The invention relates to a capacitive proximity sensor for detecting component belts, comprising at least two electrically conductive sensor surfaces (151, 152) which are arranged opposite each other on a non-conducting substrate having a low dielectricity number, whereby the component belts which are to be detected are detected in the millimetre range as a result of the low dielectric number of the substrate material and the geometric arrangement of the sensor surfaces (151, 152).
CAPACITIVE PROXIMITY SENSOR FOR DETECTING COMPONENT BELTS, COMPONENT FEEDING DEVICE AND METHOD FOR DETECTING COMPONENT BELTS

[0001] Capacitive proximity sensor for detecting component tapes, component feeding device and method for detecting component tapes

[0002] The invention relates to a capacitive proximity sensor for detecting component tapes, a component feeding device and a method for detecting component tapes in which the component tapes to be detected are detected by means of a field.

[0003] The invention further relates to a component detection device for component feeding devices, a component feeding device and a method for feeding components by means of a component feeding device.

[0004] In the automatic component placement machine, e.g. for SMD components, the components to be inserted are transported by means of feeding devices to pick-up positions from which they can be unloaded and inserted on a printed circuit board e.g. using a revolver head. The components are often disposed in component tapes. These are provided with a cover tape which is peeled back in the feeding device at least at the component pick-up position in order to enable the components to be unloaded. Although a large number of components are disposed in each component tape, it may also happen during operation that a component tape becomes empty and a new component tape has to be made available to the feeding device. In this case the end of the old component tape is joined to the start of the new component tape, e.g. using a splicing element which can be a metal strip.

[0005] In order to ensure an optimum placement process, it is necessary to reliably detect the joints in the component tapes and the end of the tape. For this purpose splice sensors are already known from EP 967 851 or EP 859 543. These concepts each teach a splice sensor which is mounted on the feeding device. However, the distance between the splice sensor and the pick-up position is very great, with the result that serious inaccuracies occur in determining the components still present in the component tape or in determining the position of the joint in the component tapes.

[0006] Also known is a method whereby, for example, components to be fed to an automatic placement machine are detected by means of a light barrier while they are passing through a component feeding device. For this purpose, for example in a component feeding channel in the component feeding device, an opening is formed in two opposite walls of said feeding channel so that an optical measuring path of the light barrier can be routed through the opening. Components transported along the feeding channel can be detected by this means if they interrupt the measuring path of the light barrier. However, detecting components by means of a light barrier has several disadvantages. For example, when using a light barrier as a detector for the components, an optical measuring path must always be provided. This can be provided either by implementing two mutually aligned openings in opposite walls of the feeding channel or by implementing one opening and appropriately mounting a reflex mirror on the feeding channel wall opposite said opening.

[0007] However, problems may arise at the opening or openings therefore required in the feeding channel while the components are being transported through the feeding channel. For example, components may become stuck at the edge region of the openings, thereby making further transportation of the components along the feeding channel impossible, whereas the measuring path of the light barrier is simultaneously interrupted, indicating that components are continuing to be transported.

[0008] Particularly in the context of increasing component miniaturization, it is difficult to detect components by means of a light barrier. The smallest components of the current generation have a diameter of just a few tenths of a millimeter. Consequently, the openings through which the components in the feeding channel are to be detected using the light barrier must have an even smaller diameter than the diameter of the components. However, such openings are very difficult and costly to manufacture.

[0009] The object of the present invention is therefore to create a sensor for detecting component tapes, a component feeding device and a method for detecting component tapes in which detection can be performed inexpensively and with a high degree of accuracy.

[0010] This object is achieved by a capacitive proximity sensor having the features detailed in claim 1, a component feeding device having the features detailed in claim 12 and a method for detecting component tapes having the features detailed in claim 18. Preferred embodiments of the invention are claimed in the dependent claims.

