



## METAL FINISHING TREATMENT EQUIPMENT



\*G00002\*

### FIELD OF THE INVENTION

The invention relates to a system for performing treatment processes on strip-shaped elements and electronic connection related elements

### DESCRIPTION OF THE RELATED ART

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 horizontal aligned loop with the web of the belt vertical.

Such equipment is also known from WO-A-0053829 in which a plurality of process stations is arranged in a circular array in order to save space, i.e. to reduce the length compared to a linear belt passing through treatment processes arranged in straight line. In the system disclosed, four consecutive plating stations are used. Each plating station has an inner cell within a common outer cell for the four stations.

A plating system previously proposed by the Applicant will now be described with reference to figure 8, 9 and 10. The present applicants have designed a plating system comprising a plurality of modules of process cells using a modular construction. Figure 8 shows a single process station (30) having a top cover (31) covering the process cell. The top cover (31) further in cooperated with shuttle (33)

for controlling the flow of exhaust. The process treatment cell further designed with cover (34) with a transparent opening (35) for the treatment cells for safety of operator viewing during the treatment process taken place. The strip-shaped elements are attached to the belt (not shown) passes through the process treatment cell (32) via the opening slot (36).

The plating system may have a plurality of such cells or similar process stations including, but not limited to, one or more of cells performing, descaling, electro-deflashing, anodic activation, rinsing using main water, rinsing using de-ionized water by spraying and/ or high pressure jet, electro-degreasing, acid etching, solder plating, neutralizing, air knife, drying, buffering, stripping. Other baths or stations may be included or substituted depending on the desired process and product. At one end of the line of cells or modules there is an automatic loading apparatus and the other an automatic unloading apparatus.

Figure 9 shows a cross section through a portion of production line. The belt (100) carrying a reel lead frame (40), is suspended horizontally with the belt web vertical. The belt (100) carries the lead frame (40) by means of grips (20). Figure 9 shows at least parts of three different cells and the belt passes through each of, a predip process cell (41), a buffer cell (42) and a plating process cell (43), in that order.

Lead frames may be simply held by the belt grips, or may be supported on a plurality of spaced rollers (44) (one is shown in figure 9). The height of the roller (44) can be varied by an air regulated cylinder actuator (45) so as to accommodate various size of lead frame. The optional roller system of figure 9 ensures zero dropages even after a long run because the lead frames are held top and bottom.

In figure 10 a cross sectional view of the process station (30) of figure 9 is shown. The belt (100) passes through an inner cell (37) containing electrolyte and an anode bar or anode basket with solder or plating material. A contact bracket (38) passes through a plugged hole (39) in the wall of the cell (32) and holds a brush assembly (50). A contact bar on the belt (100) contacts with brush assembly (50) during plating. Current is supplied to the brush assembly (50) via the contact bracket from external source (not shown). A spring grip (51) contacts the contact bar and the article to be plated. The circuit is completed by the electrolyte and the anode material of the anode basket.

The same plating system is often required to plate either tin or tin/lead alloy depending on the article to be plated. In the prior art a system disclosed in US-A-4534843 and WO-A-0053829 it is necessary to perform tedious conversion in cleaning up the process cells from single chemistry to the other. Long cleaning period cause's production loss and the purity of the chemical involve may be in doubt.

### **SUMMARY OF THE INVENTION**

It is an object of the present invention to address the abovementioned disadvantages with the prior art.

The equipment being built with two independent continuous conveyor belts or other means to hold the strip-shaped elements, running in parallel of the same direction with the strip-shaped elements clamped onto the belts or by other means passes through a plurality of independent treatment processes on each strand.

The invention provides a solution of single metal finishing treatment equipment, wherein the equipment is adapted to receive two parallel belts or by other means to perform plurality of treatment processes. Treatment processes of each belt

are carried out simultaneously and independently over the treatment baths. The treatment baths of the equipment comprises of an outer cell and an inner cell, the inner cell is further divided into two compartments. This construction enables the system to perform different treatment processes independently and simultaneously on the strip-shaped elements of the two parallel belts.

