United States Patent [19]

Crapet

[11] **3,888,270**

[45] **June 10, 1975**

[54] **AUTOMATIC DEVICE FOR SURFACE TREATMENT**

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[73] Assignee: **Compagnie Industrielle des Telecommunications Cit-Alcatel**, France

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[30] **Foreign Application Priority Data**

Aug. 2, 1972 France 72.27940

[52] **U.S. Cl.**..... **134/57 R;** 118/57; 118/427; 134/76; 204/198; 204/222; 204/297 M; 214/89

[51] **Int. Cl.**..... **B08b 3/04;** B05c 3/14; C23b 5/70

[58] **Field of Search** . 214/89; 204/222, 198, 297 W, 204/297 M; 198/19; 134/76, 77; 118/57, 118/423, 425

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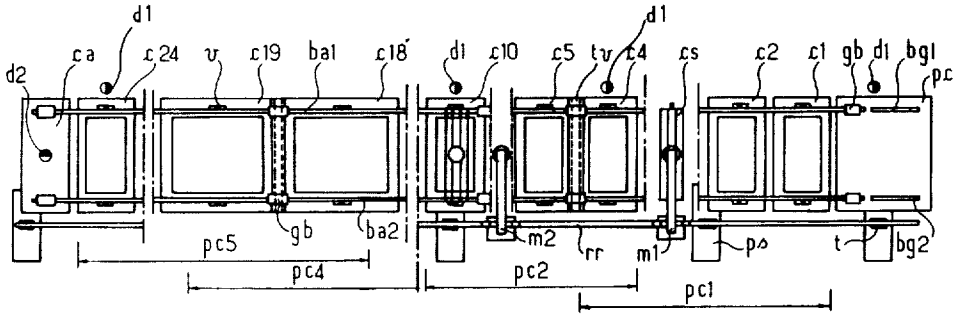
Primary Examiner—John H. Mack
Assistant Examiner—D. A. Valentine
Attorney, Agent, or Firm—Craig & Antonelli

[57] **ABSTRACT**

Automatic device for surface treatments having at least one mobile unit moving intermittently on a roll track parallel to the alinement of treatment stations and two fixed end stations situated at the ends of the said alinement, namely, a loading station enabling the supplying of the support frames with the objects to be treated and a shaker control station actuating two parallel shaker bars, the end stations being connected through the bars and each of the said mobile units transferring, from one treatment station to another and in turn, on the portion of chain assigned to it, the support frames loaded with the objects to be treated.