[0011] The capacitive proximity sensor according to the invention can be manufactured easily and inexpensively, as at least two conductive sensor surfaces can be easily and inexpensively implemented, e.g. by etching, on an electrically non-conducting substrate, e.g. printed circuit board material. In addition, the capacitive proximity sensor according to the invention can also be implemented with very small dimensions, so that it can be disposed in a feeding channel in the component feeding device in close proximity to, or directly at, the component pick-up position. This allows the joint between two component tapes to be detected in close proximity to, or directly at, the pick-up position, thereby enabling precise insertion of the end of the empty component tape and the start of the spliced-on component tape. Because of the small or non-existent distance of the sensor in the component feeding device from the pick-up position, a high degree of detection accuracy is ensured.

[0012] According to the invention, the relative permittivity of the substrate material is selected such that optimum detection of components and/or splicing elements is possible, it being critical for success according to the invention that a low permittivity is selected, i.e. much lower than for normal printed circuit board material which has a relative permittivity $\varepsilon_r$ of between 10 and 20.

[0013] Preferably the material from which the substrate is made has a dielectric constant or relative permittivity $\varepsilon_r$ of between 3 and 4. This ensures that optimum transmission of the electrical signals applied to one sensor surface to the other sensor surface can take place.

[0014] To make the capacitive proximity sensor according to the invention as flat as possible, the sensor surfaces can be disposed in a single plane. This makes it even easier to integrate the capacitive proximity sensor into a component feeding device.
[0015] The sensor surfaces are implemented in a meander or interdigitated pattern, thereby increasing the capacitance of the capacitive proximity sensor and therefore improving its sensitivity.

[0016] It is also possible to implement the capacitive proximity sensor symmetrically about an axis of symmetry, one sensor surface extending over the entire capacitive proximity sensor and at least another two sensor surfaces being provided which are symmetrically disposed relative to one another about the axis of symmetry.

[0017] The capacitive proximity sensor according to the invention is particularly suitable for detecting component tapes or components in the component tapes or splicing elements connecting component tapes, as the combination of the low dielectric constant of the sensor's substrate material and the spatial arrangement of the sensor surfaces on the substrate provides millimeter range detection for component tapes. The dielectric constant is specifically between 3 and 4 and the detection distance is between 0.1 and 25 mm.

[0018] The sensor can be adapted to suit the type of component tapes to be detected by varying these two parameters, i.e. the dielectric constant of the substrate material on the one hand and the spatial arrangement of the sensor surfaces on the other.

[0019] By implementing the sensor surfaces in an interdigitated comb or meander pattern on the substrate, the capacitance of the sensor can be maximized, thereby increasing the sensitivity.

[0020] In an axially symmetrical embodiment of the sensor with three sensor surfaces, a first sensor surface being disposed facing both the second sensor surface and the third sensor surface, differential detection of the objects to be detected, such as component tapes, components and/or component tapes splicing elements, is possible. This enables environmental effects such as atmospheric humidity, temperature and pressure to be eliminated from the measurement result. In addition, it is also possible using sensors which are suitable for differential measurement to detect the direction in which the objects to be detected pass the sensor.

[0021] In this differential embodiment, the sensor surface disposed facing the other two sensor surfaces in particular can be connected to a ground terminal through which a reference potential is applied to the sensor which improves the elimination of disturbance variables.

[0022] Particularly suitable is a sensor which is essentially implemented twice as long as the objects to be detected in the longitudinal detection direction.

[0023] According to the invention a component feeding device is also created which has a sensor according to the invention, said sensor being disposed in close proximity to the pick-up position. The sensor can be integrated, for example, in the feeding channel in which the component tapes are guided. In addition, there can be provided an evaluation device by which the output signal of the sensor can be e.g. digitally processed. It is also possible for the evaluation device to be constituted by a microcomputer present in the component feeding device.

[0024] The component feeding device according to the invention can be implemented in such a way that the coupling elements used or suitable for joining component tapes can be connected to ground during detection of said coupling elements, thereby making a more precise measurement possible.

