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## **CONVEYOR FOR PLATING SYSTEM**

### **FIELD OF THE INVENTION**

The invention relates to a conveyor for a chemical treatment system and, in particular, to a clamping means for use with an endless belt for conveying strip shaped elements through chemical and electro-chemical treatment processes, especially for electro-plating, and electro-deflashing and the like.

In the field of treatment of electronics components, it is well known to plate the leads that protrude from the insulating packaging layer before use. The leads are generally in the form of cylindrical wires or flat tines punched from sheet material. Whatever their form it is necessary to plate the wires with, for example, a copper, tin or iron based alloy, so as provide corrosion and mechanical protection and to improve the quality of interconnection with other components, e.g. by a wave soldering process. In the latter case, plating is generally with tin or a tin/lead alloy preceded with a flash coating of copper in the case of leads made from an iron based alloy.

### **DESCRIPTION OF THE RELATED ART**

Traditional methods of plating such as rack and barrel plating have been replaced by methods in which parts to be plated are conveyed on conveyors or belts through a series of treatment stations.

In US-A-4534843 an apparatus for the plating of the contact elements of encapsulated electronic components is disclosed. The parts to be plated are carried through each of a plurality of treatment stations including the principal plating baths, on a continuous, flexible conveyor belt constructed from an electrically conductive material, wherein the conveyor belt acts as one of the electrodes of the plating current supply system. The disclosed conveyor belt consists of a stainless steel belt running in a horizontally aligned loop with the web of the belt vertical. The parts to be plated are held on the belt by an array of fingers formed at the lower edge of the belt. Successive gripping fingers contacting the part on opposite sides.

There is known from EP 0382 283 a one piece resilient clamping means connected at one end with an endless belt and with a free clamping end abuts against the belt under the influence of its own resilience. In one embodiment of EP 0382283 the resilient spring grips have a portion extending through the belt from the side against which the free end abuts to the opposite side. A portion of the spring grip on the opposite side from the portion abutting the belt is used to open the belt at loading and unloading positions by a cam action, for example by contact with a drive wheel carrying the endless belt.

The present applicants have previously proposed a wire spring grip for strip shaped elements shown in Figures 10a and 10b. The grip 20 comprises a wire formed to provide two parallel arms extending from a curved, central portion 22 of the wire. The curved portion 22 is angled from the plane including the portions of the arms immediately adjacent the curved portion 22 to form a gripping portion. The end of each arm is angled to form an arm tip portion 23 for engaging with a belt web 100 so

as to support the grip 20. The arms of the grip extend from their ends and form a coil 24 having a plurality of turns. Between each coil 24 and the curved portion 22, each arm is angled to form an engagement portion 25 for biasing the arms against the tension in the spring coils. The grips are supported on a belt with a portion of the arms substantially parallel with the belt web.

#### SUMMARY OF THE INVENTION

It is an object of the present invention to provide a means of clamping strip shaped elements to a conveyor. It is specifically an object of the present invention to improve the electrical contact between the belt of the conveyor and the strip shaped element to improve the efficiency of an electroplating process. It is a further object of the present invention to increase the life span of individual gripping fingers of a conveyor that passes through a plurality of chemical processes.

The invention provides a conveyor belt for a plating system comprising, a plurality of clamping fingers pivotally mounted on the belt so that a free clamping end abuts the belt, and a resilient member attached to the belt and to at least one clamping finger so as to urge said free end of the clamping finger against the belt, whereby strip shaped elements may be gripped between the belt and the free end of the clamping finger. The use of a resilient member to increase the gripping force of a non-resilient clamping finger results in a higher gripping force and better electrical contact between the belt and the strip shaped elements.

The resilient means may comprise a torsion spring. The torsion spring may be pivotally attached to said at least one clamping finger, the axis of rotation being

parallel to the plane of the belt and the longitudinal axis thereof. Free movement between the resilient member and the clamping finger reduces the strain on the resilient member, which prolongs the life of the resilient member.

At least one pivot pin may be provided for mounting at least one of said clamping fingers for pivotal movement. The pivot pin may be mounted in brackets formed out of the material of the belt. Alternatively at least one mounting insert may be detachably mounted on the belt and include a bracket for mounting said pivot pin. The mounting insert may include at least one bracket for retaining an end of said resilient means.

Where the conveyor includes a torsion spring, the torsion spring may have a coil and two arms with respective ends, and the torsion spring may be anchored to the belt proximate to one end of the spring and to the clamping finger proximate the other end of the spring. The torsion spring may have a coil including at least one turn and the coil abuts a surface of the belt.

The torsion spring may consist of a wire material, including a central portion attached to the clamping finger, and two arms extending from the central portion, each arm including a coil.