51 Claims, 19 Drawing Figures



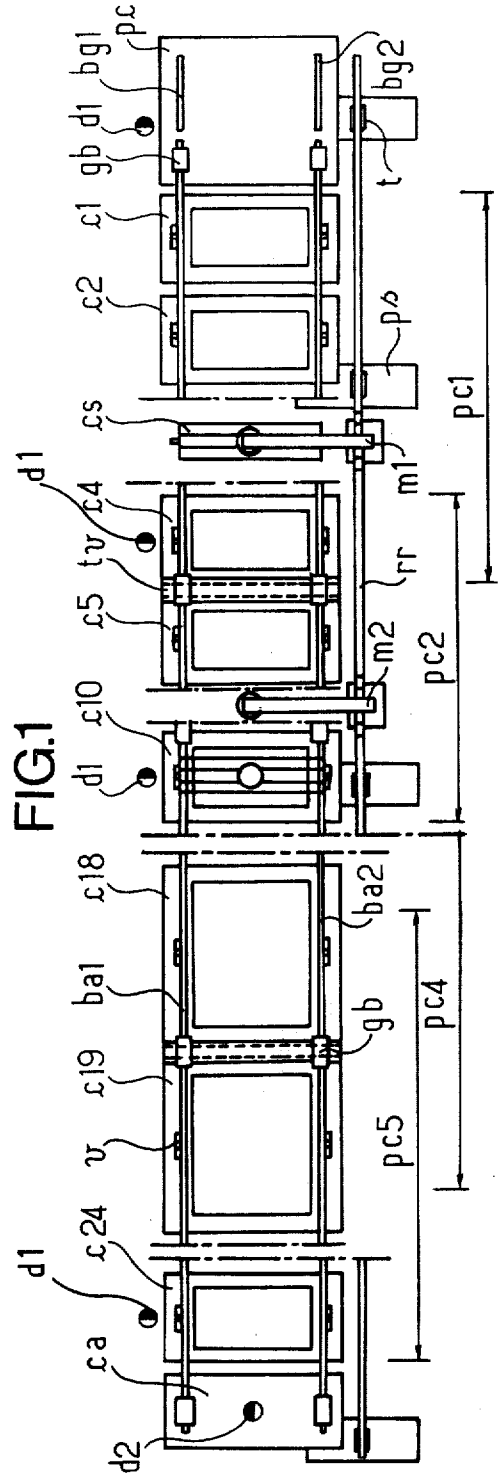


FIG.1

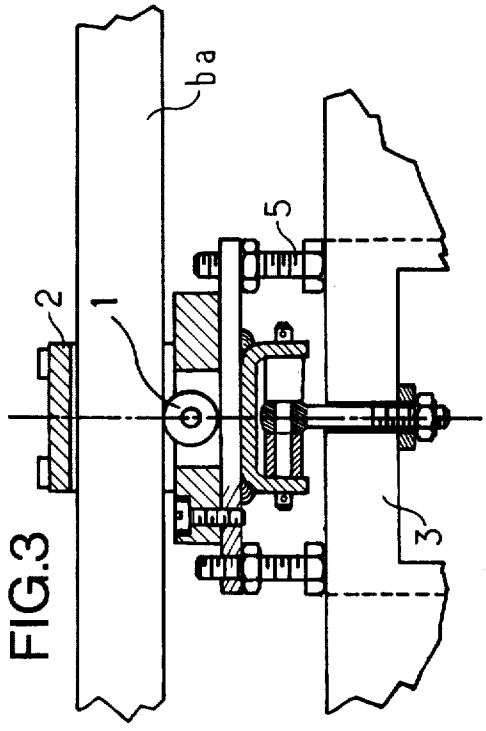


FIG.3

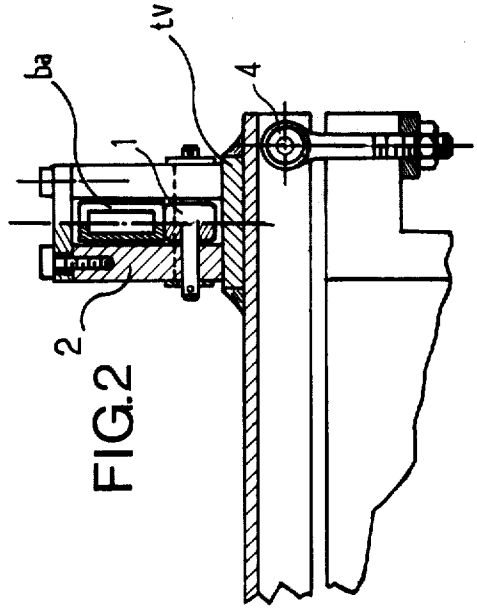


FIG.2

FIG.5

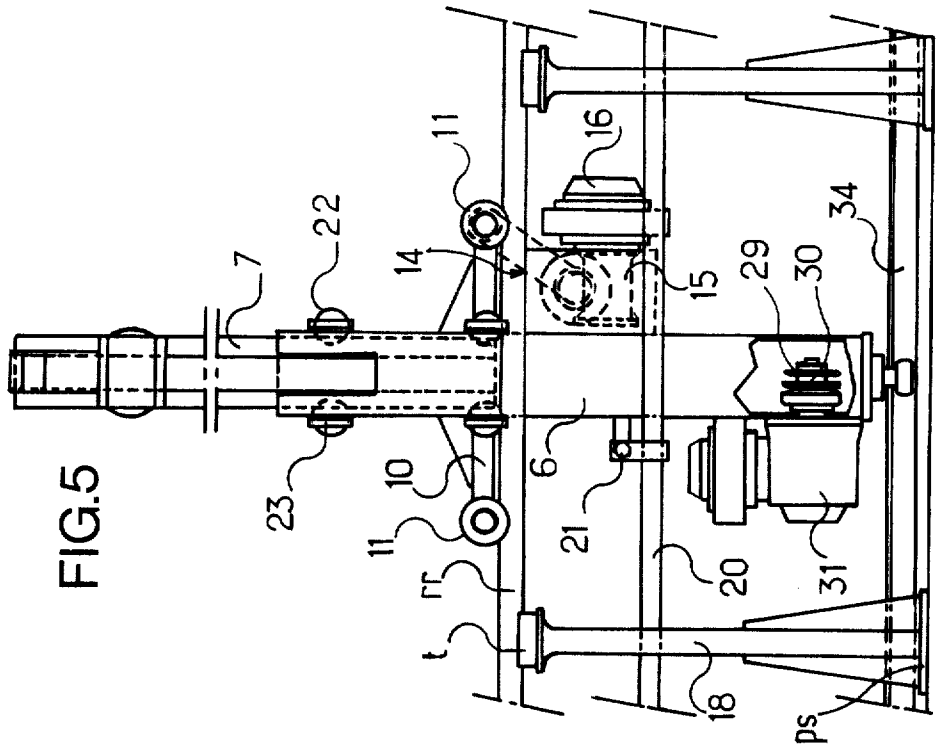

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FIG.4

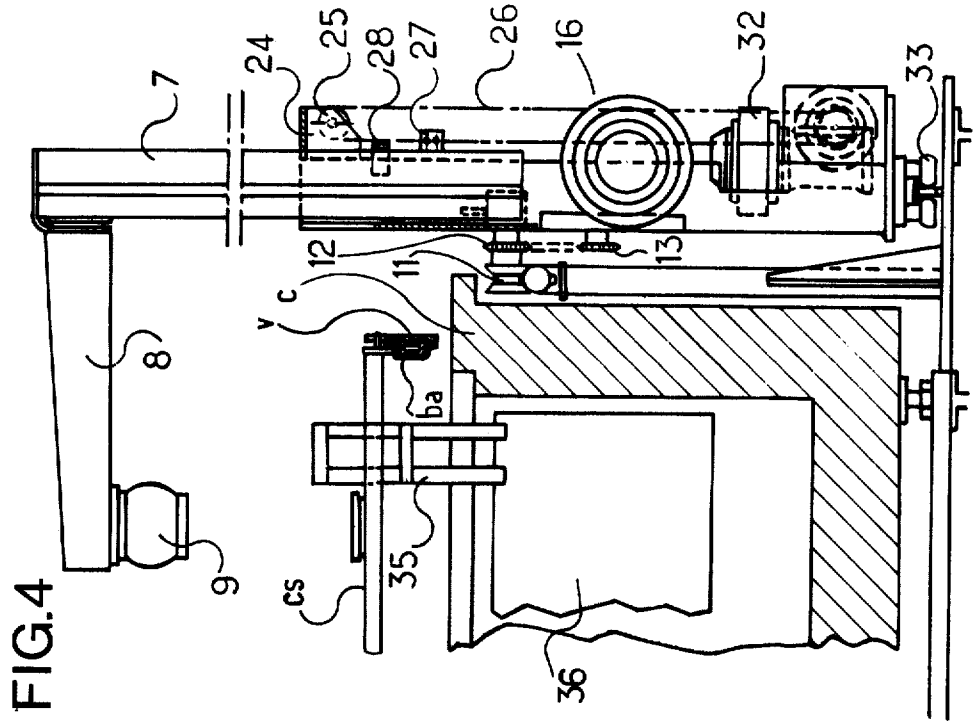
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FIG.8

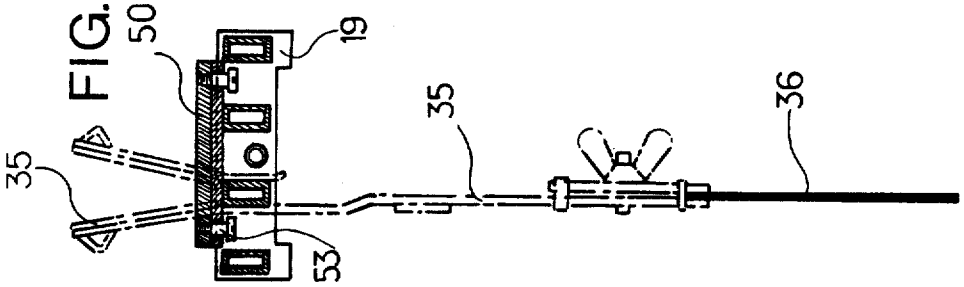


FIG.7

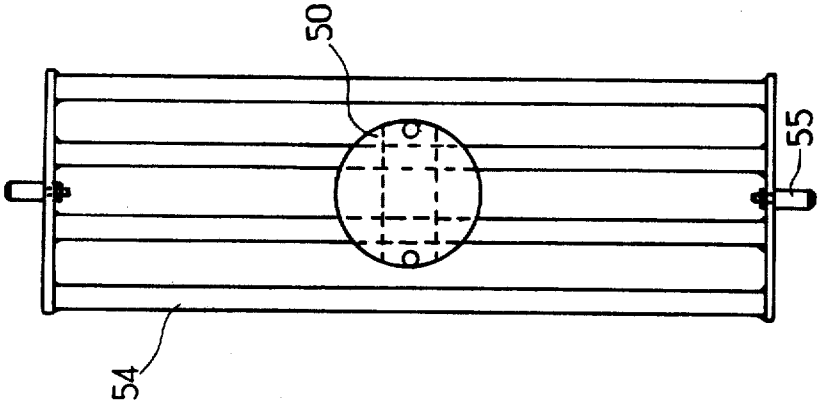


FIG.6

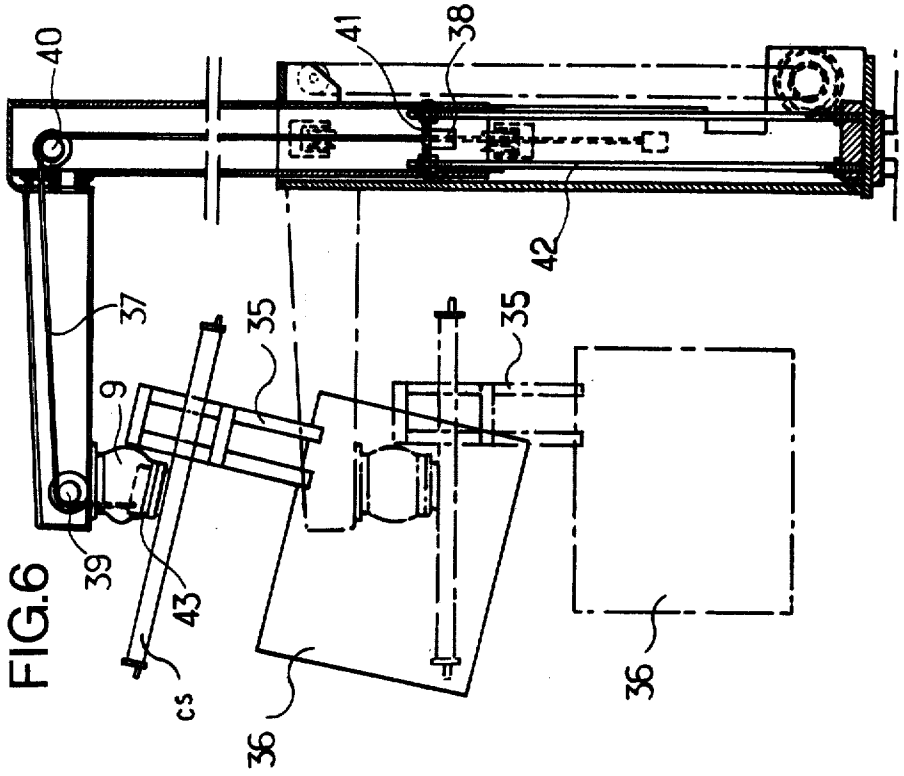


FIG. 9.

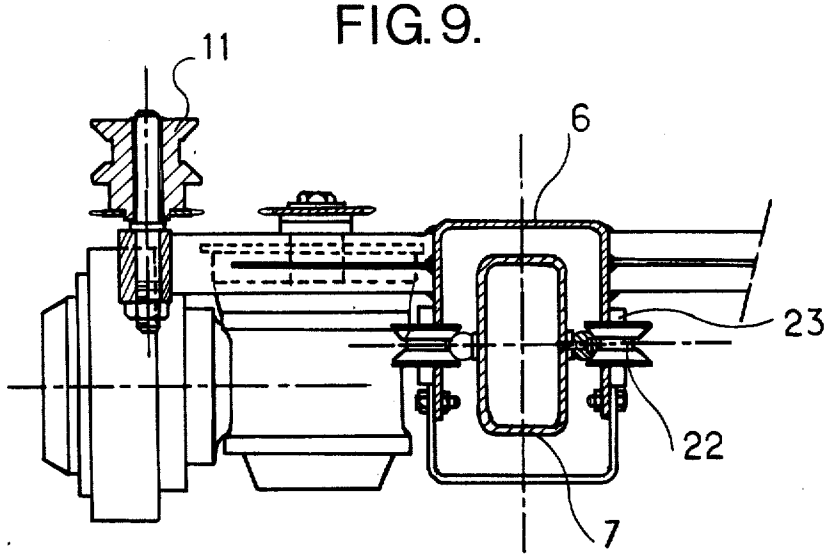


FIG. 10.

