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Belt Apparatus for Carrying Elements During Treatment

Field of the Invention

The present invention relates to belt apparatus for carrying elements during treatment of those elements. It also relates to clamping means for use in such apparatus and apparatus for treating such elements and to a method of such treatment. It is particularly concerned with such apparatus, means and methods when the elements are strip-shaped, such as strips of lead frames, as they are passed through treatment baths or the like.

Background of the Invention

Strips of lead frames are processed by electroplating, etching, etc. This usually involves them being carried in lines on endless belt apparatus through a series of process steps. They are automatically attached at a loading station prior to the first processing step and then removed, after processing is complete, at an unloading station. After the unloading station, each portion of the belt usually undergoes further processing to be cleaned before it is next used.

As it is the strip that is the target of the processing, and the belt is only there to carry the belt, the strip is usually held below the belt, so that the belt does not interfere with the processing.

One such belt apparatus for carrying lead frames is described in published patent document US-4,534,843. This document describes a belt having slits in its lower edge to create fingers. The fingers have crimps in them near their ends, with the crimps for one set of alternate fingers in one direction and the crimps for the others in the opposite direction. Likewise, one set of alternate fingers are bent in one direction with the remaining fingers bent in the other direction. In use, each finger is bent back in the opposite direction to that in which it is normally bent and lead frame strips are placed between the bent back fingers and released. One set of alternate fingers presses against a

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first side of the strips with the remaining fingers pressing against the other side of the strips, to hold them in place in the middle.

As all the fingers are actively pushing against each other in alternate directions, this tends to deform the clamped edge of the strips. If some fingers produce more of a force than those around them, this effect will be pronounced. Another disadvantage is that the fingers cannot be easily replaced once broken or once they can no longer grip. Further, if one finger is no longer usable, it is unwise to use that portion as if the finger were still present, as it would just add to the deformation. If a portion of the belt is no longer usable, it is possible just not to use it. However, the automatic systems needed to ensure that happens add to the cost and it would be simpler to replace the whole belt.

Another design of such a belt apparatus is described in published patent document EP-0,382,283. A belt has a number of removable clips attached to it. Both ends of the clips abut against the same side of the belt. The first end of each clip is connected to the belt, whilst the other, clamping end is resiliently biased against the lower edge of the belt. A middle portion, between the two ends, passes through holes in the belt to the other side, to provide the resilience for the clamping end in the right direction and to ensure connexion of the clip to the belt.

To load or unload a strip onto the belt, the middle portions of the clips are pushed in the direction of the belt, thereby pushing the clamping end away from the belt. At the loading station a strip can then be placed between the clamping end and belt and at the unloading end, the strip can then fall off when all the clamping ends holding it have been pushed away from the belt.

One problem with any such belt apparatus, including this one, is that, over time, the clips tend to lose their resilience. In this instance, the clips are always stressed as their clamping positions are only a strip width away from their normal positions. Even when they are new, they may not provide a particularly strong clamping force and it may not take long for an appreciable deterioration in the clamping force, requiring the replacement of the clips. Further, although the clips can be replaced, they must be replaced from the

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inside of the loop of the endless belt. This usually requires someone to lean over the belt, which can be quite tiring as the belts tend to work at chest height or thereabouts. The alternative is for someone to stand within the loop, which may not be that easy or safe (as the belt moving machinery may have to be turned on to get it to the right position to replace the relevant clips). In either case, the clips have to be compressed to be attached or removed, which may also be tiring and lead to the occasional clip springing out of the hand in unwanted directions. Finally, because the clamping ends of the clips are always in contact with the belt (when not clamping strips), those portions of the belt and clips in contact are not cleaned properly and require time for proper inspection.

Object of the Invention

The object of the invention is to provide a novel and inventive apparatus and/or means and/or method.

Ideally, it is intended with the present invention should overcome or at least partially alleviate at least some of the problems associated with the prior art mentioned and/or found elsewhere.