The process may further comprise of independent supply units with their own contact assemblies disposed above a corresponding compartment of the inner cells.

The invention also comprises a detachable process cell module for fast conversion of treatment process and also the purity of treatment bath over human error. This invention can use most of the different treatment chemicals required by the process. The invention of this convertible module enhances the flexibilities of equipment wherein one or more treatment processes can be configured in any order of configuration depending on the need of strip-shaped elements on the belts.

The invention also provides a treatment system including the process station of the invention and two substantially parallel conveyors, one conveyor nested within the other.

The invention now described in more detail, with reference to the accompanying drawings, in which:-

Figure 1 showing the plan and front elevation of the invention of the metal finishing treatment equipment. The figure also indicates the construction of the belts' pulleys arrangement in both views;

Figure 1a and 1b show the front elevation of the driven belt unit and the driver belt unit respectively. Constructions of all the pulleys are mounted from the top of the structure for better clearance to the processes carry out over the two belts;

Figure 2 shows the sectional view of the process cell indicating the position of the two independent belts passing through the outer and inner cells;

Figure 3 shows the sectional view of the process cells according to an embodiment;

Figure 4 shows plan view of the loading apparatus according to an embodiment;

Figure 5 shows side elevation of components of the loader of figure 4;

Figure 6 is a plan view of an unload apparatus according to an embodiment;

Figure 7 is a sectional view of the detachable process treatment cell indicating quick detachable outer process cell being movable as an alternative embodiment;

Figure 8 shows a perspective view of a genetic process module forming part of the treatment processes;

Figure 9 is a side sectional view of a portion of a modular system;

Figure 10 is a cross section through the process figure 9.

Plan and side elevation views are shown in figures 1 and 2 of the double belt metal finishing treatment equipment according to an embodiment of the invention. A series of process treatment cells (1) of figure 2 are arranged in array in series to each other with individual outer and inner cells separated and housed in the embodiment as an independent module.

The feature of the present invention is that two belts (2) and (2a) are arranged quadrilaterally and the process treatment cells (1) of figure 2, to be described in detail later, are adapted to provide treatments independently to the strip-shaped elements of the two belts 2 and 2a .

At one end of the equipment are driver pulleys (3) and (3a) for each belt and at the other end of the belts are arranged around driven pulleys (4) and (4a). The strip-shaped elements may be loaded onto the belts either by manual operation or alternatively an automatic loader may be provided at the driven pulleys (3) and (3a.) Furthermore, automatic unloading apparatus may be provided at the end having driven pulleys (4) and (4a). Automatic loading and unloading apparatus according to a second aspect of the invention are described in more detail in connection with figure 5 and 6 below.

A process treatment station (1) according to the invention is shown schematically in figure 2. The two belts (2) and (2a) are arranged vertically and generally parallel to each other at least whilst passing through a particular process treatment station. The belts (2) and (2a) are received in individual slots in the outer wall (5) of the process cell. Strip-shaped elements carried on both belts (2) and (2a) by means of gripping fingers (6) and (6a) are immersed in the treatment chemical separately in the process cells with independent treatment material housed in compartments (9) and (9a). The compartments may contain different materials depending on requirement of treatment processes.

Figure 1a shows the driven belt unit including for each belt (2), (2a), a bearing housing (70), a main pulley (71) and an idler pulley (72). Figure 1b shows the driver belt unit including for each belt (2), (2a) drive motor (73), a tensioning cylinder (74), a main pulley (75) and an idler pulley (76). Both the driven and driver units are mounted an over-hanging method, that is the bearing housing shaft (77) and drive motor shaft (78) are facing downward. The over-hanging arrangement creates more space for the loading and unloading apparatus shown in figure 4 to 6.

The process treatment station (1) is shown in greater detail in figure 3, which also shows that a separate brush assembly (10) and (10a) is provided for each belt (2) and (2a) respectively. The brush assembly (10) may be identical to that described in connection with figure 10 above. In addition, a brush assembly (10a) is mounted on the central dividing wall (8) of the inner process cell (7) in order to contact a contact bar of the belt (2a).