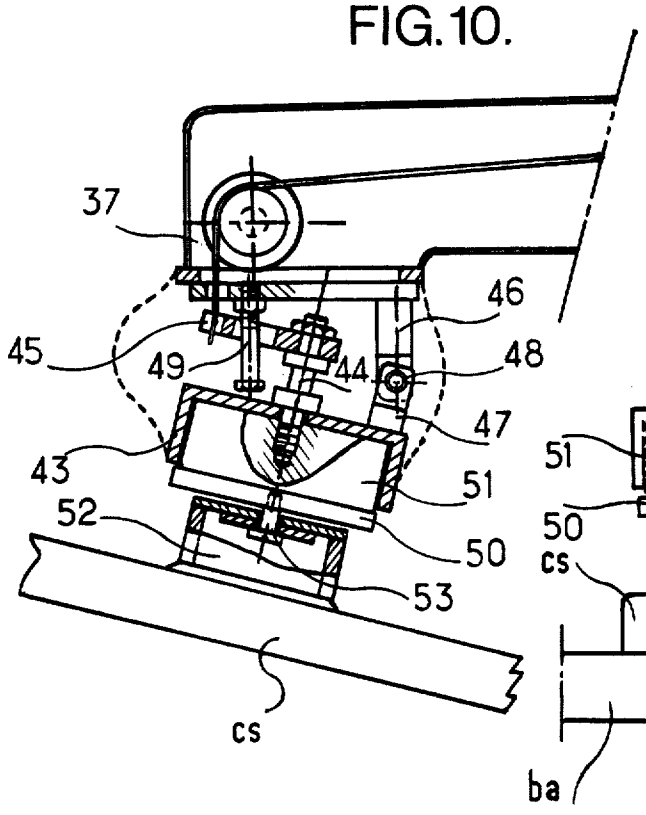


FIG. 11.