Summary of the Invention

According to a first aspect of the present invention, there is provided belt apparatus for carrying elements during treatment of the said elements, comprising:

belt means; and

clamping means for clamping said elements against said belt means; wherein

said belt means has a plurality of first holes therein; and

said clamping means have attaching portions attached to said belt means, have clamping portions spaced away from a first side of at least part of said belt means and are arranged such that the clamping portions can be pushed from said first side, through said first holes and against resilience in said clamping means, to a second side of said at least part of said belt means, to clamp said elements against said second side.

The example embodiments of the present invention also provide the clamping means and also belt means for use in such apparatus.

The example embodiments of the present invention also provide treating apparatus which includes the above belt apparatus.

According to a second aspect of the present invention, there is provided a method of attaching clamping means onto belt means to provide belt apparatus, comprising the steps of:

- inserting attaching means of said clamping means into second holes of said belt means, with said clamping portions of said clamping means above the level of said second holes;

- pivoting said clamping means about said second holes to bring said clamping portions below the level of said second holes; and

- releasing said clamping means; wherein

- after said releasing step, said clamping means are ready for use; and

- said attaching method does not include said clamping portions passing through holes in said belt means.

According to a third aspect of the present invention, there is provided a method of treating elements, including the steps of:

- mounting said elements on the belt apparatus;

- subjecting said elements to at least one treatment process; and

- unloading the processed elements from said belt apparatus.

A belt apparatus may be provided for holding strips of lead frames during treatment. It may comprise a belt and attached clips. The clips may be attached to the belt at only one end. Their free ends, being the clamping ends, may be held away from a first side of the belt. The belt may have recessed holes in its lower edge to allow clamping ends of the clips to be pushed through to the second side. At the same time a strip may be inserted between the clamping ends and the second side. When the clamping ends are released they may spring back to clamp the strip against the second side.

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Summary of the Drawings

The present invention will now be further described by way of non-limitative example with reference to the accompanying drawings, in which:-

Fig. 1 is a first perspective front view of a portion of a belt apparatus according to a first embodiment of the invention;

Fig. 2 is a second perspective front view of the portion of Fig. 1;

Fig. 3 is a perspective rear view of the portion of Fig. 1;

Fig. 4 is a front plan view of the portion of Fig. 1;

Fig. 5 is a side view of the portion of Fig. 1;

Fig. 6 is a bottom plan view of the portion of Fig. 1;

Fig. 7 is a perspective top view of the portion of Fig. 1;

Fig. 8 is the same view as Fig. 5, with a clamping end pushed through the belt means;

Fig. 9 is the same view as Fig. 8, with a clamping end released to clamp an element against the belt means;

Fig. 10 is a front plan view of a portion of a belt apparatus according to a second embodiment of the invention;

Fig. 11 is a side view of the portion of Fig. 10;

Fig. 12 is a front plan view of the portion of Fig. 10, with the clamping means removed;

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Fig. 13 is a front plan view of a portion of a belt apparatus according to a third embodiment of the invention;

Fig. 14 is a side view of the portion of Fig. 13;

Fig. 15 is a front plan view of the portion of Fig. 13, with the clamping means removed;

Fig. 16 is a schematic view of first treatment apparatus using the belt apparatus of the present invention; and

Fig. 17 is a schematic view of first treatment apparatus using the belt apparatus of the present invention.

Specific Description

The terms vertical, horizontal, upwards, downwards, etc are used herein to describe the portions of the invention relatively, assuming that the belt means is held with its top edge "vertically" above the bottom edge.

A first embodiment of the present invention will now be described with reference to Figs 1 to 9, which show various views of a portion of a first belt apparatus 10.

This first belt apparatus 10 comprises a belt means in the form of a planar belt 12 and clamping means in the form of a plurality of clips 14.

The belt 12 is usually used as an endless belt. It has parallel top and bottom edges with first holes 16 along the length of the bottom edge. These first holes are in the form of vertically elongate recesses 16, separated by elongate fingers of belt 18, to act as passive gripping surfaces. Further up, a series of second holes 20 extend along the length of the belt. These are horizontally elongate along the belt 12. Nearer the top of the belt are a series of guide holes 22, for use in guiding the belt during use.