Each compartment of the inner process cell (7) is provided with its own drainage box (11) and (11a). Other features of the process cell may be the same as described in connection with figures 8 and 9. The gripping fingers (6) shown in figures 2 and 3 is the preferred gripping fingers and is the subject of the applicants' co-pending application No. SG-A-9905316-7. However, alternative spring grips may be used such as that disclosed in US-A-4534843.

Whilst the process cell for the treatment system has been disclosed in detail, it will be understood that other process cells, for example the electrolytic deflash and the predip process cells, may also be adapted so as to provide independent treatment of two belts. In certain cases, for example rinsing process cells may need to be adapted only to receive two belts.

In an embodiment the belts are separated by a distance of about 295mm (+/- 40 mm) and the total length of the system is 20m compared to 35m of the same treatment processes for prior art single belt systems. However, the separation of the belts may vary. In a particular embodiment the belts are separated by 295mm (+/- 40mm) through the initial treatment process stations, whilst towards the final treatment process stations the belts distance narrow down to only 65mm (+/- 40mm) with the assistance of pulleys (3b), (3c), (4b), and (4c).

In an embodiment the belts (2) and (2a) have individual controls to enable the belts to be used simultaneously to perform treatment process on different strip-shaped elements of different parameters and treatment materials.

The equipment of the invention is suitable for treatment processes of strip-shaped elements in single strip form or in reel form.

The equipment according to the embodiment of figure 1 to 3 can be loaded and unloaded manually; however, it is also possible to use an automatic loading and/or an automatic unloading apparatus according to the invention.

In the case of loading the outer belt (2a), it is possible to use a standard automatic loading and unloading apparatus. However, in the case of loading inner belt (2) it is necessary to use a new automatic loading and unloading apparatus. This invention also safe guard the investment in case the invention is required to perform a fully automatic operation through a single unit automatic loading and unloading apparatus.

The automatic loading and unloading apparatus according to an embodiment are shown in figure 4 to 6. The main structure of each is constructed independently from the main equipment. The operation utilizes a single controller for parameter entry and mode selection. The automatic loading and unloading apparatus are both equipped with touch screens to enable operators to perform operation and conversion of individual strip-shaped element. Built-in database system with pre-loaded parameters minimized human errors. The apparatus are also equipped with sophisticated communication protocol linking the main equipment and the loading / unloading apparatus to synchronize the parameters preset by the responsible personnel.

Referring now to figure 4 and 5, the automatic loading apparatus comprises, for loading the strip-shaped elements to the inner belt (2), a loading conveyor module (12) driven by an AC motor (not shown), a sweeper module (13), a flipper module (14), a buffer conveyor (15), and a width adjustment module (22) driven by servo-motor with its positioning control module. There is also shown in figure 4 a horizontal index conveyor (16) that runs between the top of the loading conveyor (12) and the sweeper module (13).

In order to load the inner belt (2), an operator or an auto-pick-and-place arm, places the strip-shaped elements into carrier (17) of the loading conveyor (12). The strip-shaped elements are transferred up the loading conveyor (12), which is inclining at 45 degree as shown in figure 5, the strip-shaped elements are removed using the sweeping module (13) and transferred in a horizontal orientation across the outer belt (2a) by the action of a horizontal index conveyor (16) responsible to transfer strip-shaped elements to a feeding conveyor (19) at the distal end of the horizontal index conveyor (16). The strip-shaped elements are removed from the conveyor (16) using sweeping module (13a) shown in Figure 4a through the walking beam (18) onto the inner belt (2) by the action of conveyor (19) as shown in figure 4.

Strip-shaped elements are transported automatically into position on the inner and outer belts (2), (2a) separately. Loading of the outer belt 2a is achieved in a conventional manner using a length adjustment module (21) and feeding through conveyor (19). The length adjustment module (21) is a manually adjustable device, which is set for the length of the strip-shaped element. Both the feeding conveyors (19) are speed synchronized with the plating conveyor to avoid strip-shaped elements being miss-fed or overlapping each other. Loading of strip-shaped element onto the

inner belt (2) is performed through the top space of the outer conveyor (2a) to prevent heavy mechanism and also to provide the accessibility of maintenance.

