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Plating apparatus

The present invention relates to a plating apparatus, and more particularly, an apparatus for automatically plating objects such as IC lead frames and other objects in the form of strips.

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In plating objects to be plated such as IC lead frames and other objects in the form of strips, it requires simultaneous plating of plural objects to be plated in order to enhance efficiency. Processing speed of the plating is determined in accordance with the treating speed of the whole processing line including such as loading, pre-treatment, plating, after-treatment and unloading. Several types of plating apparatus of this kind have been conceived and employed, however, the processing speed of the whole line is comparatively slow.

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Prior to the present invention, the inventor proposed a plating apparatus to efficiently carry out automatic plating operation of conveying and plating objects to be plated, aligning and locating a plurality of objects on a carrier which is handled as a rack (Japanese patent laying open no: 99127/81; U.S. patent no: 4,318,793).

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According to the above proposed plating apparatus, the processing speed is increased substantially compared with the conventional plating apparatus, whereas further acceleration of the processing speed cannot be obtained since it employed a carrier to convey the objects to be plated.

The object of this invention is to provide a plating apparatus which enables acceleration of automatic plating with employing a plurality of rollers instead of a carrier as well as newly-designed loading device which conveys plural objects to be plated to the assembly line at a time.

The above mentioned and other objects, advantages, features and uses will become more apparent as the description proceeds, when considered with the accompanying drawings, in which:-

Figure 1 is a diagrammatic perspective view showing an embodiment of plating apparatus according to the present invention;

Figure 2 is a view of moving track of suction pad;

Figure 3 is a diagrammatic view of tapered rollers forming aligning rollers group as well as flat rollers;

Figure 4 is a diagrammatic view of engaging rollers forming of feed rollers group;

Figure 5 is a diagrammatic side view of the corresponding part of the striking process of

pre-treatment apparatus;

Figure 6 is a partly diagrammatic sectional view of the plating device; and

5. Figure 7 is a diagrammatic perspective view of unloading apparatus.

The detailed description of the invention will be made referring to the illustrated embodiment. This plating apparatus is comprising loading apparatus 1, pre-treatment apparatus 2, plating
10. device 3 which injects plating liquid to carry out plating, after-treatment apparatus 4, and unloading apparatus 5 in the order of direction of conveying objects to be plated 6 as indicated by arrow A.

The loading apparatus 1 is mainly provided
15. with deck 7 which preliminarily aligns and loads up objects to be plated 6 (in the illustrated example, IC lead frames in the form of strips), and vacuum apparatus 8 which reciprocates between the said deck 7 and aligning rollers of the pre-
20. treatment apparatus 2 which will be described after. The vacuum apparatus 8 is mainly provided with suction pad 12 which is located at the end of movable duct 10, 11 connecting with blower 9, and link mechanism 13 enabling the said suction pad 12 to
25. reciprocate with arc-shaped tracks of reverse U-shaped form (in the direction of arrow B).

Process of the pre-treatment apparatus 2 includes some processes of, for example, electrolytic de-greasing, washing with water,
30. striking and washing with water, and so on. And the said pre-treatment apparatus 2 is provided

- with aligning rollers group 14 which is located at the inlet portion and also is provided with feed rollers group 15 which is located in the inside thereof (see Figures 1, 2 and 3). The
5. aligning rollers group 14 is formed with a number of units each comprising a pair of right and left tapered rollers 16 with a flat roller 17 between them. These units are arranged in parallel rows following one another in the direction
10. indicated as arrow A. Each row includes a number of units corresponding with that of objects to be plated 6 which are aligned and loaded on the deck 7. The feed rollers group 15 is formed with a number of units, each comprising a pair
15. of upper and lower engaging rollers 18a, 18b, which are located in parallel rows following one another in the direction indicated as arrow A, each row including the same number of units as the aligning rollers group 14, (see Figures
20. 1, 4 and 5). Processing apparatuses of electrolytic de-greasing and washing with water which are located in the inside of treatment tank 19 of pre-treatment apparatus 2 are those of well known types and they are not explained here.
25. Explained now referring to the Figure 5 is striking apparatus 20. Numeral 21 denotes parting tank, inlet and outlet of which provide with a pair of upper and lower leak prevention pipes 22 which are located adjacently. And inside
30. the said parting tank 21, casing 23 preventing striking plating of the equipment of rollers, a pair of upper and lower back up rollers 24 and

- rollers for cathode 25 are located. Numeral 26 denotes meshed anode. Referring to the engaging rollers 18a and 18b of the said feed rollers group 15 located in the above mentioned parting tank 21, the lower engaging roller 18b is formed as being a groove roller shown in Figure 4 and is so designed as not to be in contact with surface to be plated 27, that is, portion to be plated of the object to be plated. The said engaging rollers 18a, 18b are located in parallel with a space which is slightly shorter than that of length of the object to be plated 6. Additionally, numeral 28 denotes a duct located at treatment tank 19 in accordance with the sort of the processes including in the pre-treatment apparatus 2.