[0025] According to the invention there is also created a method for detecting component tapes by means of a feeding device according to the invention, whereby an electric field is applied to the sensor surfaces of a capacitive proximity sensor according to the invention, the applied field is detected using the capacitive proximity sensor and the detected field is analyzed by an evaluation device. On the basis of the analysis result of the evaluation device it is determined whether an object is present between the sensor surfaces.

[0026] It is thereby possible, by analyzing the detected field, to distinguish between different objects to be detected, such as components, component tapes, blanks or gaps in component tapes and/or splicing elements for joining two component tapes, as the different objects to be detected also cause different changes in the field detected compared to the electric field applied.

[0027] If a symmetrically designed capacitive proximity sensor is used, it is additionally possible to perform a differential measurement, as claimed, for example, in claim 28, in which disturbances such as variations in atmospheric pressure, temperature or humidity can be taken into account when analyzing the detected field, thus providing a more accurate measurement result.

[0028] Using the component detection device according to the invention it is possible to detect, in a contactless manner by means of an electromagnetic sensor, components which are being transported by means of component feeding devices in a feeding rail to an unloading point of the component feeding device, or splicing elements joining component tapes to one another, said electromagnetic sensor being linked to a control device. A signal is emitted by the control device if the number of components in the feeding channel falls below a predetermined minimum number or the splicing element is detected.

[0029] The electromagnetic sensor can be a coil, for example. It is possible to dispose this coil under the feeding channel. In addition, the control device can have an excitation device which can bring the coil into resonance with the feeding rail if the number of components in the feeding channel falls below the minimum. This allows particularly sensitive detection of components in the feeding channel in a contactless manner. The components present in the feeding channel are taken into account when resonance is produced in the coil. If the number of components in the feeding channel falls too sharply, the conditions for resonance cease to be present, and the corresponding signal is emitted by the control device.

[0030] It is also possible to select the conditions for resonance of the coil in such a way that resonance obtains if the minimum number of components is present in the feeding channel.

[0031] The coil can be, for example, an elongated flat toroidal coil disposed along the feeding device.

[0032] However, a plurality of potential surfaces disposed under the feeding channel can also be used as the sensor, any variation in the voltage present between the potential sur-
faces being detected by the control device. On the basis of the voltage variation it is possible to evaluate whether the number of components in the feeding channel has fallen below the minimum, the components being detected on the basis of their dielectric properties. The potential surfaces can be successively disposed, for example, under the feeding channel in a well in the feeding rail in the feeding direction. It is also possible to implement the potential surfaces facing one another in an interdigitated manner, so that a rectangular or curvilinear meander-shaped interspace remains between the potential surfaces.

[0033] In addition, the electromagnetic sensor can be disposed on two different sides along the feeding channel, both the upper and lower side of the feeding channel as well as an arrangement along the lateral surfaces of the feeding channels being possible options. It is also possible to dispose the electromagnetic sensor on two different adjacent sides along the feeding channel.

[0034] The component detection device according to the invention has a feeding rail. In the feeding rail there is provided a recess which is used as the feeding channel for the components. The feeding channel is provided with a cover except at an unloading point so that a component delivered to said unloading point can be removed from the feeding rail by means of a handling device, the components being transported along the feeding rail in the feeding direction e.g. by means of a tape or directly in the feeding channel.

[0035] A sensor is mounted below the feeding channel. This sensor can be disposed, for example, in a cutout in the feeding rail. The sensor extends in the feeding direction below the feeding channel.

[0036] For example, an elongated flat toroidal coil can be used as a sensor. According to the invention, this toroidal coil is linked to a control device (not shown). The toroidal coil can be brought into resonance under the feeding channel in the feeding rail by the control device.

[0037] As the triggering event for the emission of a signal, it is possible to evaluate not only the event of the onset of resonance of the oscillatory system comprising sensor and feeding rail as well as feeding rail cover and the components in the feeding channel, but also the event of the discontinuation of resonance of this system by means of the control device. On the basis of the triggering event, the control device can output the signal indicating that the number of components in the feeding channel is less than a predefined minimum.

