Sept. 17, 1963 C. C. VOULTON-BAUDIN 3,104,180

APPARATUS FOR SEQUENTIALLY VAPOR METALLIZING A NUMBER OF ARTICLES IN A BELL UNIT

Filed June 29, 1960 4 Sheets-Sheet 1

FIG. 2

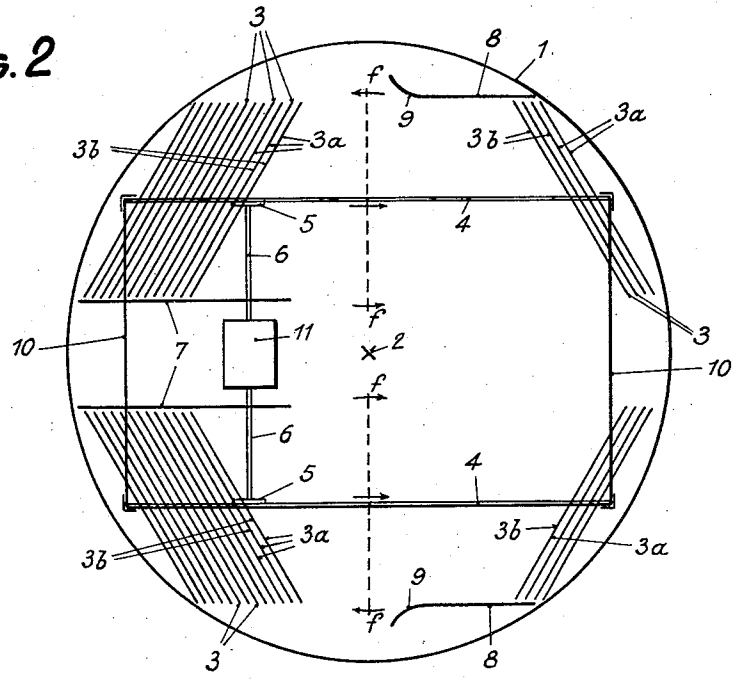
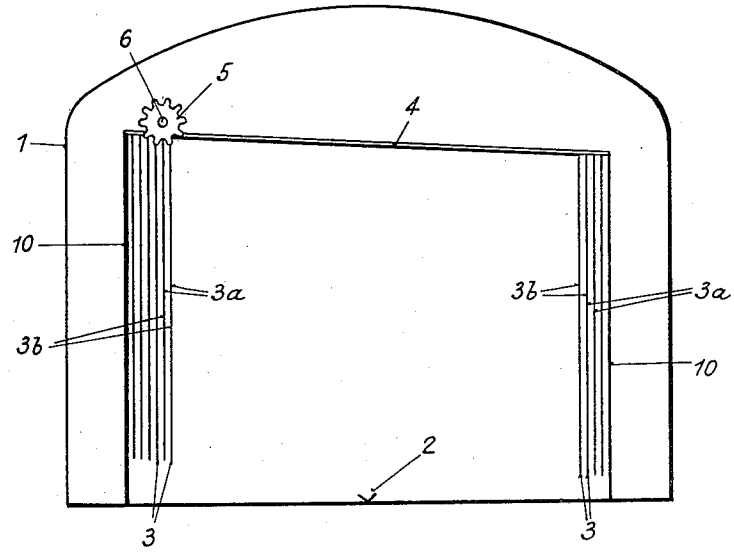