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Each clip 14 is effectively a bent planar leaf spring which is bent in the middle. An attaching portion 24, at a first end of the clip 14, attaches to the belt 12 and clamping portions 26 are provided at a second end of the clips 14, remote from said first end.

The clips 14 are mounted on a first side portion of the belt 12, on a first side of the belt 12. End parts 28, 30 of the attaching portion 24 pass horizontally through the second holes 20 of the belt 12, onto a second side portion of the belt 12, being the second side of the belt 12. Each clip has three such end parts 28, 30 to its attaching portion, a central end part 28 separated from two side end parts 30, one on each side of the central end part 28. Each end part passes through a separate second hole 20. The central end part 28 is bent upwards once through the second holes 20 to abut against the second side. The two side end parts 30 are shorter than the central end part 28 and continue to protrude a short distance out from the second side.

Two abutting means 32 are provided on each clip 14, to abut the first side of the belt 12. They extend from portions of the clip just in front of where the two side end parts 30 pass through their second holes 20. They are each formed by cutting two sides and an end of a rectangular hole in the clip 14 and bending the flap 32 defined by the cuts upwards. The ends of the flaps 32 abut the belt on the first side and the central end part 28 abuts the second side of the belt at approximately the same level. This keeps the clips 14 in place, as can be seen most clearly in Fig. 5.

Clamping portions 26 and attaching portions 24 of the clips 14 are connected by joining portions. These include at least the top ends of leg portions 34. Each clip has two leg portions 34 at the end of each of which is a clamping portion 26. The attaching portion 24 is generally horizontal on the first side, with the joining portion joining the attaching portion 24 and leg portions 34 at an acute angle to each other, with the leg portions 34 directed diagonally downwards towards the belt 12. The clamping end 36 of the clamping portion 26, for clamping elements against the belt, is directed generally downwards, as can be seen in Fig. 5, and is at an obtuse angle with the leg portion 34.

The clamping portion 26 is narrower than the first holes 16. Thus they can be pushed against the resilience of the clip 14 through the first holes 16 to the second side of the belt 12, where their tendency is to return to their original positions on the first side. The lengths of the first holes 16 is such that the clamping portions 26 can be pushed through a sufficient distance onto the second side to allow parts of elements, for instance the upper edge of strips of lead frames 38, to be inserted between the first sides of the clamping portions 26 and the second sides of the fingers 18. Fig.8 shows a clip 14 with the clamping portions 26 pushed through and beyond the first holes 16. Once the upper edge of the strip of lead frames 38 has been inserted, the clamping portion 26 is released. Its resilience then causes it to grip the upper edge of the strip against the fingers 18, as can be seen in Fig. 9, with a single such strip 38 gripped by numbers of clamping ends 36 according to its length. As can be seen in Fig. 9, the clamping ends 36 are designed to be vertical when they are clamping strips 38.

Clips 14 can readily be attached and removed from the belt 12 from just the first side. To remove them, one simply lifts up the front of each clip to pivot it about where the end parts 28, 30 pass through the second holes 20. This must overcome some resilience provided by the abutting means 32, which can be done by pushing them down into the clip (if they are to be reused). Once that happens, the clip can be removed entirely. Likewise to add a new clip, the end parts are slotted into the second holes 20, from an diagonally upward direction, with a top edge of the abutting means against the first side of the belt. As the front of the clip is then brought down and slightly below the horizontal (against the resilience of the central end part 28), the end of the abutting means is able to spring round to come into contact with the first side. The clip 14 can then be released for use.

A second embodiment of the present invention will now be described with reference to Figs 10 to 12, which show various views of a portion of a second belt apparatus 100.

This second belt apparatus 100 comprises a belt means in the form of a planar belt 112 and clamping means in the form of a plurality of clips 114.

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The belt 112 of the second embodiment is similar to that of the first. As shown, it differs in only having one first hole 116 and two round second holes 120 per clip 114. It also has a row of two round third holes 140 per clip 114.

Each clip 114 is effectively a U of wire, with two spring coils 132, with one such coil 132 between each end of the wire and the base of the U. Each end of the wire is an attaching portion 124, at a first end of the clip 114, attached to the belt 112. The base of the U is a clamping portion 126, at a second end of the clip 114, remote from said first end.