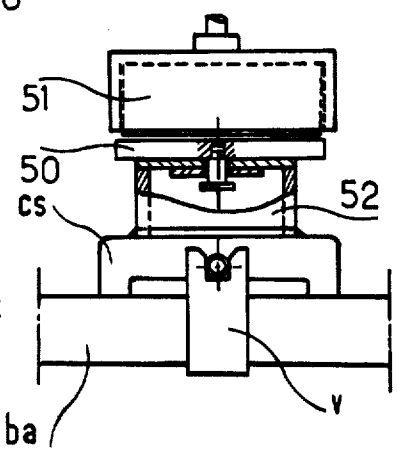


FIG.12

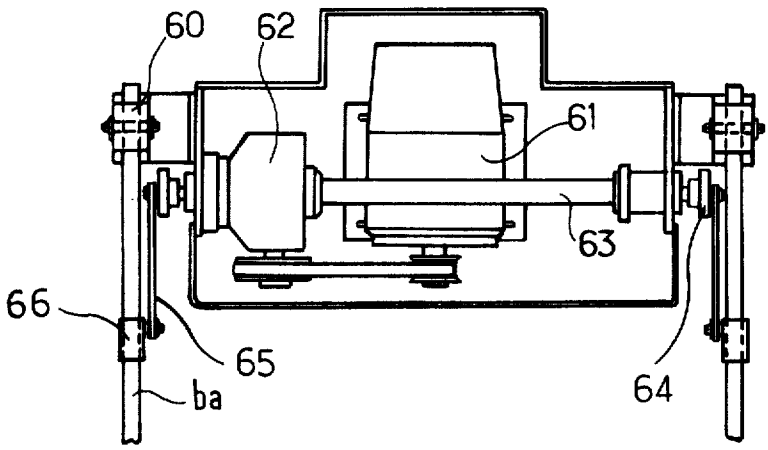


FIG.13

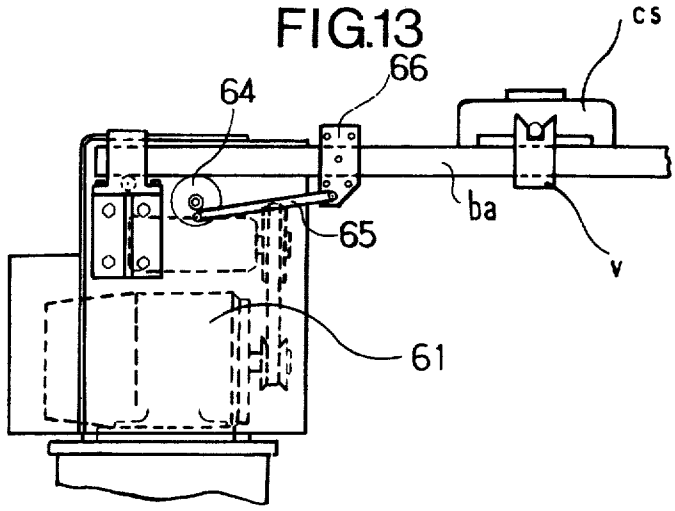


FIG.14

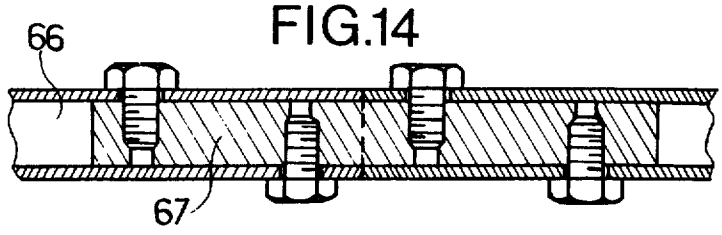


FIG.15

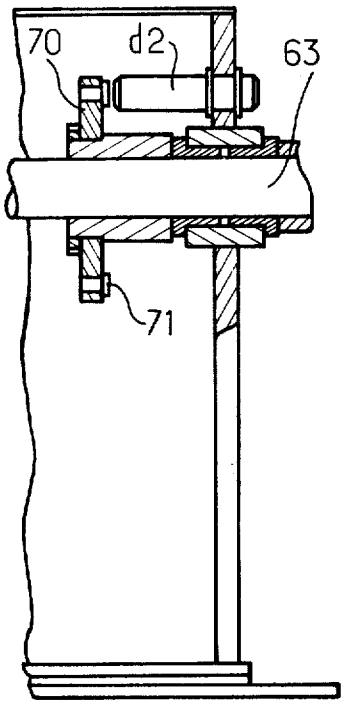


FIG.16

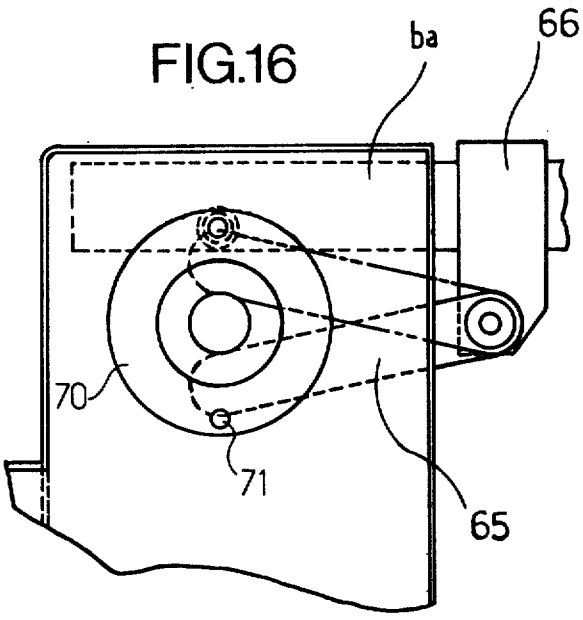


FIG.17

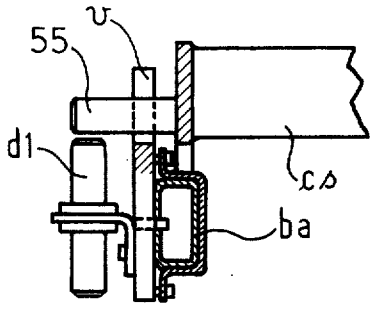


FIG.18

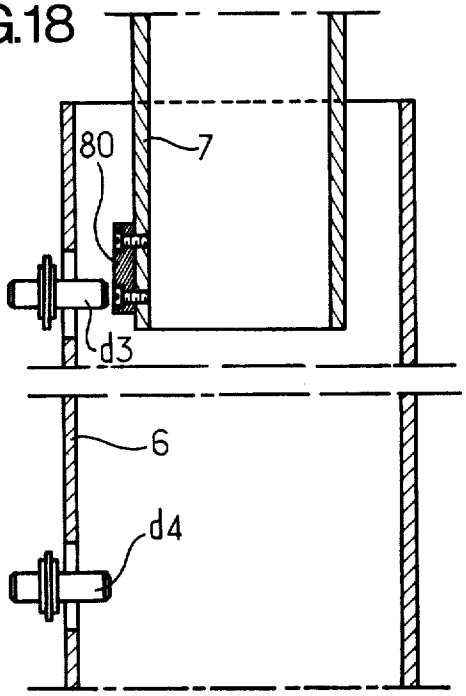
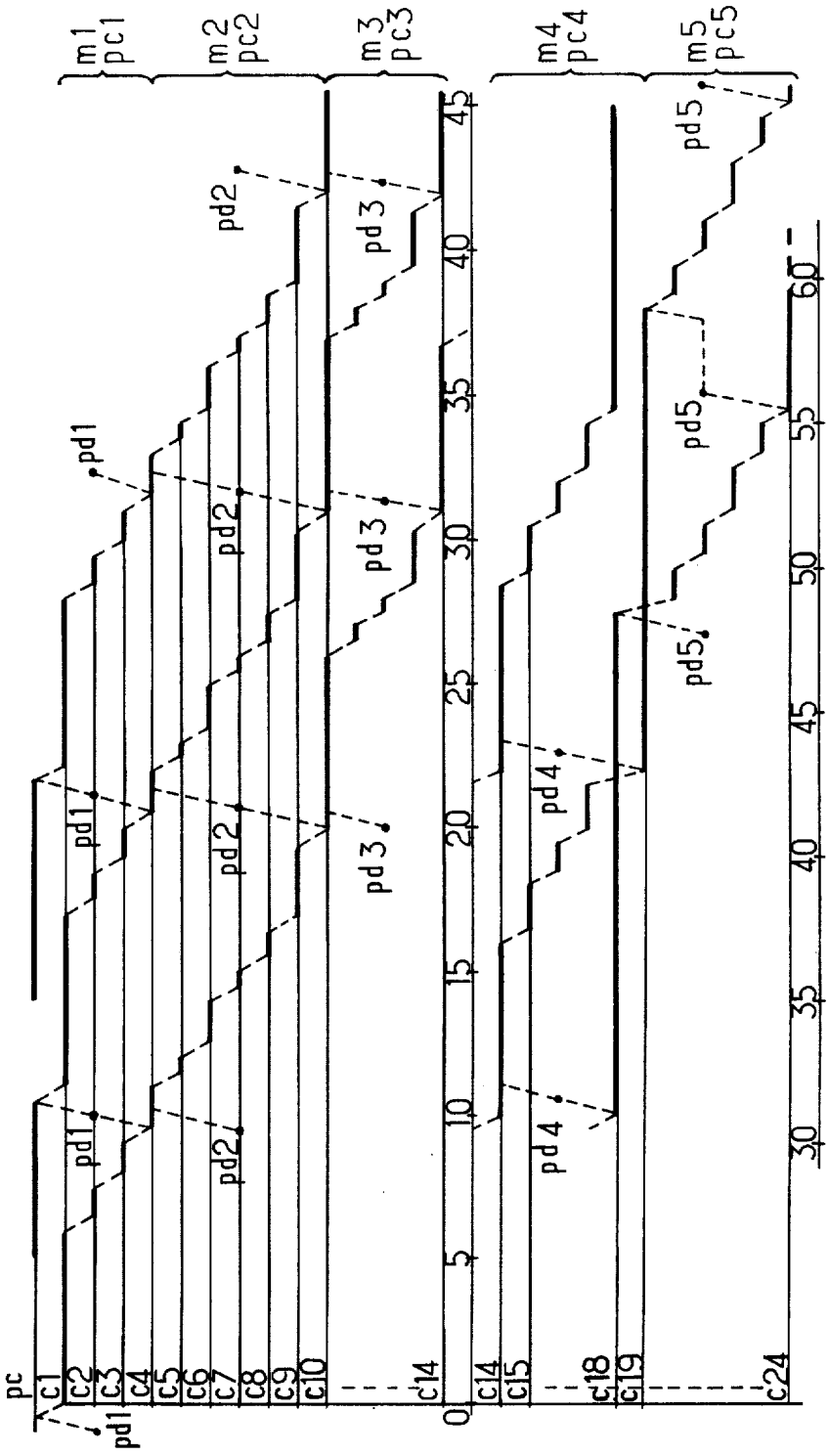


FIG.19


m1
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AUTOMATIC DEVICE FOR SURFACE TREATMENT

BACKGROUND AND SUMMARY OF THE INVENTION

The present invention concerns an automatic apparatus for treating surfaces, more particularly, for the treatment of printed circuit plates by baths.

It is known that the metallization of printed circuit plates is obtained by immersing these plates in electrolyte baths decomposed by an electric current. That operation, previously, numerous de-greasing, rinsing and scouring operations, and is also followed by successive rinsing and scouring. The metallization of printed circuit plates requires, consequently, the successive immersing of the said plates in vats containing baths of various compositions, during specific times for the nature of each of the said baths.

Up until now, the transfer of printed circuit plates was effected manually from one vat to another, the said plates being fixed to a suitable support frame. The support frames for the printed circuit plates bear against a pair of parallel bars called shaker bars placed above the vats and in the alinement thereof. The aforementioned operations and more particularly those concerning the electrolytic metallization of printed circuit plates are greatly improved by the shaking of the said printed circuits in the baths of the vats. That shaking of the printed circuits may be effected either parallel or perpendicular to the planes of the said circuits according to whether it is required to obtain a metallization of the planes or a metallization of the cavities (holes of the twin-face printed circuits).

The alternating movement of the shaker bars being obtained previously by means of a single eccentric driven by an electric motor, the said eccentric affecting a cross-bar fast with the two shaker bars. This type of drive of the bars gave rise to frequent jamming.

The aim of the invention is to produce an automatic apparatus ensuring the automatic laying of the support frames for printed circuits above the vats and the automatic transfer of the said frames from one vat to another. It comprises a system making it possible to avoid the jamming of the shaker bars. Moreover, it programs automatically the immersing times of the plates of circuits in the vats.

The automatic apparatus for treatment of surfaces, according to the invention, is characterized in that it comprises one or several mobile units moving on a roller track parallel to the alinement of the treatment stations and two fixed end stations situated at the ends of the said alinement, namely, a loading station enabling the supplying of objects to be treated and a shaker control station actuating the shaker bars, the end stations being connected together through the the shaker bars and each of the said mobile units transferring, from one treatment station to the other and in turn, on the portion of line assigned thereto, the support frames loaded with the objects to be treated.

According to another characteristic of the invention, each mobile unit is constituted by a column sliding in a shaft, the column being provided with a beam at its upper part and the shaft being able to move longitudinally in relation to the alinement of the vats, the two movements of the mobile unit (raising and lowering of the beam and linear movement of the shaft) being controlled each by a direct current motor and checked by proximity detectors.

According to another characteristic of the invention, the shaker control station comprises two eccentrics fast with a same shaft and operating at the two ends of the shaft in the longitudinal axis of the shaker bars, the shaft being driven by a brake motor operating through a reduction gear.

The various component parts of the automatic apparatus according to the invention comprise, moreover, preferably the following characteristics:

The mobile units move linearly on a track comprising a pair of horizontal and parallel rails comprised in an oblique plane, namely, a roller track placed at the upper level of the vats and contiguous with the alinement of the vats and a guide rail placed at the lower level of the vats at the center line of the shaft of the automatic apparatus.

