A' from hole 4' or 5' to the

support surface 3 (processing point) of the system support 1 illustrated as an example in Figure 7. The distances A and A′ with respect to the support or process surface 3, respectively, are used as what is termed the reference geometry, and are reference quantities which depend on the respective system support, which are input into a corresponding actuator 102 or the like as corresponding data for controlling the drive 30. The advance movement can thus be adjusted by the arrangement (distance of hole from processing point) of the respective system support 1 which is to be fitted with electronic components or the like, i.e. it can be preprogrammed in the actuator which is actively connected to the drive 30, depending on the respective distance from the holes to the processing point. A time-consuming manual operation, as in comparable devices known in the art, is thus no longer necessary.

In the above-mentioned first phase the first clamping element 23, which is displaceable in arrowed direction X, has the position in relation to the first fixed clamping element 13 which is schematically illustrated in Figure 1 for instance, or the first group of clamping elements 23 to 27 has the position in relation to the second group of clamping elements 13 to 18 which is schematically illustrated in Figure 1 for instance, in which the individual clamping elements of the first group of clamping elements 23 to 27 are open in a manner which is not illustrated.

The group of clamping elements 23 to 27 of the first group, which are not illustrated in detail but which exert a clamping effect on the lateral edge 6 or 6′ of the system support 1 (Figure 7), are then closed by suitable means, for example by pneumatic means, which are not illustrated, and the clamping elements 13 to 18 of the second group are opened. The electric motor drive 30 for the transport movement in arrowed direction X′ is correspondingly actuated approximately simultaneously, so that the system support 1 is fed to the first, fixed clamping element 13, which is in an open position which is not illustrated (clamping elements 13 to 18 are open). In the position which is approximately delimited by the fixed clamping elements 13 to 18, the first group of clamping elements 23 to 27 which are actively connected to the support element 20 has approximately the position illustrated in Figure 2, in which the clamping elements 13 to 18 of the second group are closed and the clamping elements 23 to 27 of the first group are open again, so that the support element 20 with the

clamping elements 23 to 27 fixed thereto can be moved back into the base position shown in Figure 1 by means of the drive 30, which is preferably constructed as a linear motor drive. The individual system supports 1 are fed step-wise or in a phased manner, as described above for instance, to the processing or bonding station 75, and are correspondingly controlled by suitable means.

The advance and transport movement of the system support 1 in arrowed direction X' and the reference geometry (distance A,A' of the holes from the processing point) are measured dynamically, in a manner which is not illustrated, by means of a sensor 80 which is disposed with its measuring axis denoted by M at a distance in front of the actual processing or operating point (bonding point) in the direction of throughput or arrowed direction X', and the requisite advance is calculated from the values determined in the computer and the electric motor drive 30 is controlled by means of corresponding signals. The reference geometry is preferably measured continuously during the advance and transport movement of the system support 1.

As schematically illustrated in Figures 1 and 2, a further processing station (dispenser), which is disposed in front of the bonding station 7 in the direction of transport X' and which is provided with a sensor 60 for opto-electronic measurement, may be associated with the transport apparatus 70, by means of which further processing station the processing points 3 of the system support 1 can be pretreated with suitable means (epoxy material or the like) which are not illustrated. The processing station 65 can be adjusted to one side or the other approximately in the direction of transport by means which are not illustrated, depending on the measured results.

Pretreatment of the processing points 3 is employed, for example, to achieve the optimum contacting and/or bonding of the electronic components, which are schematically illustrated in Figure 3, on the system support 1'. Pre-inspection, lowering, application of adhesive or marking of the processing point 3 of the system support 1 may be carried out as a further pretreatment by the processing station 65, which can also be adjusted in arrowed direction Y (alignment with the respective system support).

In a further embodiment of the apparatus 70, which is not illustrated, one or more correspondingly constructed processing station(s), in which the system supports 1 can be subsequently inspected, marked or cut at appropriate points, may be disposed behind the processing or bonding station 75 as seen in the direction of transport X'.

At this point it should be mentioned that the transport apparatus 70 described above in connection with the device 100 can also be used with a correspondingly constructed and associated station (not illustrated) as a checking apparatus for system supports 1 which are already bonded and/or provided with electronic components (chips).

CLAIMS

1. A process for fitting strip-shaped system supports (1) with electronic components in a processing or bonding station, in which process the strip-shaped system supports, which are provided with processing points and holes at a distance from each other, are fed to the processing or bonding station by means of a transport apparatus operable by an electric motor drive and are held clamped and electrical circuits and/or the electronic components (3') are bonded to the processing points (3), characterised in that the individual strip-shaped system supports (1) are fed to the processing or bonding station (75) by means of second clamping elements (23, 24, 25, 26, 27) which are disposed on a support member (20) and which can move back and forth in the direction of transport in relation to first clamping elements (13, 14, 15, 16, 17) which are disposed fixed on a main support (10), and that during the feeding movement firstly the actual position of the second clamping elements (23, 24, 25, 26, 27), which can be moved back and forth, is permanently determined and compared with the scheduled position, and secondly reference geometries with respect to the respective processing point (3) and with respect to a reference hole (4) of the system support (1) are measured optically/electronically, wherein the position-dependent data of the second clamping elements (23 to 27) which can be moved back and forth, which data are determined in this manner, as well as the geometry-dependent data of the system supports (1), are used for controlling the electric motor drive (30).