[0038] It is also possible to use a capacitive sensor as the sensor, two or more potential surfaces being disposed below the feeding channel to provide said sensor. By means of the control device, steady-state voltages or predetermined oscillations are impressed on these potential surfaces and the voltages or oscillations present on the potential surfaces after application or impressing are simultaneously detected. From the difference between the impressed voltage or oscillation and the detected voltage or oscillation it is possible to determine whether a sufficient number of components are present in the feeding channel. For this purpose, for example, a predetermined minimum difference between the impressed signal and the detected signal can be specified. It is also possible to detect changes, particularly capacitance variations which are attributable to variations in permittivity in the measurement field or space of the sensor. This is the case, for example, when components and/or splicing elements pass through the sensor’s measurement field.

[0039] The arrangement according to the first preferred embodiment of the invention is also suitable for use with an ultrasonic sensor as the sensor for the component detection device according to the invention, said ultrasonic sensor being disposed at the location shown in the figure under the feeding channel of the feeding rail. The ultrasonic sensor can be tuned, for example, to a component-filled feeding rail or feeding channel or to an empty feeding channel. The reflection of the sound waves in the ultrasonic range is varied by the presence or absence of the components. Using the control device it is possible to analyze this variation and, if the number of components is less than a predetermined minimum in the feeding channel, to emit the signal.

[0040] A second preferred embodiment of the component detection device according to the invention differs from the first preferred embodiment in that sub-sensors are disposed on two different sides of the feeding channel, the different sides of the feeding channel possibly being opposite sides as well as adjacent sides of the feeding channel. This embodiment according to the invention is particularly suitable for using a plurality of potential surfaces and as a capacitive sensor for detecting components, as this arrangement between the sub-sensors and/or the potential surfaces provides a more homogeneous field distribution than that provided by the first preferred embodiment of the component detection device according to the invention.

[0041] A third preferred embodiment of the component detection device according to the invention differs from the second preferred embodiment of the component detection device according to the invention in that at least one of the two sub-sensors is comprised of more than one piece on one side of the feeding channel. This is implemented in the third preferred embodiment of the component detection device according to the invention by a four-part sub-sensor disposed below the feeding channel. Compared to the sensor types described above, this embodiment lends itself particularly to the use of a magnetoresistive sensor. For this purpose there is disposed in the cover of the feeding channel a permanent magnet or a field coil, for example, by which a magnetic or electromagnetic field can be generated. In the feeding rail there is disposed a plurality of Hall sensors which detect the changed flux density of the field generated by the permanent magnet or field coil in response to the components moved along the feeding channel. The Hall sensors are linked to the control device to enable the detected field variation to be analyzed so that the signal can be emitted by the control device if the number of components in the feeding channel falls below a predetermined minimum number.

[0042] With the third preferred embodiment of the component detection device according to the invention it is also possible to dispose a single Hall sensor under the feeding channel in the feeding rail.

[0043] This component feeding device according to the invention has a framework. Disposed on said framework is a feeding rail as described in greater detail above in connection with the embodiments of the component detection device according to the invention. The feeding rail basically
extends from an unloading point at which components 200 transported along the component feeding channel in the feeding direction can be removed from the component feeding device by a handling device, the components being supplied from a magazine which is disposed in a magazine housing of the component feeding device according to the invention. The sensor of the component detection device according to the invention is preferably disposed under the feeding channel in the proximity of the unloading point for the components of the component feeding device according to the invention. However, the other arrangements for the electromagnetic sensor explained in connection with the different embodiments of the component detection device according to the invention are also possible.

[0044] One embodiment of the electromagnetic sensor according to the invention is particularly suitable for capacitive detection of components or splicing elements in the feeding channel. For this purpose the sensor has two sub-sensors which are essentially disposed facing one another in an interdigitated pattern so as to leave a meander-shaped interspace in one sensor plane between the sub-sensors. Because of the intermeshing of the two sub-sensors, the sensor is highly sensitive to permittivity variations in its vicinity. The sensor is therefore suitable for sensitive detection of tiny components in the feeding channel.