FIG. 1



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FIG. 3

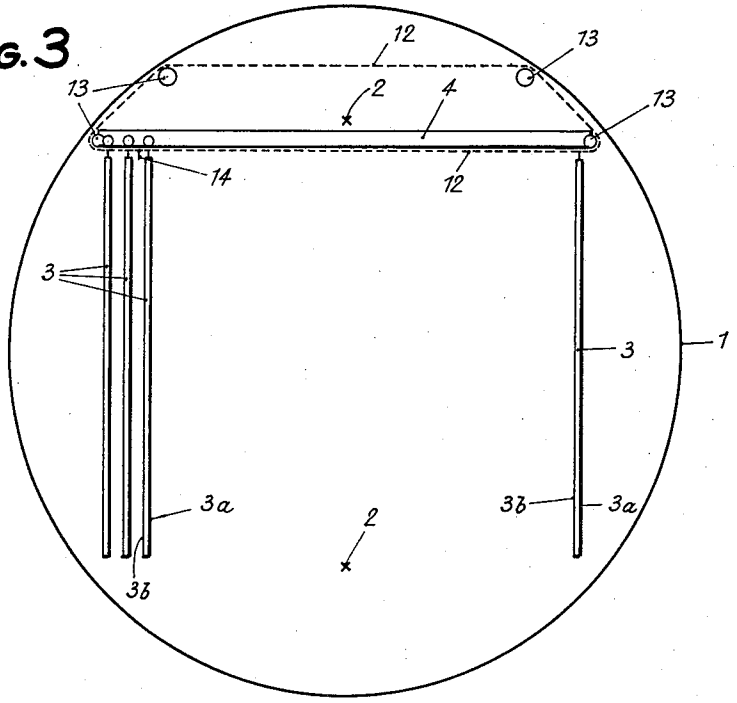
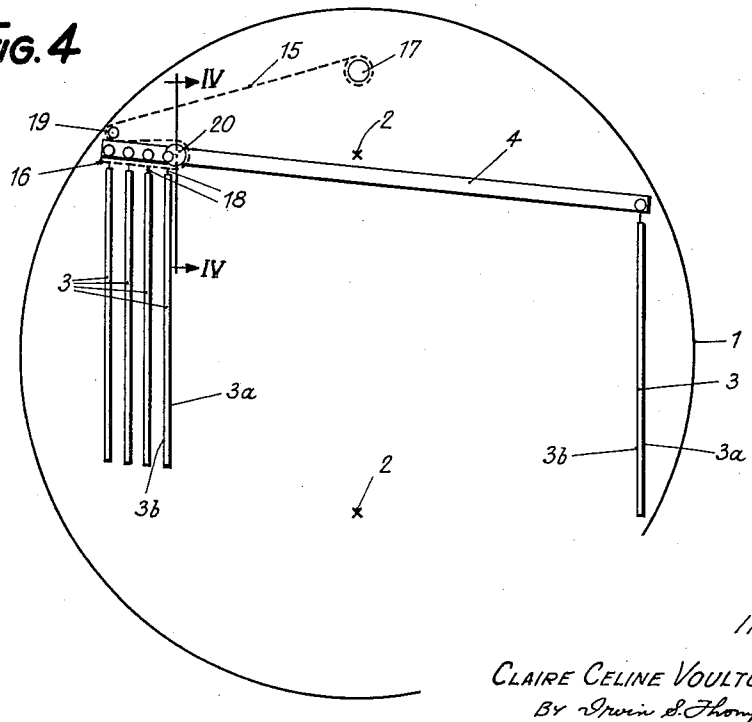