In an embodiment a single pivot pin supports a plurality of clamping fingers and a single wire material has a portion connected to each of said plurality of clamping fingers and at least one coil acting as a torsion spring to urge a free end of each of said plurality of clamping fingers against the belt. There may be two clamping fingers supported on the pivot pin and an arm of the spring material received in an opening in each clamping finger and a coil of each arm supported on the pivot pin.

The wire spring material may pass through a bracket on each clamping finger so as to form an arm on either side of each clamping finger extending to the pivot pin where a coil of each arm is formed thereon either side of each clamping finger, a bracket for each arm of the wire spring material is associated with each clamping finger, and the wire spring material passes through its respective bracket and the respective bracket for the next clamping finger, whereby the wire spring material forms the resilient means for each of a plurality of clamping fingers.

The clamping finger may be formed by a portion stamped out of the belt and an abutment member may be fixed to an edge of the belt against which the free end of the clamping finger abuts.

In a second aspect of the invention a conveyor belt for a plating system comprising a plurality of gripping fingers for gripping strip shaped elements, a plurality of brackets for receiving a wire spring material located on a side of the belt, one or more brackets being provided for each gripping finger, wherein a single piece of wire spring material forms said plurality of gripping fingers.

A pair of brackets may be provided for each gripping finger, the brackets receiving the wire spring material therethrough.

The wire spring material may form each gripping finger by forming two arms and a bent portion that forms a free end which abuts against the belt.

Each arm of a gripping finger may have a coil acting as a torsion spring urging said free end against the belt.

The belt may include an opening for each gripping finger and gripping finger extends from the side of the belt on which the free end abuts through the opening.

The invention will now be described in more detail and by way of example only with reference to the accompanying drawings in which:

Figures 1a and 1b are a view from the side and from the front respectively of a conveyor according to a first embodiment;

Figures 2a and 2b are a view from the side and from the front respectively of a conveyor according to a second embodiment;

Figures 3a and 3b are a view from the side and from the front respectively of a conveyor according to a variation of the second embodiment;

Figures 4a and 4b are a view from the side and from the front respectively of a conveyor according to a third embodiment;

Figure 5 is a perspective view of the front and the rear of a conveyor according to a fourth embodiment;

Figure 6 is a side view of the conveyor of the fourth embodiment;

Figures 7a and 7b are a view from the side and from the front respectively of a conveyor according to a fifth embodiment;

Figures 8a and 8b are a view from the side and from the front respectively of a conveyor according to a second aspect of the invention;

Figures 9a and 9b are a view from the side and from the front respectively of a conveyor according to the second aspect of the invention;

Figures 10a and 10b are a view from the rear and from the side respectively of a gripping finger according to the prior art;

Figures 1a and 1b show a first embodiment of the present invention. The belt, 1, is a stainless steel, endless belt for use in plating process. The belt, 1, passes about a

driven pulley wheel and a driving wheel (not shown) which rotate about a vertical axis. Strip shaped element such as lead-frames are supported on the belt in a vertical orientation parallel to the belt by a plurality of solid, stainless steel, clamping fingers, 2, supported on the belt, 1. A free end, 3, of the clamping finger, 2, abuts the belt at a lower edge thereof under the urging force of a torsion spring, 4.

The belt, 1, has a vertically extending slot, 5, for each clamping finger, 2 stamped out of the belt. A mounting insert, 6, is supported at the top end of the opening on one side of the belt, 1. In the present embodiment the mounting insert is formed so as to supported by means of a mounting catch, 7, stamped out of the belt and a portion of the mounting insert, 6, sits in the mounting catch, 7, to hold it firmly in place. The mounting insert, 6, includes an abutment portion 8, against which the ends of the torsion spring, 4 abut. At the lower end of the mounting insert, 6, a portion thereof extends through the slot, 5, to form a groove in which the top edge of the slot 5 is located. A bracket, 9, for a pivot pin, 10, is formed by the mounting insert, 6, on the opposite side of the belt to the abutment portion 8.

The pivot pin, 10, supports the torsion spring, 4, and the clamping finger, 2. The clamping finger, 2, has a pivot curve, *11 or bracket*, formed at the end supported by the pivot pin, 10. The pivot curve, *11*, receives the pivot pin therethrough. The clamping finger, 2, pivotally supported on the pivot pin, 10, extends through the pivot curve, *11*, and a clamping portion, 12, is formed with the clamping end, 3, so as to abut the lower edge of the belt, 1, as shown in Figure 1a.