[0045] The common feature of all the embodiments according to the invention is that, in order to detect components in the feeding channel of a component feeding device, no openings need to be provided in the feeding rail or feeding rail cover to enable components to be detected in said feeding channel. This is advantageous particularly in the case of small or very small components, as the openings for these components can only be manufactured with the required precision at very high cost.

[0046] The invention will now be described in greater detail with reference to the accompanying drawings, in which:

[0047] FIGS. 1a and 1b show a first embodiment of the capacitive proximity sensor according to the invention,

[0048] FIGS. 2a and 2b show a second embodiment of the capacitive proximity sensor according to the invention,

[0049] FIGS. 3a and 3b show further embodiments of the capacitive proximity sensor according to the invention,

[0050] FIG. 4 shows an axially symmetrical embodiment of the capacitive proximity sensor according to the invention, and

[0051] FIG. 5 shows a further axially symmetrical embodiment of the capacitive proximity sensor according to the invention.

[0052] For all the embodiments of the invention, two or more sensor surfaces are for example etched onto a substrate such as FR4 or printed circuit board material. The substrate in conjunction with the sensor surfaces forms a capacitive sensor or a capacitive coupling element. The sensor according to the invention is simple and inexpensive to manufacture, easily contacted electrically and can be integrated or mounted for example in a tape channel of a feeding module for placement systems on the upper or and/or lower side. For example, to detect the splice between two component tapes, the sensor according to the invention is made approximately as wide as the component tape sprocket holes 210 used to transport the component tape by means of a pin wheel whose pins engage in the holes 210. The sensor is disposed for example below or above the position of these holes 210 in the tape channel of the feeding module. As soon as a splice at which a splicing element is located passes the sensor according to the invention, either data transmission between the sensor surfaces of the capacitive proximity sensor according to the invention is disturbed or an oscillator connected to the transmitter surfaces of the capacitive proximity sensor is influenced.

[0053] To perform analysis, an evaluation device is provided which can be designed as a discrete circuit and/or can be implemented by means of programming in a computer present in the feeding module or in the placement system. For the analysis, the type of material of the object to be detected is essentially irrelevant. It is merely necessary for the material of the object to be detected to have a different relative dielectric constant than that of the component tape material.

[0054] It would also be possible by this means to detect the end of a component tape. The tape end can also be detected by disposing the sensor outside the feeding module at another part of the placement system and guiding the tape past the sensor so that the end of the tape can be detected. FIGS. 1a and 1b show a preferred embodiment of the inventive capacitive proximity sensor 110 and its arrangement relative to a tape channel of a feeding device (not shown) for component tapes 310, 320, the sensor 110 according to the invention having two sensor surfaces each of interdigitated comb design and with the teeth facing one another so as to leave a clearance between the teeth in each case. The sensor surfaces of the sensor 110 are disposed on a substrate (not shown) in this manner. FIG. 1a illustrates the position of the sensor 110 according to the invention relative to a component tape 200 that can be transported in the tape channel 310, 320 of the feeding module. The component tape 200 has sprocket holes 210 along its longitudinal direction, and component pockets in which components 240 can be accommodated.

[0055] As shown in FIG. 1b, the inventive capacitive proximity sensor 110 is disposed in the lower section 320 of the feeding channel 310, 320. This enables in particular components 240 in the component tape 200 to be easily detected. It is also possible to dispose the sensor 110 above the component tape 200 on/in the feeding channel 310, 320.

[0056] FIGS. 2a and 2b illustrate an embodiment of the capacitive proximity sensor according to the invention which is suitable for detecting splicing elements 230 used to join two component tapes 200, the inventive capacitive sensor 120 being disposed in the region of the sprocket holes 210 of the component tape 200 on the upper side 310 and/or the lower side 320 of the tape channel of a component feeding module, as the splicing element 230 is also mounted on the sprocket holes 210 of the component tape 200. This provides easy detection of the splicing element 230 by means of the inventive capacitive proximity sensor 120 according to this embodiment.