The said roller track is preferably constituted by a cylindrical stainless steel bar bearing on metallic posts so that the bar rests on the V-shaped bearing heads of the posts;

The shaft of the mobile unit is supported by two grooved rollers bearing against the upper diametral part of the roller bar, the rollers each being fixed to an end of a pair of horizontal arms whose opposite end is fixed to the shaft of the mobile unit so that the rollers, situated on either side, bear the shaft, one of the rollers being provided with a chain gear enabling the longitudinal linear movement of the mobile unit;

The guide rail of the mobile unit preferably has a T-profile, the vertical cross-section of the profile being "straddled" between two single rollers fixed to the base of the mobile unit;

The shaft comprises, at its upper part, a clevis provided with an idler sprocket connected by a roller chain to the drive gear situated at the lower part of the shaft, a link of the said chain being fixed to the column;

The guiding of the column inside the shaft is obtained by means of four grooved rollers fixed by clevises to the wall of the upper half of the shaft, the rollers being symmetrically opposite in pairs and their grooves facing towards the inside of the shaft, the column having a cross-section whose shape is preferably hollow and rectangular, on which two guide bars, opposite in relation to the center line of the column, are fixed on the outside and longitudinally with respect to that column, each of the bars acting as a roller path for one pair of the rollers;

The end of the beam is provided with an articulated electromagnetic head or boot which may be inclined automatically when the column comes to the high position;

The support frame for printed circuits comprises a cylindrical platform consisting of two elements, the first being fast with the frame and the second being connected in a non-rigid configuration to the first, the frame comprising, moreover, several support bars and two centering studs;

The linear movements of the mobile units and those of their column fitted with a beam are controlled respectively by a direct current motor combined with a reduction gear whose shaft is connected to a drive gear by a chain, the connecting of the drive gear of the column being effected through a torque limiter;

The control station of the two shaker bars comprises a brake motor actuating a reduction gear connected to a shaft which drives, at each of its ends, an eccentric

operating, by means of a connecting rod, in the longitudinal axis of the corresponding shaker bar, the end of the bar sliding in a bushing fixed to the station;

The shaft of the shaker control station drives a flange comprising two diametrically opposite lugs, the lugs passing successively in front of a proximity detector fixed so as to check the middle position of the reciprocating stroke of the shaker bars;

At least at every other vat, the vats are fixed edge to edge by means of guide-support cross-members, the cross-members supporting the guides of the shaker bars, the guides each comprising a bushing and, inside the bushing, a bushing roller on which rests the bar, the level of the bushings being adjusted by means of jack screws bearing against the cross-members and against the edge of the said vats;

The ve's, or V-members, fixed to the shaker bars, at the level of the center line of the vats, make it possible to accomodate the support frames of printed circuits, certain of the said ve's, or V-members, being equipped with a proximity detector for relaying the transfer of the frames by the mobile units;

The movements of the mobile units, the shaking of the printed circuit plates and the exposure periods of the plates to the baths in the vats are programmed by means of a logic unit electrically connected by cables to the electric motors of the mobile units and of the shaker control station, the logic unit being contained in a cupboard comprising a block display unit showing the state and the position of the mobile units, counters for counting the bath periods, visual indicators.

The characteristics of the invention will become quite apparent from the following description given by way of an example, having no limiting character, of an embodiment of the automatic apparatus according to the invention, in which:

FIG. **1** shows a top view of the automatic apparatus as a whole;

FIGS. **2** and **3** give a detailed view of a guide support for a shaker bar;

FIGS. **4, 5** and **6** show one automatic apparatus seen at various angles and in several cross-section views;

FIGS. **7** and **8** show a support frame for printed circuits and the means for fixing one of the circuits on the said frame;

FIG. **9** gives a detailed view of the guiding of the mobile column inside the shaft of the mobile unit;

FIGS. **10** and **11** give a detailed view of the inclination of the electromagnetic head or boot and of the removal of the support frame on the ve's, or V-member, of the shaker bars;

FIGS. **12** and **13** show the control station for the shaker bars;

FIG. **14** shows the means used for effecting the connection between the shaker bar elements;

FIGS. **15** and **16** disclose the device with which the control station for the shaker bars is equipped and enabling the stopping of the bars to be controlled in a center position in relation to their alternating linear movement;

FIG. **17** shows a cross-section view of a shaker bar on which is fixed a ve, or V-member, equipped with a proximity detector;

FIG. **18** shows a part cross-section view of the shaft and of the column of a mobile unit, showing the proximity detectors for the high and low positions of the said column;

FIG. **19** is a diagram of the movements of the mobile units as a whole, operating on their respective portion of chain.

In the embodiment illustrated, in FIG. **1**, a certain number of vats referenced *c***1** to *c***24** are comprised between a loading station *pc* and a shaker control station *ca*, the stations being connected together by shaker bars *ba***1** and *ba***2** whose ends slide in bar guides *gb* fixed on cross-members *tv*. Ve's, or V-members, referenced *v*, are fixed to the shaker bars, at the center line of each vat. The loading station comprises two guide bars *bg* **1** and *bg***2** situated in the extension of the shaker bars. A mobile unit *m***1** is assigned for serving the vats *c***1** to *c***4** representing the first portion of chain *pc***1**. A mobile unit *m***2** is assigned for serving the vats *c***4** to *c***10** representing the second portion of chain *pc***2.** The mobile units (not shown) of the portions of chain *pc***4** and *pc***5** produce an overlap in the serving of the portions on the last vat *c***19** of the portion *pc***4** and on the first vat *c***18** of the portion *pc***5.** A support frame *cs* for printed circuits is shown during transport by the mobile unit *m***1.** The mobile unit *m***2** is shown in the release position after having deposited another support frame above the vat *c***10.** The automatic apparatus is supported and guided in its linear movement by a roller rail *rr* supported by the heads *t* of posts fixed vertically at their base to horizontal support legs *ps*.

The take-up station *pc* and one of the ve's, or V-members, keyed to the last vat of each section each comprise a detector *d***1** detecting the presence of the support frames of the circuits. The shaker control station *ca* comprises a detector *d***2** detecting the stopping of the shaker bars in the center position of the stroke of the said bars.

FIGS. **2** and **3** give respectively a cross-section view, a profile view and a front view of a shaker bar guide such as that referenced *gb* in FIG. **1.** The shaker bar *ba* rests on single rollers **1,** the bar *ba* and the rollers **1** being held on the inside of bushings **2,** each pair of bushings being fixed on a cross-member *tv* held on the cover board **3** of two vats placed side by side, by means of flanged clevices **4** and jack screws **5,** the bushings **2** being preferably made of vinyl polychloride.

FIGS. **4** and **5** show respectively a cross-section view, partly in profile and a front view of a mobile unit. The mobile unit comprises a vertical shaft **6** inside which slides a column **7** fast with a beam **8** at whose end is fixed an electromagnetic head or boot **9.** The shaft **6** comprises two horizontal arms **10** whose free ends, elbowed at right-angles, each comprise a grooved roller one of which, **11,** is fast with chain sprocket **12** connected to a drive gear **13** by a roller chain **14.** The drive gear **13** is meshed on a worm-type reduction gear **15** combined with a direct current electric motor **16.** The two rollers **11** distribute the weight of the mobile unit on a cylindrical roller rail *rr* supported by posts **18** whose heads *t* have a V-shaped profile. A bar **20** fixed to the posts **18** supports proximity detectors **21** enabling, by electromagnetic detection, the stopping of the mobile units at the center line of the vats, one of which *c*, is partly shown in a cross-section view, some of the detectors **21** operating exclusively during the outgoing stroke and others only during the return stroke of the mobile units. The upper half of the shaft **6** comprises four grooved rollers **22** fixed to the shaft by clevices **23,** the said rollers **22** enabling the column **7** to be guided in its rising and descending movements

inside the shaft **6** as appears in FIG. **9** showing a cross-section view of the mobile unit seen from above at the height of the bearing rollers **11.** For that reason, the shaft **6** comprises, fixed to its upper part opposite to the beam **8,** a clevis **24** fitted with an idler sprocket **25** and with a roller chain **26,** the roller chain being fixed by one of its links to a lug **27** fast with the column, the said column being limited in its stroke in the high position by a stop **28.** The chain **26** meshes onto a drive gear **29** placed at the base of the shaft, the gear **29** being keyed to a torque limiter **30** connected to an irreversible worm type reduction gear **31,** the said reduction gear **31** being combined with a direct current motor **32.**

The base of the shaft comprises two guide rollers **33** straddling a rail **34** having a T-shaped profile. Above the vat *c* in FIG. **4** may be seen the support frame *cs* for printed circuit plates on which is fixed a clip **35** holding a printed plate **36.**

FIG. **6** shows a complete cross-section view of the mobile unit illustrated in a profile, showing the mechanism for inclination of the electromagnetic head or boot **9** in order to perform the draining of the plates of printed circuits when these latter are removed from the vat, the beam **8** being brought back to the high position. For that reason, a steel cable **37** has one of its ends fixed inside the head or boot **9.**

The cable **37,** stretched by a counter-weight **38,** passes over two grooved pulleys, one of which, **39,** is situated in the head of the beam **8** and the other, **40,** is situated in the head of the column **7.** A plate **41,** drilled perpendicularly with respect to the cable **37,** is bolted horizontally to the free ends of two vertical bars **42** whose opposite ends are fixed to the base of the shaft **6,** the counter-weight **38** rising or descending inside the shaft and beyond the said plate **41,** according to the rising or descending movement of the column **7.** The armature **43** of the electromagnetic suction chamber head or boot **9** remains in the horizontal position except when the column **7** ends its stroke in the high position, the length of the cable **37** being such that, the counter-weight **38** abutting against the plate, a traction force is exerted by the cable **37** on the electromagnetic head or boot **9** whose armature assumes an inclined position.