- Through the loading apparatus 1 and the pre-treatment apparatus 2, plural objects to be plated 6 in the form of strips are conveyed consecutively to the plating device 3 and then further conveyed to upper of top plate 29 of the said plating device 3 as in aligned condition through grab device which is not illustrated. Upon the completion of the plating, the plural objects to be plated 6 are conveyed to the inlet of the after-treatment apparatus 4 through the grab device which is not illustrated in the Figure. As shown in Figures 1 and 6 the plating device 3 is mainly provided with the top plate 29 serving both as masking which is formed with plural numbers of injection aperture 30 of plating liquid, nozzles 31

- serving both as anode faced to injection aperture 30 and a pressure plate 32 which is movable both in upper and lower directions pressing the objects to be plated 6 to the upper surface of the top plate 29. Numeral 33 denotes a wire which is strung on the upper side of the top plate 29, and the objects to be plated 6 descend in a condition of being loaded on the wire 33 by the flexion of wire 33 in accordance with the
5. descendment of the pressure plate 32, and the plating part of the objects to be plated 6 are positioned in accordance with the injection aperture 30 of the plating liquid. When the
10. pressure plate 32 ascends and returns, the said wire 33 removes the objects to be plated 6 from the top plate 29 by its own tensile force.
15. Numeral 34 denotes pressure cylinder which moves upward and outward motion of the pressure plate 32.

Processing of the after-treatment

20. apparatus 4 includes some processes in the treatment tank 35, for example, recovery, removal, washing with pure water and drying and so on. In the inlet of the said after-treatment apparatus 4, aligning rollers group (not illustrated) such as
25. the aligning rollers group 14 of the pre-treatment apparatus 2 is located and at the inside of the tank 35 feed rollers group (not illustrated) such as the feed rollers group 15 of the pre-treatment apparatus 2 is located. Numeral 36 denotes a
30. duct. Further processing apparatuses for the

said after-treatment process can employ the already known apparatus, therefore, detailed explanation is not given here.

- As shown in Figures 1 and 7, the
5. unloading apparatus 5 is mainly provided with sloping guide plate 37 which slips off the objects to be plated 6, curved guide plate 38 located on the upper part of lower ends of the sloping guide plate 37 controlling the slip off direction of
10. the objects to be plated 6, and containing box 39 which is located on the lower part of the said curved guide plate 38 and can contain the piled plural objects to be plated 6. The said sloping guide plate 37, curved guide plate 38 and containing
15. box 39 are provided in plural and are located in parallel in accordance with the number of aligned objects. Numeral 40 denotes the partition wall of the plate 37.

- Followings are detailed description of
20. the operation under the present invention. The plural numbers of the object 6 to be plated already aligned and loaded on the deck 7 is sucked to the lower side of the suction pad 12 kept by this pad 12. They are then conveyed in the direction
25. indicated as arrow B with arc-shaped track. Compared with the conventional apparatus in which the vacuum apparatus (not illustrated) conveys the suction pad in the squared track in the order of ascendment, lateral movement and descendment,
30. the track under the present invention is arc shaped

and consequently prompt and smooth loading of the objects to be plated 6 can be achieved. Utilising its tapered shape, a pair of right and left tapered rollers 16 of the aligning rollers group 14 receives the plural numbers of the objects to be plated 6 supplied by the suction pad 12, positions their respective alignment, conveys the plural numbers of the objects 6 in parallel condition at a time horizontally through the flat rollers 17 in the direction indicated as arrow A, and feeds them to the engaging rollers 18a, 18b of the feed rollers group 15.

The plural objects to be plated 6 are subject to various pre-treatments while they are conveyed through the treatment tank 19 through the above engaging rollers 18a, 18b. In the striking process, for example, when rollers 25 for cathode contacts the upper side of the object to be plated 6 the meshed anode 26 located at the bottom of the parting tank 21 which is filled with striking plating liquid, supplies ion to provide satisfactory striking plating, i.e. copper striking plating to the objects to be plated 6. The plural objects to be plated 6 are then conveyed to the top plate 29 of the plating device 3, more specifically, on the wire 33 at a time in aligned condition and descends with the wire 33 by pressure of the pressure plate 32 by means of the pressure cylinder 34. The plating part of the objects to be plated 6 is positioned in accordance with the injection