[0057] FIGS. 3a and 3b depict further embodiments of the sensor surfaces of the capacitive proximity sensor according to the invention, FIG. 3a shows an embodiment wherein a plurality of parallel sensor surfaces are disposed one after
the other in the longitudinal direction of the component tape 200, said sensor surfaces of the sensor 130 each being connected alternately in the transport direction of the component tape 200 to one of two connecting leads of the sensor 103 so that, viewed in the transport direction of the component tape 200, one or more bar-like sensor surfaces disposed crosswise to the transport direction are provided with alternate sensor connection or polarity.

[0058] FIG. 36 shows an inventive capacitive proximity sensor 140 provided with two sensor surfaces which extend parallel to one another in the transport direction of the component tape 200 over a plurality of sprocket holes 210.

[0059] FIGS. 4 and 5 depict axially symmetrical sensor surfaces of a capacitive proximity sensor according to the invention. The embodiment of the invention according to FIG. 4 has an axially symmetrical capacitive proximity sensor 150. This has a first sensor surface 151 extending in a first direction over approximately the entire length of the sensor 150. The first sensor surface 151 is symmetrical about an axis perpendicular to the first direction. It has an interdigitated or comb-like structure, the teeth or fingers essentially pointing in a second direction perpendicular to the first direction.

[0060] The capacitive proximity sensor 150 shown in FIG. 4 is additionally provided with a second sensor surface 152 and a third sensor surface 153 which are likewise of interdigitated or comb-like design and disposed symmetrically about the axis of symmetry of the sensor 150 in such a way that the fingers of the second sensor surface or the fingers of the third sensor surface are disposed facing those of the first sensor surface. This produces a meander-shaped interspace between the fingers or teeth of the first sensor surface and the second sensor surface or third sensor surface. This structure is particularly suitable for differential detection of components and/or splicing elements. The measuring result can be improved still further by electrically connecting the first sensor surface 150, as illustrated in FIG. 4, to a reference potential.

[0061] In the embodiment of the capacitive proximity sensor 160 depicted in FIG. 5, a structure similar to that shown in FIG. 4 has been selected. However, the first sensor surface 161 of the sensor 160 has two interdigitated or comb-like extensions in and counter to the first direction of extension which are spaced facing one another crosswise with respect to the direction of extension. Within the interspace of the extensions of the first sensor surface 160 which are disposed in or counter to the first direction there is disposed a second sensor surface 162 and a third sensor surface 163. The second sensor surface 162 and the third sensor surface 163 are implemented and disposed symmetrically about the axis of symmetry of the sensor 160. They have a bar-like structure with interdigitated or comb-like extensions essentially perpendicular to the first direction of the capacitive proximity sensor 160 in such a way that a meander-shaped interspace is left between the second sensor surface and the first sensor surface 161 and between the third sensor surface 163 and the first sensor surface 161 in each case.

[0062] For all the embodiments of the invention it is advantageous to dispose the sensor surface essentially in one plane.

1. Capacitive proximity sensor for detecting component tapes, said sensor having an electrically non-conducting substrate made of low dielectric constant material, and at least two electrically conductive sensor surfaces (151, 152) implemented facing one another on the substrate, so that because of the dielectric constant of the substrate material and the arrangement of the sensor surfaces (151, 152) on the substrate, component tapes (200) to be detected can be detected in the millimeter range.

2. Capacitive proximity sensor according to claim 1, wherein the dielectric constant of the substrate material is between 3 and 4 and the detection distance between 0.1 and 25 mm.

3. Capacitive proximity sensor according to claim 1 or 2, wherein the sensor surfaces (151, 152) are disposed in a single plane.