2. A process according to claim 1, characterised in that the data of the second clamping elements (23 to 27), which are determined depending on the actual and scheduled position, and the data of the individual system support (1), which are determined depending on the reference geometries, are fed to an actuator (102) and to a computer (103) for the formation of dependent pulses for controlling the electric motor drive (30).

3. A process according to claim 1, characterised in that during the feeding movement of the individual system supports (1) to the processing or bonding station (75) the support member (20) which is provided with the second clamping elements (23 to 27) which can

move back and forth is moved at a horizontal angle (α) in relation to the main support (10) which is oriented in the direction of transport and which is provided with the fixed, first clamping elements (13 to 18), wherein before it reaches the processing or bonding station (75) the individual system support (1) is aligned by at least one of the fixed, first clamping elements (13 to 18) disposed fixed on the main support (10) by means of a movement oriented transversely to the linear feeding movement.

4. A process according to claim 1, characterised by the combination of the following features, that

a) the system supports (1) are measured optically/electronically during the transport movement before reaching the first processing station (75) by at least one further second processing station (65),

b) the position of the second processing station (65) is adjusted to one side or the other approximately in the direction of transport (X') depending on the measured results,

c) the system supports (1) are pretreated by the second processing station (65) in the form of a pre-inspection, lowering, or marking at the processing points (3), and

d) the system supports (1) are inspected, marked, and/or cut at the corresponding points by means of a further processing station disposed downstream of the first processing or bonding station (75).

5. A device for carrying out the process according to claim 1, consisting of a transport apparatus (70) which can be operated by an electric motor drive (30) and an associated processing or bonding station (75) to which system supports (1) provided with processing points and holes at a distance from each other can be fed for bonding electrical circuits and/or electronic components (3'), and further consisting of a sensor (80) by means of which the data required for controlling the electric motor drive (30) can be determined, characterised in that the transport apparatus (70) comprises a main support (10) oriented in the direction of transport (X') with first clamping elements (13, 14, 15, 16, 17) disposed fixed thereon at a distance from each other and a support member (20) oriented in the direction of transport and having second clamping elements (23, 24, 25, 26, 27) disposed thereon at a distance from each other, wherein the support member (20) together with the second clamping elements (23 to 27) feeding the individual system supports (1) to the

processing or bonding station (75) can be moved back and forth in the direction of transport in relation to the first clamping elements (13 to 17) disposed on the main support (10) by means of the electric motor drive (30) and a guide unit (35) actively connected thereto, and the electric motor drive (30) can be controlled by an actuator (102) which can be triggered by signals generated from the data determined by the sensor (80) by means of a computer (103), and by a positional inspection and control unit (101) for determining the instantaneous position of the second clamping elements (23 to 27) which can be adjusted in the direction of transport (X').

6. A device according to claim 5, characterised in that the support member (20) which is actively connected to the guide unit (35) can be fed, with the second clamping elements (23 to 27) disposed thereon, to the processing or bonding station (75) at an extremely acute horizontal angle (α) of the order of 0.0001 rad in relation to a rib (12) of the main support (10), which rib is oriented in the direction of transport (X') and carries the first clamping elements (13 to 18).

7. A device according to claim 5, characterised in that an electromagnetically or pneumatically or hydraulically operable positioning apparatus (150) is associated in each case with at least one of the first, fixed clamping elements, for example the clamping element (17) disposed in the region of the processing or bonding station (75), but preferably with all of the fixedly disposed clamping elements (13, 14, 15, 16, 17, 18), by means of which positioning apparatus the individual system support (1) can be aligned orthogonally to the clamping movement or transversely to the direction of transport (X').

8. A device according to claim 5, characterised in that the individual first and second clamping elements (13 to 18 and 23 to 27) which are fixed and which can move back and forth, respectively, comprise an electromagnetically or pneumatically or hydraulically operable clamping body (130 or 330) which is provided with a clamping face (128' or 328'), which is actively connected on both sides to pressure elements (118, 219), and which is disposed between a first housing part (110 or 310) and a second housing part (220 or 320) provided with a clamping face (224' or 324'), in which clamping body (130, 330) the clamping face (128' or 328') is subdivided by a recess (131'') into two clamping face

portions and is provided with lateral sliding runners (131, 131'), wherein the corresponding clamping face (224' or 324') of the second housing part (220 or 320) is constructed as a flat surface with lateral sliding runners (132, 132').

9. A device according to claim 7, characterised in that the individual positioning apparatus (150) comprises at least one positioning element (140) which is actively connected to an electrical, pneumatic or hydraulic energy source, which can move transversely to the direction of transport (X') of the system support (1) against the restoring force of a spring element (137, 144), and which is provided with two limbs (141, 141') disposed at a distance from each other, in which positioning element the limbs (141, 141') are provided with sliding surfaces (139, 139') constructed in the shape of runners and oriented in the direction of transport (X') of the system support (1).