The detail of the inclination device inside the head or boot **9** appears in FIG. **10,** the said suction chamber comprising a pin **44** screwed perpendicularly with respect to the center of the armature. A plate **45** is bolted perpendicularly with respect to the pin **44,** the end of the plate **45** being situated perpendicularly with respect to the cable **37** and fixed to the cable. A tenon **46** and a mortise **47** articulated on a shaft **48** are fixed respectively to the head of the beam **8** and to the armature of the head or boot **9** to form a clevis. The inclination of the armature **43** is adjustable and limited horizontally by a stop screw **49.**

The platform **50** of the support frame *cs* clamps the electromagnet **51** of the head or boot **9,** the base **52** of the frame being connected to the platform **50** by means of pin screws **53** providing a certain play between the base **52** and the platform **50.** This enables the platform **50** to clamp the electromagnet **51** easily when the latter is energized, the platform **50** then being in the position shown by FIG. **11** when the support frame *cs* is laid on the shaker bars *ba* and held above the vat by the centering ve's, or V-members, *v*.

A support frame for printed circuits is shown in detail in FIGS. **7** and **8,** FIG. **7** showing the top view and FIG. **8** showing a cross-section profile view of the said support frame. The platform **50** held by pin screws **53** may be recognized therein. The platform **50** is fixed on hollow rectangular bars **54** forming the skeleton of the support frame and on which are placed the clips **35** to hold the plates of printed circuits **36.** The support frame comprises, moreover, two lugs **55** and four legs **19.** FIGS. **12** and **13** show respectively a top view and a profile view of the control station *ca* in FIG. **1.** The shaker bars *ba* slide in roller type bushings **60** similar to that shown in FIGS. **2** and **3.** A brake motor **61** drives, by a belt, a reduction gear **62** of the worm screw type causing the rotating of a cross shaft **63.** Each end of the shaft **63** comprises an eccentric **64** connected by a connecting rod **65** to a tab **66** fixed to the shaker bar.

The two shaker bars are each constituted, as shown in FIG. **14,** by hollow elements **66** connected together by means of a fish plate **67** arranged inside the contiguous ends of the elements **66** and bolted to the ends.

FIGS. **15** and **16** show a device of the shaker control station enabling the central position of the reciprocating movement of the shaker bars to be situated. The proximity detector *d*2 diagrammatically shown in the shaker control station *ca* illustrated in FIG. **1** is fixed to a lateral wall of the station *ca*, parallel to the shaft **63.** A flanged sleeve **70** is keyed to the shaft **63** and comprises two diametrically opposite lugs **71,** and the lugs **71** passing successively in front of the proximity detector *d*2. The flange **70** and the eccentric **64** (FIG. **13**) being arranged on the same shaft **63,** the passing of each lug in front of the proximity detector corresponds to half the stroke of the shaker bars in relation to the midpoint of the stroke. This makes it possible to stop the shaker action in the center position before the beam **8** descends.

FIG. **17** shows a part cross-section view of a ve, or V-member, *v* fitted with a proximity detector *d*1, the said ve, or V-member, being fixed by a collar on the shaker bar *ba* and the support frame *cs* resting on the pair of the said bars by four legs which are symmetrical two by two in relation to the centering ve's, or V-members, of the said frame, as shown in FIG. **11.**

FIG. **18** is a part cross-section view of the shaft **6** and of the column **7** shown in FIG. **5.** It illustrates the proximity detectors *d*3 and *d*4 fixed to the shaft **6** and enabling respectively the detecting of the presence of a plate **80** fixed to the column **7** according to whether that column comes to the high position or to the low position.

FIG. **19** is a diagram of the movements of the mobile units and of the stopping periods above the vats they serve. The ordinates show the vats *c*1 to *c*24 and the loading station *pc* and the abscissae show periods **0** to **60** expressed, for example, in minutes. The mobile unit *m*1 serves the portion of chain *pc*1 corresponding to the vats *c*1 to *c*4; the mobile unit *m*2 serves the portion of chain *pc*2 corresponding to the vats *c*4 to *c*10, etc.

The thick lines represent the intervals of time during which the mobile units remain positioned above the vats and the discontinuous lines represent the movements of the said mobile units. The points *pd*1, *pd*2 . . . etc., represent the release positions of the mobile units *m*1, *m*2 . . . etc., in the middle of their respective portion of chain. The automatic operation of the auto-

matic apparatus according to the invention will be explained with reference to certain of FIGS. 1 to 19.

The movements of the mobile units and of the shaker bars are controlled and checked by a logic unit cupboard connected by cables to the various electric motors and proximity detectors with which the automatic apparatus is fitted. The cables are suspended by pulleys fixed above the installation so as to enable the lateral movement of the mobile units along the portions of chain assigned to them. The cupboard and the cables are not shown in the drawings.

The support frame *cs* (FIGS. 4, 7 and 8) is loaded manually with printed circuit plates, then placed on the guide bars *bg*1 and *bg*2 of the loading station *pc* (FIG. 1). The switch of the cupboard being actuated in the "automatic start up" position, the electric motor 16 (FIG. 5) starts up and the mobile unit *m*1 which was stopped in the middle of its portion of chain *pc*1 (release position *pd*1, FIG. 19), moves in reverse gear on its roller track *rr*, the beam being in the high position, towards the stocked loading station *pc*. The switch of the cupboard causes simultaneously the starting up of the motor 61 (FIG. 12) which controls the alternating movement of the shaker bars *ba*. The mobile unit m1 stops under the action of the proximity detector *d*1, so that the electromagnetic head or boot 9 of the beam 8 (FIG. 4) may come to the vertical position with respect to the platform 50 of the support frame *cs* (FIG. 7). The column 7 descends to the low position detected by the proximity detector *d*4 fast with the shaft (FIG. 18).

The logic unit cupboard, warned of that detection, controls the energizing of the electromagnet 51 of the head or boot 9 (FIG. 11) and the platform 50 of the support frame clamps the said head or boot 9. The column 7 is made to rise to the high position by the proximity detector *d*3 (FIG. 18), the beam 8 lifting the support frame *cs*. The logic unit cupboard interprets that detection and again controls the rotation of the electric motor 16, but in the reverse direction: the mobile unit *m*1 moves in the forward direction up to the vat *c*1 and stops at the level of the center line of the said vat under the effect of the energizing of a proximity detector such as 21 (FIG. 5). Simultaneously, the detector 21 gives the order to the logic unit cupboard to stop the reciprocating movement of the shaker bars and to make the beam of the automatic apparatus descend to place the support frame in the ve's, or V-members, situated above the vat *c*1. The proximity detector *d*2 combined with the shaker control station *ca* (FIGS. 1, 15 and 16) enables the ve's, or V-members, fixed to the shaker bars to position themselves at the center line of the vat, the ve's, or V-members, being stopped at the mid-point of their reciprocating movement. The beam stops at the end of the downward stroke when the proximity detector *d*4 is energized. The detector also orders the logic unit cupboard to effect the de-energizing of the electromagnet, which releases the support frame *cs* whose fingers 55 engage in the ve's, or V-members, of the shaker bars and whose legs 19 bear against the bars (FIGS. 7, 8 and 11).

The cupboard effects, at the same time, the starting up of the shaker bar control station, as well as the releasing of a time counter fixing a first time delay for the treatment (alkaline degreasing, for example) of the printed circuit cards exposed to the bath in the vat *c*1. The counting up of the time delay being ended, the movement of the shaker bars stops, each pair of ve's, or V-members, positioning itself as previously at the center line of the corresponding vat.