4. Capacitive proximity sensor according to one of claims 1 to 3, wherein the sensor surfaces (151, 152) are implemented in a meander or interdigitated pattern and the meanders or fingers of the sensor surfaces are intermeshed with a predetermined clearance with respect to one another.

5. Capacitive proximity sensor according to claim 4, wherein the predetermined clearance of the sensor surfaces with respect to one another is constant for the entire sensor.

6. Capacitive proximity sensor according to one of claims 1 to 5, wherein a first sensor surface is an essentially rectangular basic surface having an extension disposed thereon in a first direction, wherein the extension has a plurality of fingers in each case, and wherein facing said extension there is disposed a second sensor surface which is provided with fingers so as to leave a meander-shaped interspace (300) between the first sensor surface and second sensor surface.

7. Capacitive proximity sensor according to claim 6, wherein the sensor (150) has a symmetrical structure with respect to the rectangular basic surface relative to the first direction, so that altogether the first sensor surface (151) has extensions respectively in and counter to the first direction, of which the extension disposed in the first direction faces the second sensor surface (152) and the extension disposed counter to the first direction faces the third sensor surface (153) which is implemented and disposed symmetrically with respect to the second sensor surface (152).

8. Capacitive proximity sensor according to one of claims 1 to 5, wherein a first sensor surface is an essentially rectangular basic surface having two extensions disposed thereon in a first direction, the extensions each having a plurality of fingers which are disposed facing the fingers of the other extension in each case, and a second sensor surface being disposed between the extensions which is provided with fingers facing the first sensor surface and the second sensor surface in such a way that a meander-shaped interspace (300) remains between the first sensor surface and the second sensor surface.

9. Capacitive proximity sensor according to claim 8, wherein the sensor (160) has a symmetrical structure with respect to the rectangular basic surface relative to the first direction, so that altogether there are formed the first sensor
surface (161) with two extensions respectively in and counter to the first direction, the second sensor surface (162) between the two extensions disposed in the first direction and a third sensor surface (163), similar to the second sensor surface (162), disposed between the two extensions disposed counter to the first direction.

10. Capacitive proximity sensor according to claim 7, 9 or 10, wherein the first sensor surface is electrically connected to a reference potential.

11. Capacitive proximity sensor according to claim 7 or 9, wherein the sensor (150, 160) in the first direction is essentially made twice as long as an object to be detected.

12. Component feeding device with a component transporting device by means of which components can be transported in a feeding direction to an unloading position, and a sensor by means of which the presence or absence of objects can be detected, wherein

the sensor is a capacitive proximity sensor according to one of claims 1 to 11 which is disposed in proximity to the unloading position.

13. Component feeding device according to claim 12, wherein

the objects are components and/or coupling elements suitable and used for joining component tapes together.

14. Component feeding device according to claim 13, wherein the coupling elements are conductive and can be connected to a reference potential.

15. Component feeding device according to one of the preceding claims,

wherein the sensor is integral with a feeding channel through which the components can be transported to the unloading position.

16. Component feeding device according to one of the preceding claims, additionally having an evaluation device by which a sensor output signal can be processed.

17. Component feeding device according to claim 16, wherein the evaluation device is set up in such a way that digital filtering of the output signal is performed.

18. Method for detecting component tapes by means of a feeding device according to one of claims 12 to 17, wherein an electric field is applied between the sensor surfaces of the capacitive proximity sensor, the field applied is detected using the capacitive proximity sensor, the field detected is analyzed by an evaluation device, and from the analyzed field it is determined whether there is an object between the sensor surfaces.

19. Method according to claim 18, wherein a component disposed in a component tape and/or a splicing strip for joining two component tapes is detected as the object to be detected.

20. Method according to claim 18 or 19, wherein by means of a capacitive proximity sensor according to claim 7, 9, 10 or 11 a first field detected between the first sensor surface and the second sensor surface and a second field detected between the second sensor surface and the third sensor surface are compared with one another in order to determine environmentally caused disturbances in the field applied between the sensor surfaces, and the disturbances determined are taken into account in the analyzing of the detected field.

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