The clips 114 are mounted on a first side portion of the belt 112, on a first side of the belt 112. End parts 128 of the attaching portions 124 pass horizontally through the second holes 120 of the belt 112, onto a second side portion of the belt 112, being the second side of the belt 112. Each clip has one such end part 128 per attaching portion. Each end part 128 passes through a separate second hole 120 and is bent upwards once through the second holes 120 to abut against the second side. A top part 142 of each end part protrudes back through the third holes 140 to the first side a short distance.

Each spring coil acts also as an abutting means 132, to abut the first side of the belt 112. One edge of each spring coil 132 abuts the belt 112 on the first side and each end part 128 abuts the second side of the belt 112. Together with the top parts protruding through the third holes, this keeps the clips 114 in place, as can be seen most clearly in Fig. 11.

The clamping portion 126 and each attaching portion 124 of the clips 114 are connected by joining portions, which include the spring coils 132. These include at least the top ends of leg portions 134. Each clip has two leg portions 134 at the end of which is the clamping portion 126. The attaching portion 124 is generally horizontal on the first side, with the joining portion joining the attaching portion 124 and leg portions 134 at an acute angle to each other, with the leg portions 134 directed diagonally downwards towards the belt 112. The clamping end 136 of the clamping portion 126, for clamping elements against the belt, is directed generally downwards, as can be seen in Fig. 11, and is at an obtuse angle with the leg portion 134.

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The clamping portion 126 is narrower than the first holes 116. Thus they can be pushed against the resilience of the clips 114 through the first holes 116 to the second side of the belt 112, where their tendency is to return to their original positions on the first side. As with the first embodiment, the lengths of the first holes 116 is such that the clamping portions 126 can be pushed through a sufficient distance onto the second side to allow parts of elements, for instance the upper edge of strips of lead frames, to be inserted between the first sides of the clamping portions 126 and the second sides of the fingers 118. These are loaded and unloaded from the belt apparatus in similar ways to those in the first embodiment.

Clips 114 can readily be attached and removed from the belt 112 from just the first side. To remove them, one simply lifts up the front of each clip to pivot it about where the end parts 128 pass through the second holes 120 and turns the clip 114 upside-down. Likewise to add a new clip, it is held upside-down and the top parts 142 are pushed into the second holes 120, from in front, and the front of the clip is then brought down to the horizontal.

A third embodiment of the present invention will now be described with reference to Figs 13 to 14, which show various views of a portion of a third belt apparatus 200.

This third belt apparatus 200 comprises a belt means in the form of a planar belt 212 and clamping means in the form of a plurality of wire clips 214.

The belt 212 of the third embodiment is similar to that of the first. As shown, it differs in that each first hole 216 is only just wider than the wire of the clips. Further, it has one horizontal elongate second hole 220 per clip 214 and one horizontal elongate third hole 240 per clip 214.

Each clip 214 is effectively an inverted U of wire, with two spring coils 232, with one such coil 232 between each end of the wire and the inverted base of the U. The inverted base of the U of the wire is an attaching portion 224, at a first end of the clip 214,

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attached to the belt 212. Each end of the wire, is a clamping portion 226, at a second end of the clip 214, remote from said first end.

The clips 214 are mounted on a first side portion of the belt 212, on a first side of the belt 212. End parts 228 of the attaching portions 224 pass horizontally through the second holes 220 of the belt 212, onto a second side portion of the belt 212, being the second side of the belt 212. Each clip has one such end part 228. The two wires of the end part 228 are bent upwards once through the second holes 220 to abut against the second side. A top part 242 of the end part, being the inverted base of the U protrudes back through the third holes 240 to the first side a short distance.

Each spring coil acts also as an abutting means 232, to abut the first side of the belt 212. One edge of each spring coil 232 abuts the belt 212 on the first side and each wire of the end part 228 abuts the second side of the belt 212. Together with the top part protruding through the third hole, this keeps the clips 214 in place, as can be seen most clearly in Fig. 14.