The following part of the operations is effected in a similar way to those effected starting from the taking up, by the automatic apparatus, of the support frame at the loading station. The following occur successively:

Energizing of the electromagnet of the head or boot 9;

Raising of the beam 8 and stopping in the high position;

Time delay to enable the draining of the circuit cards;

Linear movement of the mobile unit *m*1 towards the vat *c*2;

Stopping of *m*1 opposite the vat *c*2;

Lowering of the beam 8 and stopping of the shaking in the center position;

Stopping of the beam 8 in the low position;

Electromagnet de-energized and starting up to the shaking;

Release of the time delay for the treatment of circuit cards by the bath in the vat *c*2 (rinsing, for example) . . . etc.

The mobile unit *m*1 having transferred the support-frame *cs* above the last vat *c*4 of the portion of chain which it serves and having deposited the frame *cs* in the positioning ve's, or V-members, assigned to the vat, starts off again in the reverse direction and stops in the middle of the portion of chain *pc*1 which it serves (release position *pd*1, FIG. 19). The stopping of the mobile unit m1 in that position is controlled by means of a proximity detector such as 21 shown in FIG. 5 but having no action during the outgoing stroke of the automatic apparatus. The mobile unit *m*1 will leave that position *pd*1 to move towards the loading station *pc* only if the said station is stocked with support frames, the logic unit cupboard then being warned by the proximity detector *d*1 of the station.

The mobile unit *m*1 having deposited the support frame above the last vat *c*4 of its portion of chain *pc*1 and the said vat being the first of the portion of chain *pc*2 (vats *c*4 to *c*10) served by the mobile unit *m*2, the mobile unit *m*2 is warned of the presence of the frame on the vat by the proximity detector *d*1 on one of the ve's, or V-members, of the vat (FIGS. 1 to 17).

The mobile unit *m*2, stopped in the release position *pd*2 (FIG. 19) of its portion of chain *pc*2, waits until *m*1 has released itself from the vat *c*4 to move towards the vat, where it will take up the support frame deposited by the mobile unit *m*1. The frame will then be transferred successively from the vat *c*4 to the vat *c*10 by *m*2. In the interval of time, 10 to 15 minutes, for example, the bath treatment in the vat *c*1 of the printed circuit plates of a new support frame deposited by the mobile unit *m*1, on the one hand and the successive bath treatments, in the vats *c*4 to *c*7, of the support frame plates which have already undergone complete bath treatments in the vats *c*1 to *c*3 and a part of the bath treatment in the vat *c*4, on the other hand, will take place.

The mobile unit *m*1 will leave its release position *pd*1 and move towards the loading station *pc* only if the station *pc* is stocked with support frames, the logic unit cupboard being warned by the proximity detector *d*1 of the station.

This system for relaying the support frames by mobile units enables the simultaneous treatment of as many support frames as there are mobile units, the treatment

phases being shown in parallel cascades on the first part of the diagram in FIG. **19**. The second part of the diagram gives another example of the distribution of the treatment phases due to the fact that one of the operations (copper coating, for example), requiring a particularly long treatment, is effected in two consecutive vats (*c***18** and *c***19**).

The mobile unit *m***4** effects several transfers followed by short successive treatments (vats *c***14** to *c***17**) and a transfer followed by a long treatment (vat *c***19**), the transfer taking place at about ⅔ of the long bath treatment effected in the vat *c***18**. At the end of the treatment coming from the vat, the mobile unit *m***5** transfers the support frame from the vat *c***18** to the vat *c***14** then remains in the waiting position until the end of the long treatment effected in the vat *c***19**; at the end of the said treatment, it effects the transfer of the plates after each short treatment successively in the vats *c***19** to *c***24**.

It must be understood that the invention is in no way limited to the embodiment described and illustrated, which has been given only by way of an example; more particularly, without going beyond the scope of the invention, certain arrangements may be modified or certain means may be replaced by equivalent means.

I claim:

1. An automatic arrangement for treatment of objects comprising: a plurality of alined treatment stations including a loading station and a shaker control station disposed at respective ends of said alined treatment stations, said loading station enabling the supplying of support frame means for carrying the objects to be treated, said shaker control station including a pair of parallely disposed shaker bars and means for actuating said shaker bars; said shaker bars operatively interconnecting said loading station and said shaker control station; a roller track disposed parallel to said alined treatment stations; at least one mobile unit means for transferring the objects to be treated; means for intermittently moving said mobile unit means on said roller track, said mobile unit means transferring said support frame means loaded with objects to be treated from one treatment station to another.

2. An arrangement according to claim **1** wherein said means for intermittently moving said mobile unit includes at least one chain means disposed proximate to said alined treatment station, said mobile unit means being moved along a predetermined portion of said chain means.

3. An automatic arrangement for treatment of objects comprising: a plurality of alined treatment stations including a loading station and a shaker control station disposed at respective ends of said alined treatment stations, said loading station enabling the supplying of support frame means for carrying the objects to be treated, said shaker control station including a pair of parallely disposed shaker bars and means for actuating said shaker bar, said shaker bars operatively interconnecting said loading station and said shaker control stations; a roller track disposed parallel to said alined treatment stations; at least one mobile unit means for transferring the objects to be treated; means for intermittently moving said mobile unit means on said roller track, said mobile unit means transferring said support frame means loaded with objects to be treated from one treatment station to another, said means for intermittently moving said mobile unit includes at least one chain means disposed proximate to said alined treatment station, said mobile unit means being moved along a predetermined portion of said chain means; each mobile unit means includes a shaft; a substantially vertical column slidably disposed in said shaft; a beam provided on said column, said beam being provided with an engaging means for selectively engaging said support frame means; and positioning means for controlling the positioning of each mobile unit along said predetermined portion of said chain including means for selectively raising and lowering said column.

4. An arrangement according to claim **3** wherein logic means are provided for controlling said positioning means as a function of the position of said mobile unit means.

5. An arrangement according to claim **3** wherein said engaging means is an electromagnetic head.

6. An arrangement according to claim **3** wherein said mobile unit means move linearly on said roller track, and said roller track includes a first rail disposed above and contiguous to said plurality of alined treatment stations, a guide rail disposed proximate to the bottom of said treatment station, and a plurality of spaced post means for supporting said first rail.

7. An arrangement according to claim **6** wherein said mobile unit means is provided with at least one pair of single rollers straddling said guide rail.

8. An arrangement according to claim **3** wherein said means for intermittently moving said mobile unit includes a motor, a speed reduction gear having a drive sprocket, a driven sprocket provided with a roller bearing and a chain means for interconnecting said drive sprocket and said driven sprocket.

9. An arrangement according to claim **8** wherein said mobile unit means is provided with a pair of substantially horizontal arms, said roller bearing provided on said driven sprocket being disposed on one of said horizontal arms and an additional roller bearing is provided on the other of said horizontal arms, said arms being arranged in a cross-configuration on said mobile unit means shaft so that said roller bearings bear against the top of said roller track.

10. An arrangement according to claim **3** wherein said means for selectively raising and lowering said column includes an electric motor; a speed reduction gear provided with a gear shaft; a drive tooth sprocket; a torque limiter means coupling said gear shaft with said drive tooth sprocket, an idler gear; and an endless chain operatively connecting said drive tooth sprocket with said idler gear.

11. An arrangement according to claim **10** wherein a clevis means is provided for fixing said idler gear to said shaft of said mobile unit means.

12. An arrangement according to claim **11** wherein said shaft of said mobile unit means is provided with grooved roller means for aiding in raising and lowering of said column.

13. An arrangement according to claim **12** wherein said column is provided with a guide bar means for guiding said grooved roller means provided on said shaft.

14. An arrangement according to claim **13** wherein said grooved roller means includes four rollers fixed to said shaft of said mobile unit means; and wherein a pair of guide bar means are provided on said column; said four rollers being disposed on said shaft in symmetrically opposite pairs, each of said pairs of roller bearing respectively on one of said guide bar means.

15. An arrangement according to claim 14 wherein said four rollers are fixed to said shaft by a clevis means.

16. An arrangement according to claim 6 further comprising a bar means disposed parallel to said first rail and fixed to said spaced post means, and said positioning means includes a plurality of first proximity detector means fixed to said bar means for controlling the linear movement of said mobile unit means.

17. An arrangement according to claim 16 wherein said mobile unit means executes an outgoing stroke and a return stroke along said predetermined portion of said chain means and wherein some of said first proximity detector means are operable solely during said outgoing stroke and the remaining proximity detector means are operable solely during said return stroke.

18. An arrangement according to claim 17 wherein said proximity detector means operable during said outgoing stroke is operable to stop said mobile unit means at a respective treatment station.