The torsion spring, 4, is made from a wire spring material. The torsion spring, 4, is received in a bracket, 13, so that a central portion of the wire material rests

against the surface of the clamping finger, 2, on the side of the clamping finger, 2, opposite the belt, 1. Arms of the wire material are bent to extend parallel back through the opening either side of the clamping finger, 2. The arms of the spring material form a cam portion, 14, on the other side of the belt, 1, from the clamping end, 12. At the cam portion, 14, the arms are bent upwardly towards the pivot pin. The wire material is wrapped around the pivot pin, 10, for a plurality of turns on both sides of the pivot curve, 11, and between the bracket, 9. The arms of the spring material extend through the opening, 5, flush with the mounting insert, 6, and the ends are retained in the wire brackets, 8.

In use the clamping portion, 12, is urged towards the belt, 1, by virtue of the torsion spring, 4. At a loading station and a loading station of the plating system, means for applying a force to the cam portion, 14, is provided for opening the clamping fingers. Typically, the cam portion, 14, will abut a portion of the drive pulley or the driven pulley as the belt passes around the pulleys.

In the present embodiment the mounting insert is detachable and the clamping assembly can therefore be replaced in its entirety if necessary. The brackets for retaining the torsion spring, the pivot pin and the clamping finger, 2, fixedly attached to the bracket by means of clamping or spot welding.

The mounting insert, 6, may be mounted on the belt, 1, in any convenient manner and may have brackets to retain the ends of the torsion spring, 4, rather than a simple abutment portion, 8.

A second embodiment is shown in figures 2a and 2b. The clamping finger, 2, is formed not by a separate clamping finger but by a portion of the belt, 1, punched

out of the belt material to form a slot 5. The clamping finger, 2, of the second embodiment does not require a pivot pin because the clamping finger is formed by a part of the belt. As can be seen from Figure 2a, the clamping finger is pressed out to one side of the belt 1, and then bent to protrude back through the slot 5. Finally, the clamping portion is bent to form a clamping portion, 12. The lower edge of the belt, which has been removed in forming the clamping finger, 2, is replaced using a strip of conductive metal forming an abutment portion 1a. The configuration of the clamping portion, 12, is such that the free end, 3, of the clamping portion, 12, abuts the abutment portion 1a of the belt. A wire spring, 4, is fixed at one end to an upper portion of the belt, 1, using a bracket 15. Underneath the bracket the wire spring forms a coil, 16. The remainder of the wire spring, 4, is formed so as to lie flush with the clamping finger, 2, along a proportion of its length as it extends through the slot, 5. The wire spring is fixed to the clamping finger by at least one bracket, 17, formed out of a portion of the clamping finger, 2.

An alternative design of the second embodiment is shown in Figures 3a and 3b. The same reference numerals have been applied to like parts. In Figures 3a and 3b, a larger coil spring is used and a slightly different shape of the clamping finger. Furthermore, the wire spring extends through an opening in the clamping finger, 2, to be affixed to the clamping finger, 2, by a bracket, 17, on the opposite side of the clamping finger, 2, to the belt, 1.

The designs of Figures 2 and 3 have different configurations for the cam portion. In Figures 2a and 3a the direction in which force must be applied to open the clamping fingers, 2, is shown by arrow F.

Figures 4a and 4b relate to a third embodiment of the present invention. The third embodiment is a variation of the above first and second embodiments. The clamping finger, 2, is similar to the first embodiment, whereas the torsion spring is similar to that shown in Figures 3a and 3b. The pivot pin brackets 9 are formed by pressing out portions of the belt, 1.

Figures 5 and 6 relate to a fourth embodiment of the present invention.

Figure 5 shows perspective views of the front and back of a belt according to the present invention in perspective. A pivot pin, 10, is supported between brackets, 31. The pivot pin supports clamping fingers, 2, at either of the pivot pin, 10, proximate the brackets, 31. The pivot pin, 10, passes through an opening in the clamping fingers 2 to support them for pivotal movement. A wire spring 4 has a central portion, 33 that abuts against the belt, 1, and two arms, 34 that extend towards the pivot pin, 10, and form two spring coils, 35, around the pivot pin, 10. The arms extend downwardly from the pivot pin and are bent outwards at their ends to be received in retaining openings, 32 in the clamping fingers, 2.

Figure 6 is an explanatory side view of figure 5 showing one of the two clamping fingers, 2. The present embodiment works on the same principle as the previous embodiments. A cam portion 14 of the clamping finger is acted upon at the loading and unloading stations in order to open the fingers.

Figures 7a and 7b show a fifth embodiment of the present invention.

A belt, 1, supports a plurality of clamping fingers, 2, which are identical to those of the first embodiment. The brackets 41 are formed by stamping out of the belt to form the slot, 5. A pivot pin, 10, is located in holes in the brackets, 41. It can be

seen from Figure 7b that a single pivot pin, 10, extends along the length of the belt, 1, supporting a plurality of clamping fingers, 2. In an identical fashion to the first embodiment, the torsion spring 4, forms a plurality of coils, 42, either side of the clamping finger, 2, on the pivot pin, 10. The wire spring material of the torsion spring 4 extends up and through retaining holes, 43, in the brackets 41. The arms, 44, of the coil wire extend in opposite direction through the retaining holes, 43, of the next bracket 41 and continue to form the torsion spring 4 of the next clamping finger, 2. By this means a plurality of clamping fingers, 2, can be linked by a single wire forming a respective torsion spring, 4, for each clamping finger, 2.