The clamping portions 226 and the attaching portion 224 of the clips 214 are connected by joining portions, which include the spring coils 232. These include at least the top ends of leg portions 234. Each clip has two separate leg portions 234 at the end of each of which is a clamping portion 226. The attaching portion 224 is generally horizontal on the first side, with the joining portion joining the attaching portion 224 and leg portions 234 at an acute angle to each other, with the leg portions 234 directed diagonally downwards towards the belt 212. The clamping ends 236 of the clamping portions 226, for clamping elements against the belt, are directed generally downwards, as can be seen in Fig. 14, and are at an obtuse angle with the leg portions 234.

The clamping portions 226 are narrower than the first holes 216. Thus they can be pushed against the resilience of the clips 214 through the first holes 216 to the second side of the belt 212, where their tendency is to return to their original positions on the first side. As with the first embodiment, the lengths of the first holes 216 is such that the clamping portions 226 can be pushed through a sufficient distance onto the second side to

allow parts of elements, for instance the upper edge of strips of lead frames, to be inserted between the first sides of the clamping portions 226 and the second sides of the fingers 218. These are loaded and unloaded from the belt apparatus in similar ways to those in the first embodiment.

Clips 214 can readily be attached and removed from the belt 212 from just the first side. To remove them, one simply lifts up the front of each clip to pivot it about where the end parts 228 pass through the second holes 220 and turns the clip 214 upside-down. Likewise to add a new clip, it is held upside-down and the top parts 242 are pushed into the second holes 220, from in front, and the front of the clip is then brought down to the horizontal.

The belt apparatus and the methods of the present invention can be used with existing treatment machinery, to provide apparatus as in Fig. 16. It can also be used with new machinery, for instance to provide apparatus as in Fig. 17.

In Fig. 16, lead frames are loaded onto belt apparatus 300 at a loading station 302 and unloaded at unloading station 304 on the same side of the apparatus. Between these two stations the strips are processed in processing baths etc 306. After unloading, the empty belt apparatus 300 is then cleaned on the other side of the machinery in cleaning baths etc 308 before returning to the loading station 302.

The apparatus of Fig. 17 is similar to that of Fig. 16, except that: the strip processing occurs on two sides of the machinery, in baths etc 306a, 306b; the loading and unloading stations are side by side and the belt cleaning processes 308 occur in the middle of the apparatus.

The loading and unloading stations 302, 304 work by pushing means pushing a number of the clamping portions (at least equivalent to the length of a strip to be processed) simultaneously through the first holes to the second side of the belt. In the loading station 302, a strip is inserted between the clamping portions and the second side of the belt, and released to load the strip. In the unloading station 304, the processed strips immediately

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fall off. The pushing means either allow the pushed clamping portions to slide along them or, more preferably, the pushing means move with them for the duration of the pushing. Likewise a bracing means braces the second side of the belt against twisting due to the pushing means and allows the belt to slide along it or, more preferably moves with it for the duration of the pushing (allowing it to be in contact nearer to the lower part of the belt).

Alternatively, the loading and unloading can be achieved using the end wheels about which the endless belt passes. The clamping means are on the inside of the loop and the circumferences of the end wheels are profiled to accommodate the clamping means within them as the belt passes over those wheels. However, one part of the profile is shaped to contact the clamping means to push the clamping portions through the first holes to allow loading or unloading as appropriate. In the case of loading, the strips are supplied to the belt apparatus tangentially to the end wheel.

The above loading and unloading could use the concepts disclosed at least in patent published document EP-0,382,283 mentioned earlier (although the profiling of the wheels at least would have to be different).

The belt means and clips in the above are normally stainless steel but other conducting or non-conducting materials are possible, metal or otherwise.

Although the clamping ends do not grip the elements directly against portions of the belt, but diagonally with the fingers, the above-described embodiments do not cause the same distortion problems as the prior art. This is because the belt itself only acts as a passive surface, the transverse position of the belt does not change during the loading process and the belt does not deform.

Whilst the belt has been described with the first holes as recesses in the lower edge, other arrangements are possible. For example, they could be completely surrounded by the belt means or almost surrounded, but with slots to the lower edge. The difference between such embodiments and those described above would be an extra portion of belt means

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extending continuously along what has so far been the lower edge of the belt. Again, the clamping means would not be clamping elements directly against the belt means, but it would provide an extra passive gripping surface diagonally below the clamping means, in addition to those diagonally beside the clamping means.