FIG. 4



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FIG 4a

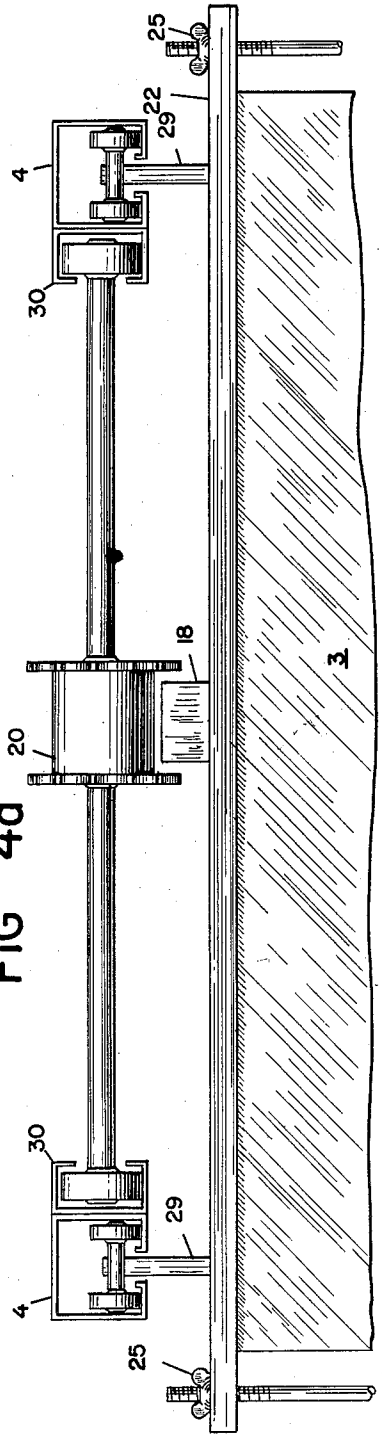


FIG 8

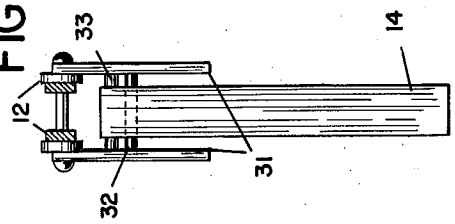
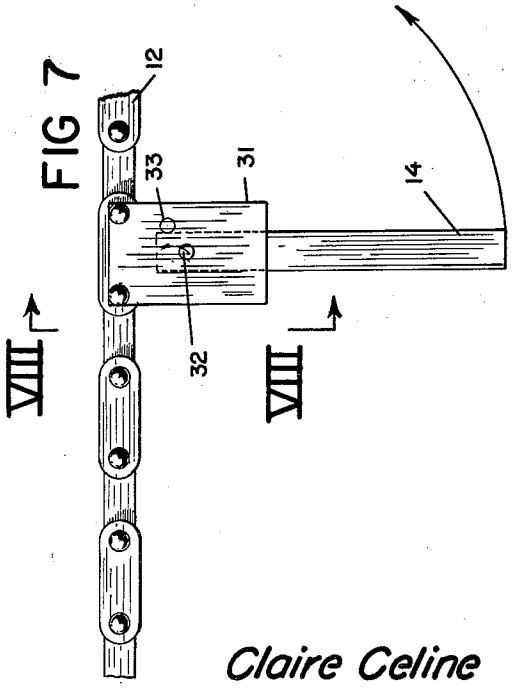


FIG 7



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APPARATUS FOR SEQUENTIALLY VAPOR METALLIZING A NUMBER OF ARTICLES IN A BELL UNIT

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FIG. 5

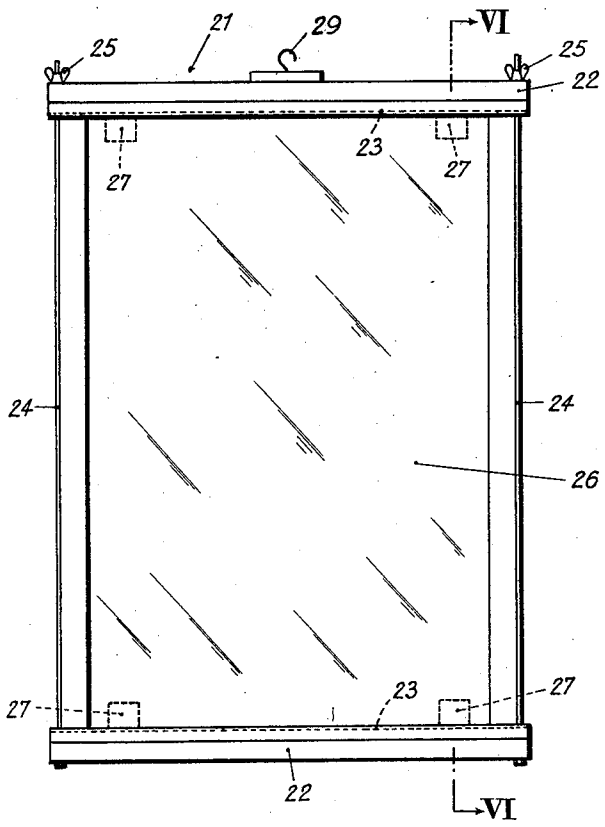
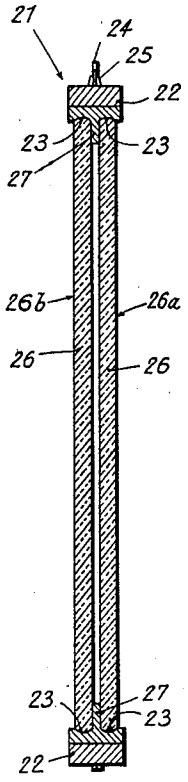


FIG. 6



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United States Patent Office 3,104,180 Patented Sept. 17, 1963

3,104,180
APPARATUS FOR SEQUENTIALLY VAPOR METALLIZING A NUMBER OF ARTICLES IN A BELL UNIT

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Claims priority, application France July 2, 1959
13 Claims. (Cl. 118—49)

The present invention relates to a mechanical device specially adapted for the equipment of bell units for heat evaporation under vacuum utilized for coating and more particularly for metallizing the surface of miscellaneous articles or objects such as plate-like articles like reflecting mirrors.

Such bell units constitute a tight enclosure in which a high degree of vacuum is produced and wherein an evaporable source (generally of metal) is placed for sending its molecules in all directions along rectilinear paths.

In view of metallizing the articles to be treated, the walls of the bell unit are generally clad with said articles, the arrangement being such as to cluster the maximum number of such articles in the minimum of space but care should be taken that no article overlaps or covers another article and forms a screen in front of it. In order to meet such a requirement, it often happens that the industrial output of such a bell unit is not satisfactory particularly when fairly large surfaces such as those of reflecting mirrors have to be treated or metallized.

An object of the invention is to provide a device for solving the aforesaid technical problem wherein far from so arranging the articles to be treated that none of them form a screen in front of others, said articles are arranged in superimposition in the bell unit in the form of one or several stacks, and after having received the metallizing treatment during the desired period, each article is so arranged as to be displaceable for unmasking the following article, the latter being then exposed in turn to the treatment.