Figures 8a and 8b show a second aspect of the invention. A single torsion spring wire material is formed so as to provide a plurality of clamping fingers, 50. A plurality of mounting inserts, 51, are retained on the belt, 1, by means of respective brackets, 52, stamped of the belt, 1. The mounting inserts 51, each have two brackets, 53, for receiving an arm of the wire spring material, 54. The wire spring material, 54, is formed to pass through the brackets, 53, and into a coil, 55, is formed for each bracket, 53. The wire spring material extends through a slot, 56, proximate the lower edge of the belt and is bent to form the gripping finger, 57.

Figures 9a and 9 show side and front views of an alternative arrangement of the second aspect of the present invention. The arrangement of figures 9a and 9b is similar to the arrangement of figures 8a and 8b except that instead of forming torsion springs by means of coils 55 (Figures 8a and 8b) the arms of the spring wire material form a leaf spring type resilient member 58.

Whilst embodiments of the invention have been described, modifications will suggest themselves to those skilled in the art without departing from the scope of the invention as defined in the appended claims. For example, the stainless steel clamping finger of the first embodiment may be replaced by a leaf spring clamping finger having its own resilience. The gripping force of the leaf spring clamping finger being increased by means of the torsion spring.

CLAIMS

1. A conveyor belt for a plating system comprising, a plurality of clamping fingers pivotally mounted on the belt so that a free clamping end abuts the belt, and a resilient member attached to the belt and to at least one clamping finger so as to urge said free end of the clamping finger against the belt, whereby strip shaped elements may be gripped between the belt and the free end of the clamping finger.
2. A conveyor belt as claimed in claim 1, including at least one pivot pin for mounting at least one of said clamping fingers for pivotal movement.
3. A conveyor belt as claimed in claim 2, wherein the pivot pin is mounted in brackets formed out of the material of the belt.
4. A conveyor belt as claimed in claim 2 or 3, including at least one mounting insert detachably mounted on the belt and including a bracket for mounting said pivot pin.
5. A conveyor belt as claimed in claim 4, wherein the mounting insert includes at least one bracket for retaining an end of said resilient means.

6. A conveyor belt as claimed in any one preceding claim wherein the belt includes an opening for each clamping finger and at least one of the clamping finger and the resilient means extends from the side of the belt on which the free end abuts through the opening.
7. A conveyor belt as claimed in any one preceding claim, wherein the resilient means comprises a torsion spring.
8. A conveyor belt as claimed in claim 7, wherein the torsion spring is pivotally attached to said at least one clamping finger, the axis of rotation is parallel to the plane of the belt and the longitudinal axis thereof.
9. A conveyor belt as claimed in claim 7 or 8, wherein the torsion spring has a coil and two arms with respective ends, and the torsion spring is anchored to the belt proximate to one end of the spring and to the clamping finger proximate the other end of the spring.
10. A conveyor belt as claimed in claim 7, 8 or 9, wherein the torsion spring has a coil including at least one turn and the coil abuts a surface of the belt.
11. A conveyor belt as claimed in any one of claims 7 to 10, wherein the torsion spring consists of a wire material, including a central portion connected to the clamping finger, and two arms extending from the central portion, each arm including a coil.

12. A conveyor belt as claimed in any one preceding claim, wherein a single pivot pin supports a plurality of clamping fingers and a single wire material has a portion connected to each of said plurality of clamping fingers and at least one coil acting as a torsion spring to urge a free end of each of said plurality of clamping fingers against the belt.

13. A conveyor as claimed in claim 12, wherein there are two clamping fingers supported on the pivot pin and an arm of the spring material is received in an opening in each clamping finger and a coil of each arm is supported on the pivot pin.

14. A conveyor as claimed in claim 12, wherein said wire spring material passes through a bracket on each clamping finger so as to form an arm on either side of each clamping finger extending to the pivot pin where a coil of each arm is formed thereon either side of each clamping finger, a bracket for each arm of the wire spring material is associated with each clamping finger, and the wire spring material passes through its respective bracket and the respective bracket for the next clamping finger, whereby the wire spring material forms the resilient means for each of a plurality of clamping fingers.

15. A conveyor belt as claimed in claim 1 wherein the clamping finger is formed by a portion stamped out of the belt and an abutment member is fixed to an edge of the belt against which the free end of the clamping finger abuts.