The passive gripping surfaces for the above embodiments are roughened (not shown) to improve the clamping, although this is not necessary. Likewise, it is preferable to provide some form of roughening on the first side of the clamping ends of the clamping means.

The clamping means described above are all resilient clips. It is possible to use other clips where the clamping force is provided by other means such as an attached spring. Other clamping means, whether clips or otherwise, are also covered by the invention.

The clamping means have been embodied above as clips with one or two clamping portions. However, a single clip or other clamping means may have more than two, for instance three or four, etc. For example, the clamping means could be equivalent of two or more or the clips 14 of the first embodiment joined together, preferably with some form of hinge portion between them to allow for bending of the belt means.

As described, the attaching portions are at one end of the clamping means and the clamping portions at the other. This is not necessary. The clamping means may extend beyond the attaching portions and/or beyond the clamping portions, so long as it does not interfere with their function.

The first holes are showed in varying spacing in the first and third embodiments and as constant spacing in the second embodiment. This is unimportant.

Various aspects of the described embodiments are planar or elongate in one direction or the other. Quite clearly it is not always necessary, but may be preferred. In the case of the belt means, it does not need to be flat or planar, as long as there is a surface for the clamping means to cooperate with.

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The second holes that the end parts of the clips pass through in the described embodiments are all separate. According to the invention, all the end parts of a single clamping means can pass through a single second hole. It is even possible for several clamping means to share second holes.

The clamping means are described with end portions that are directed upwards, once through the second holes. Of course they may be downwards. It is possible to have them in both directions on the same clip, although this may require larger second holes and manipulation from the second side to remove them. Likewise, the abutting means can be above or below the second holes, or both. Indeed the invention also covers embodiments without such abutting means, such that there is nothing in the clamping means to stop it rotating upwards. This would make them even easier to add and replace. However, at the loading and unloading stations, there could be a horizontal surface placed immediately above the tops of the clamping means, which prevents them rotating upwards as the clamping portions are pushed to the second side.

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CLAIMS

1. Belt apparatus for carrying elements during treatment of the said elements, comprising:
belt means; and
clamping means for clamping said elements against said belt means;
wherein
said belt means has a plurality of first holes therein; and
said clamping means have attaching portions attached to said belt means, have clamping portions spaced away from a first side of at least part of said belt means and are arranged such that the clamping portions can be pushed from said first side, through said first holes and against resilience in said clamping means, to a second side of said at least part of said belt means, to clamp said elements against said second side.
2. Belt apparatus according claim 1, wherein at least some of said first holes are recesses in an edge of said belt means.
3. Belt apparatus according claim 1 or 2, wherein at least some of said first holes have portions of said belt means on all sides, with at least one slit on one side to an edge of the belt means.
4. Belt apparatus according to any one of the preceding claims, wherein at least some of said first holes are edged all around by said belt means.
5. Belt apparatus according to any one of the preceding claims, wherein said belt means is substantially planar at the level where the elements are to be clamped against it.
6. Belt apparatus according to any one of the preceding claims, wherein said belt means is substantially planar, said first side of at least part of said belt means

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being a first side of the belt means and said second side of said at least part of said belt means being the second side of the belt means.

7. Belt apparatus according to any one of the preceding claims, wherein said belt means is a belt.
8. Belt apparatus according to any one of the preceding claims, wherein said belt means is endless.
9. Belt apparatus according to any one of the preceding claims, wherein said clamping means are removable from said belt means.
10. Belt apparatus according to claim 9, wherein said clamping means are re-attachable to said belt means.
11. Belt apparatus according to any one of the preceding claims, wherein said attaching portions are at a first end of said clamping means.
12. Belt apparatus according to any one of the preceding claims, wherein said clamping portions are provided at a second end of said clamping means, remote from said first end.
13. Belt apparatus according to any one of the preceding claims, wherein said attaching portions pass from said first side through second holes in said belt means to said second side.
14. Belt apparatus according to claim 13, wherein said attaching portions pass back to the first side through third holes in said belt means.
15. Belt apparatus according to any one of the preceding claims, wherein said attaching portions abut against said second side.