The width adjustment module (22) allows for variation in width of the strip-shaped elements, which can be performing automatically through the preset parameters through the touch screen.

An unloading apparatus according to an embodiment is shown in figure 6 and comprises an unload buffer conveyor (23), (23a) driven by an AC motor, an unload support roller (24), (24a), an unloading horizontal conveyor (25), (25a) driven by a pneumatic system. Strip-shaped elements are transferred back to the interchangeable container module (26), (26a).

Strip-shaped elements from the equipment are unloaded at the unloading station (27), (27a) with the assistance of buffer conveyor (23), (23a). The width of the strip-shaped elements is taken care of by a programmable servo-motor at the unloading station (27), (27a). The speed of the buffer conveyor (23), (23a) is twice as fast as the plating conveyor so as to ensure that the strip-shaped elements unloaded from the belts of the equipment do not obstruct the on-coming materials to prevent unnecessary collision.

The horizontal conveyor (25), (25a) is provided to enable operator to do random inspection of the treated strip-shaped elements during the process of treatment. The containers or magazines are automatically interchangeable in co-operation with the lot control respectively.

An alternative embodiment of a process cell according to the invention is shown in figure 7. The improvement comprising a detachable process module (60) including a process tank (61) and associated apparatus in a lower part of the structure.

The process tank (61) of the process module (60) constitutes in use the process tank of the outer belt (2a) (not shown) whereas the process tank (62) of the main structure (63) receives the inner belt (2) as shown. A cover (64) attached to the main structure (63) covers both the process tanks (61) and (62) when the detachable process module (60) is attached to the main structure (63). In a preferred embodiment the process station including the detachable unit is the treatment station including a treatment cell and a treatment tank in the detachable unit. The remaining process stations have internal and external process cells that cannot be separated.

The present embodiment incorporating the detachable process module (60) provides a convenient means for altering the process performed on the strip-shaped element. For example, the process cell can be detached and change to another treatment material by replacing the detachable process module (60) without removing the hazardous chemical in the process and storage tank.

Whilst an embodiment of the invention has been described, various modifications will suggest themselves to those skilled in the art without departing from the scope of the invention as defined in the appended claims.

## CLAIMS

1. A treatment process station for treating strip-shaped elements, wherein the process station is adapted to receive two conveyors (2) and (2a) and treat strip-shaped elements on each belt independently.
2. A treatment process station as claimed in claim 1 and comprising an outer treatment cell and an inner cell within the outer cell, the inner cell being divided into two compartments, each compartment separately receiving one of said conveyors.
3. A treatment process station as claimed in claim 2 and further comprising of two independent contact brush assemblies (10) and (10a) disposed above a corresponding compartment of the inner and outer cells.
4. A treatment process station as claimed in claim 3 wherein the treatment process station is selected from the group consisting of various metal finishing treatment processes for strip-shaped element.
5. A treatment process station as claimed in claim 1 including a main treatment process unit (63) and a detachable treatment process unit (60), each unit for receiving one of said strip-shaped element for independent treatment process.

6. A treatment process system including at least one treatment process station as claimed in any one preceding claim and two conveyors passing through said at least one process station.
7. A treatment process system as claimed in any one preceding claim wherein said conveyors are substantially parallel endless belts and one of said belts is nested within the other.
8. A treatment process system as claimed in claim 6 or claim 7 and comprising main pulleys (3),(3a),(4),(4a) at front part of the equipment with a 295 mm (+/- 40 mm) distance between tangent of pulleys (3) and (3a), (4) and (4a).
9. A treatment process equipment as claimed in claim 8 including a driven unit and a driving unit, the driven unit including two main pulleys (4), (4a) and two idler pulleys (4b), (4c), the driving unit including two main pulleys (3), (3a) and two idler pulleys (3b), (3c) arranged in a quadrilateral form.
10. A treatment process equipment as claimed in claim 9, wherein the driven unit and driving unit are arranged such that the main pulleys (71), (75) and idler pulleys (72), (76) are suspended below respective shafts (70), (78).