- aperture 30 for the plating liquid where the part to be plated is exposed and fixed under the pressure on the top plate 29 serving both as masking. The plating liquid is injected from the nozzle 3 serving both as the anode to carry out plating, i.e. partial silver plating, to the plating part of the objects to be plated 6.
5. By ascending and returning movement of the pressure plate 32 and by recovery of the wire 33, the objects
10. to be plated 6 are now free from the fitting condition with the top plate 29, and returned to the original position illustrated in Figure 6.
15. The plural objects to be plated are conveyed at a time to the upper part of the aligning rollers group (not illustrated) located at the inlet of the after-treatment apparatus 4 by the grab device not shown, and the feed rollers group (not illustrated) then feeds the objects to be plated 6 in lateral condition for the after-treatment in accordance
20. with each step required. Upon completion of the after-treatment, each object to be plated 6 slips off on the sloping guide plate 37 between a pair of right and left partition walls 40 falling down in the direction which is controlled by the curved
25. guide plate 38, and finally is contained in the containing box 39. In case that the containing box 39 is filled up with piles of the plural objects to be plated 6, they are picked out.

30. According to the present invention, the objects to be plated can be carried out pre-treatment

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- and after-treatment in the pre-treatment apparatus and after-treatment apparatus being conveyed laterally by means of the rollers group instead of a carrier as a rack, the plating is carried out by injection of the plating liquid, and the loading is achieved promptly by moving with arc shaped tracks of the suction pad of the vacuum apparatus. The processing speed of the whole line, therefore, can be increased substantially, which leads to efficient handling of automatic plating of the plural objects to be plated in the form of strips such as IC lead frames which are difficult to handle.
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C L A I M S

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1. A plating apparatus for automatically plating objects in the form of strips which are simultaneously laterally conveyed comprising, in the following sequence, loading apparatus, 5. pre-treatment apparatus, plating device, after-treatment apparatus and unloading apparatus, the loading apparatus including a device which simultaneously conveys the objects to be plated on a conveyor line, the pre-treatment apparatus and 10. after-treatment apparatus incorporating a conveyor line constituted by a group of aligning rollers and a group of feed rollers and the plating device being provided with partial plating arrangement which injects the plating liquid to carry out 15. the partial plating.
2. The plating apparatus as claimed in claim 1, wherein the said loading apparatus comprises a deck which initially aligns and loads the objects to be plated, a vacuum apparatus having a suction 20. pad which lifts the objects to be plated onto the deck in aligned condition, and a link mechanism which moves the said suction pad to reciprocate between the deck and the conveyor line of the pre-treatment apparatus with an arc shaped track 25. of reverse U shaped form.
3. A plating apparatus as claimed in claim 1 or claim 2, wherein the group of aligning rollers forming a part of the conveyor line incorporates a number of units each comprising a pair of right 30. and left tapered rollers with a flat roller located

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- between them, the units being located in parallel rows following one another in sequence in the direction of conveying, each row comprising a number of units arranged end to end in a direction
5. transverse to the direction of conveying in accordance with the numbers of objects to be plated.
4. A plating apparatus as claimed in any of claims 1, 2 and 3 wherein the group of feed
10. rollers forming a part of the conveyor line comprises pairs of upper and lower engaging rollers located in parallel rows following one another in sequence in the direction of conveying, each row comprising a number of units arranged end to end in a direction
15. transverse to the direction of conveying in accordance with the number of objects to be plated.
5. A plating apparatus as claimed in claim 4 wherein the lower rollers of each pair of upper and lower engaging rollers forming the
20. group of feed rollers are provided with grooves preventing contact of the plating part of the objects to be plated.
6. A plating apparatus as claimed in claim 1 wherein a partial plating device being located
25. after striking plating device is comprising top plate serving both as masking which is formed with plural injection apertures of plating liquid, nozzles serving both as anode for the injection of the plating liquid which are located in accordance
30. with the under portion of the each injection



aperture of the plating liquid and a pressure - plate which can move in upward and downward direction to press the objects to be plated on the upper surface of the top plate.

5. 7. A plating apparatus as claimed in claim 6 wherein plural wires are stringed on the said top plate so that when the said pressure plate descends, the said wires flex to the upper surface of the said top plate to be positioned the objects to be plated against the said injection apertures of the plating liquid, while when the said pressure plate ascends and returns, the said wires remove the objects to be plated from the top plate by their own tensile force.
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15. 8. A plating apparatus as claimed in claim 1 wherein the unloading apparatus comprises a sloping guide plate to discharge the objects to be plated, a number of partition walls projecting from the said sloping guide in accordance with the width of the objects to be plated, a plurality of curved guide plates which is located on the upper part of the lower end of the said sloping guide to control the discharge direction of the objects to be plated, and a containing box which is located at the lower part of the said curved guide plates to contain piles of the objects to be plated.
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