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16. Belt apparatus according to any one of the preceding claims, wherein said clamping means further comprise joining portions, joining said clamping portions to said attaching portions.
17. Belt apparatus according to claim 16, wherein said attaching portions extend away from said first side of at least part of said belt means and said joining portions include leg portions directed diagonally back towards said belt means.
18. Belt apparatus according to any one of the preceding claims, wherein said clamping means further comprise abutting means, abutting said first side.
19. Belt apparatus according to claim 18 when dependent upon at least claim 13, wherein the parts of said attaching portions passing through said second holes are between said abutting means and said clamping portions.
20. Belt apparatus according to claim 19, or to claim 18 when dependent upon at least claim 13, wherein the parts of said attaching portions passing through said second holes are on the other side of the abutting means from said clamping portions.
21. Belt apparatus according to any one of the preceding claims wherein said clamping means are of a resilient material.
22. Belt apparatus according to any one of the preceding claims wherein said clamping means include spring portions.
23. Belt apparatus according to claim 22 when dependent on at least claim 18, wherein said abutting means comprise said spring portions.
24. Belt apparatus according to claim 22 or 23, wherein said spring portions comprise coil spring portions.

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25. Belt apparatus according to claim 22 or 23, wherein said spring portions comprise leaf spring portions.
26. Belt apparatus according to any one of claims 1 to 24, wherein said clamping means comprise wire springs.
27. Belt apparatus according to any one of the preceding claims, wherein said clamping means comprise of a plurality of clips.
28. Belt apparatus according to claim 27, wherein at least some of said clips each have a plurality of separate clamping portions.
29. Belt apparatus according to claim 28, wherein said at least some of said clips each have two clamping portions.
30. Belt apparatus according to any of the preceding claims arranged on the basis that said elements are strip-shaped elements.
31. Belt apparatus according to claim 30, arranged on the basis that said strip-shaped elements are strips of lead frames.
32. Clamping means for belt apparatus, comprising attaching portions and clamping portions and being arranged to attach to belt means to provide belt apparatus according to any one of the preceding claims.
33. Belt means having first holes in the form of recesses in one edge thereof and second holes for use with clamping means according to claim 32 to attach said clamping means to said belt means to provide belt apparatus according to any one of claims 1 to 31.

34. Apparatus for treating elements, including belt apparatus according to any one of claims 1 to 31, clamping means according to claim 32 and/or belt means according to claim 33.
35. Apparatus according to claim 34, further comprising loading means for pushing said clamping portions through said first holes as part of the process of mounting said elements onto said belt apparatus.
36. Apparatus according to claim 34 or 35, further comprising unloading means for pushing clamping means which are clamping said elements further through said first holes to unload said elements from said belt apparatus.
37. A method of attaching clamping means onto belt means to provide apparatus according to any one of claims 1 to 31, comprising the steps of:
inserting attaching means of said clamping means into second holes of said belt means, with said clamping portions of said clamping means above the level of said second holes;
pivoting said clamping means about said second holes to bring said clamping portions below the level of said second holes; and
releasing said clamping means; wherein
after said releasing step, said clamping means are ready for use; and
said attaching method does not include said clamping portions passing through holes in said belt means.
38. A method of treating elements, including the steps of:
mounting said elements on belt apparatus according to any one of claims 1 to 31;
subjecting said elements to at least one treatment process; and
unloading the processed elements from said belt apparatus.
39. Treated elements, said elements having been treated according to the method of claim 38.

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40. Belt apparatus constructed and arranged substantially as hereinbefore described with reference to and/or as illustrated in the accompanying drawings.
41. Clamping means constructed and arranged substantially as hereinbefore described with reference to and/or as illustrated in the accompanying drawings.
42. Apparatus for treating elements, constructed and arranged substantially as hereinbefore described with reference to and/or as illustrated in the accompanying drawings.
43. A method of treating elements, substantially as hereinbefore described with reference to and/or as illustrated in the accompanying drawings.