19. An arrangement according to claim 18 wherein said proximity detector means operable during said return stroke is operable to stop said mobile unit means in the middle of said predetermined portion of said chain means.

20. An arrangement according to claim 19 further comprising a second plurality of proximity detector means for detecting said support frame means at said loading station and at a respective one of said alined treatment stations, said second detector means being disposed opposite the end of said predetermined portion of said chain means.

21. An arrangement according to claim 20 wherein said second proximity detector means disposed at a respective one of said alined treatment stations are fixed to one of two V-members disposed above said treatment station.

22. An arrangement according to claim 21 further comprising an additional proximity detector means provided at said shaker control station for controlling the positioning of the V-members at the center of a respective treatment station.

23. An arrangement according to claim 22 wherein said shaker bars are mounted for reciprocating stroke movement and wherein said shaker control station is provided with a shaft means operatively connected to said shaker bars, said shaft means driving a flange having lug means cooperating with said additional proximity detector means to check the middle position of said reciprocating stroke of said shaker bars.

24. An arrangement according to claim 23 wherein said lug means includes a pair of diametrically opposite lugs, said lugs being mounted so as to pass successively in front of said additional proximity detecting means.

25. An arrangement according to claim 24 further comprising further proximity detecting means provided on said shaft of said mobile unit means for detecting the position of said column on said mobile unit means shaft.

26. An arrangement according to claim 25 wherein said column is provided with a projection means cooperating with said further proximity detecting means.

27. An arrangement according to claim 26 wherein said further proximity detecting means includes a pair of spaced proximity detectors, said spaced proximity detectors cooperating with said projection means on said column means to detect the raised and lower positions thereof.

28. An arrangement according to claim 5 wherein means are provided for articulatingly connecting said electromagnetic head to said beam.

29. An arrangement according to claim 28 wherein said connecting means includes tab means connected respectively to said beam and to said electromagnetic head.

30. An arrangement according to claim 29 wherein said electromagnetic head includes an armature, said tab means being connected to said armature.

31. An arrangement according to claim 30 wherein means are provided for automatically inclining said electromagnetic head when said column is in a raised position.

32. An arrangement according to claim 31 wherein said automatic inclining means includes pulley means operatively connected to said beam and said column, a cable means disposed between said pulley means operatively connected to said electromagnetic head, and means for stretching said cable between said pulley means and said head.

33. An arrangement according to claim 32 wherein said pulley means includes a pair of grooved pulleys, one of said pulleys being fixedly attached to an end of said beam, the other of said pulleys being fixedly attached to the upper portion of said column.

34. An arrangement according to claim 33 wherein said shaft of said mobile unit means is provided with a horizontal plate, said horizontal plate being provided with an orifice which receives said cable means.

35. An arrangement according to claim 34 wherein said means for stretching said cable means includes a weight attached to said cable means inside said shaft below said horizontal plate, said weight abutting the lower face of said horizontal plate when said column is in its raised position thereby inclining said electromagnetic head to aid in draining said treated objects when removed from a respective treatment station.

36. An arrangement according to claim 35 wherein said cable means is connected to said electromagnetic head diametrically opposite to said articulated connecting means.

37. An arrangement according to claim 3 wherein said support frame means includes a plurality of support rods, clip means provided on said support rods for bearing the object to be treated, means for supporting said support frame on said shaker bars, and means for stabilizing said support frame means on said shaker bars.

38. An arrangement according to claim 37 wherein said shaker bars are provided with V-members, and wherein said means for supporting said support frame means includes a pair of studs, said studs being disposed in V-members.

39. An arrangement according to claim 38 wherein said support frame means further includes a bi-partite cylindrical platform, the first part of said platform being fixed to said support frame means, the second part of said platform being loosely connected to said support frame means by pin screw means thereby facilitating gripping of said support frame means by said electromagnetic head.

40. An arrangement according to claim 3 further comprising support cross-members provided on said alined treatment stations for said shaker bars, each of

said cross-members being provided with shaker bar guide means for guiding said shaker bars.

41. An arrangement according to claim **40** wherein said shaker bar guide means includes a bushing and a roller disposed in said bushing upon which said shaker bars rest.

42. An arrangement according to claim **41** wherein said alined treatment stations are disposed in abutting relationship and wherein said support cross-members are blocked on said treatment stations by flanged clevis means.

43. An arrangement according to claim **42** wherein said clevis means are fixed on said cross-member and said flanges are fixed under contiguous edges of said treatment stations, and wherein jack screws are provided on said cross-member bearing against the top edges of said treatment stations thereby obtaining a perfect horizontal level of said shaker bars.

44. An arrangement according to claim **3** wherein said shaker bars consist of a plurality of hollow elements and fish plate means are provided inside of said hollow elements for interconnecting contiguous ends of said elements, said fish plate means secured to said contiguous ends of said elements.

45. An arrangement according to claim **2** wherein said shaker control station includes a first shaft; eccentric cam means disposed on said shaft; means for reciprocating said shaker bars; and means for synchronizing the reciprocating movement of said shaker bars.

46. An automatic arrangement for treatment of objects comprising: a plurality of alined treatment stations including a loading station and a shaker control station disposed at respective ends of said alined treatment stations, said loading station enabling the supplying of support frame means for carrying the objects to be treated, said shaker control station including a pair of parallely disposed shaker bars and means for actuating said shaker bars, said shaker bars operatively interconnecting said loading station and said shaker control station; a roller track disposed parallel to said aligned treatment stations; at least one mobile unit means for transferring the objects to be treated; means for intermittently moving said mobile unit means on said roller track, said mobile unit means transferring said support frame means loaded with objects to be treated from one treatment station to another, said means for intermittently moving said mobile unit includes at least one chain means disposed proximate to said alined treatment station, said mobile unit means being moved along a predetermined portion of said chain means; said shaker control station includes a first shaft; eccentric cam means disposed on said shaft; means for reciprocating said shaker bars; and means for synchronizing the reciprocating movement of said shaker bars, said first shaft of said shaker control station is driven by a brake motor and reduction gear means, said reciprocating movement being effected in the longitudinal axis of the shaker bars, and logic means for controlling said brake motor to selectively stop said reciprocating movement of said shaker bars.

47. An arrangement according to claim **46** wherein said plurality of alined treatment stations include a plurality of vats for bath treatment of the objects.

48. An arrangement according to claim **47** wherein said shaker control station includes a second shaft, said second shaft driving a flange provided with lug means; and wherein a proximity detector means is provided for checking the middle portion of the reciprocating movement of said shaker bars.

49. An arrangement according to claim **1** wherein said plurality of alined treatment stations include a plurality of vats for bath treatment of the objects.

50. An automatic arrangement for treatment of objects comprising: a plurality of alined treatment stations including a loading station and a shaker control station disposed at respective ends of said alined treatment stations, said loading station enabling the supplying of support frame means for carrying the objects to be treated, said shaker control station including a pair of parallely disposed shaker bars and means for actuating said shaker bars, said shaker bars extending between said loading station and said shaker control station; means provided at said shaker control station and said loading station for movably supporting the respective ends of said shaker bars; a roller track disposed parallel to said alined treatment station; at least one mobile unit means for transferring the objects to be treated; means for intermittently moving said mobile unit means on said roller track, said mobile unit means transferring said support frame means loaded with objects to be treated from one treatment station to another; said means for actuating said shaker bars including means for synchronizing the shaking of said pair of shaker bars, and means connected with said means for synchronizing for shaking said pair of shaker bars in a direction orthogonal to the respective axis of said shaker bars.

51. An automatic arrangement for treatment of objects comprising: a plurality of alined treatment stations including a loading station and a shaker control station disposed at respective ends of said alined treatment stations, said loading station enabling the supplying of support frame means for carrying the objects to be treated, said control station including a pair of parallely disposed shaker bars and means for actuating said shaker bars, said shaker bars operatively interconnecting said loading station and said shaker control station; a roller track disposed parallel to said alined treatment station; at least one mobile unit means for transferring the objects to be treated; means for intermittently moving said mobile unit means on said roller track, said mobile unit means transferring said support frame means loaded with objects to be treated from one treatment station to another; said shaker control station including a first shaft, eccentric cam means disposed on said shaft, means for reciprocating said shaker bars, and means for synchronizing the reciprocating movement of said shaker bars; said first shaft of said shaker control station is driven by a brake motor and reduction gear means, said reciprocating movement being effected in the longitudinal axis of said shaker bars, and logic means for controlling said brake motor to selectively stop said reciprocating movement of said shaker bars.

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