Another object of the invention is to provide a semi-continuous manufacturing process which permits the overall output of the bell to be increased, said device being so constructed that the articles to be treated are so arranged that they can be mechanically displaced for being successively exposed to a metallizing or other treatment, said articles being held in supporting elements arranged for undergoing successive displacements and built so that nothing forms a screen in front of said articles, the articles being for example held by being clamped in the supporting elements.

The supporting elements and the articles to be treated are vertically disposed for that purpose and are suspended by roller bearings on rails in order to roll along said rails from one end to the other. These rails may extend horizontally. Alternatively they may be slightly inclined.

In the former case (where the rails extend horizontally) the elements are suspended and stacked on a portion of the rail or rails and an endless chain is provided which moves around sprocket pulleys and runs parallel to the rails, said chain being provided with a stud or peg capable of rocking by 90° on its axis, whereby when a reciprocatory motion is imparted to said chain, said stud or peg moves a suspended element and causes the same to roll along the rail or rails from one side to the other side of the enclosure, then rolls back and collapses and so forth until all the articles have successively moved from one side to the other side and have been metallized in turn.

In the latter case (where the rails are inclined) a primary method for obtaining the sought result utilizes a toothed wheel fast upon an axis extending horizontally

and at right angles to each inclined rail, said wheel retaining the stacked elements and sequentially releasing them, each element being released only when the preceding element has reached the end of the inclined rail from which it is suspended.

In the aforesaid latter case i.e. when inclined rails are resorted to and according to a possible modification, use is made of a chain held in tightened condition parallel to the rails one end of which is stationary while its other end is wound around a winch drum, the chain links having fixed pegs tucked thereinto and respectively associated with each suspended element. As the chain is wound on the winch drum, each element is successively released and runs successively by gravitational action to the lower end of the rails, whereafter they are treated e.g. metallized.

A further object of the invention is to provide a device as aforesaid wherein the stacked supporting elements may be held by side guides arranged for so directing them as to expose one of their faces to the spray formed by the molecules of the heated metal source, whereafter their opposite face is in turn exposed after each element has undergone a translational movement and has been rocked back due to the action of a ramp provided on said side guides.

A still further object of the invention is to provide a device as aforesaid wherein the supporting elements receiving the articles to be treated are constituted by frames on which said articles are clamped in position and are arranged either singly if both their faces require to be metallized or in back to back relation if one of their faces only requires to be metallized as is the case with reflecting mirrors.

With these and such other objects in view as will incidentally appear hereafter, the invention comprises the novel construction and combination of parts that will now be described with reference to the accompanying diagrammatic drawings exemplifying the same and forming a part of the present disclosure.

In the drawings:

FIGURE 1 is a diagrammatic elevational view showing the device according to the invention, assuming the rails to be inclined and a toothed wheel being used, no matter whether the cylindrical tight enclosure has a vertical or a horizontal axis, the shape of the illustrated bell unit being merely conventional.

FIGURE 2 is a diagrammatic plan view showing a plant incorporating the device according to the invention, said plant including a vacuum bell unit having a vertical axis, inclined rails and toothed wheels.

FIGURE 3 is a view similar to FIG. 2 showing a plant including a bell unit having a horizontal axis, horizontal rails and an endless chain.

FIGURE 4 is a diagrammatic view showing in elevation another device in the case of a plant including a bell unit having a horizontal axis, inclined rails and a chain engaged around a winch drum.

FIGURE 4*a* is a sectional view along the line IV—IV in FIGURE 4.

FIGURE 5 is a detail elevational view showing one of the elements adapted to maintain the articles to be treated in back to back relation when said articles are mirrors whose reflecting surfaces require to be metallized.

FIGURE 6 is a sectional view along the line VI—VI of FIG. 5.

FIGURE 7 is an enlarged view showing the pivoted catch of FIG. 3.

FIGURE 8 is a view along lines VIII—VIII of FIG. 7.

The plant or installation shown in FIG. 1 comprises a bell unit 1 which may have a vertical or a horizontal axis and which forms a tight enclosure inside which a

high degree of vacuum is maintained. One or several sources of metal **2** adapted to be heated for producing a spray of metal molecules are arranged at suitable positions of the bell unit whereby, during the entire duration of the evaporation, metal molecules are emitted in all directions along rectilinear paths toward elements **3** which support in the present instance flat articles such as mirror blanks the surfaces of which are to be rendered reflective. The supporting elements **3** which form a part of the device according to the invention are suspended from slightly inclined overhead rails **4** (see FIG. 1) so that due to gravitational action they roll down from the upper end to the lower end of such rails. Owing to this arrangement, it is first the face **3***a* of each article which is exposed to the emission of molecules from the heated metal source **2**, whereupon, after each article has run under its own weight along the inclined rails **4**, it is the face **3***b* of said article which in turn undergoes the treatment, no matter whether the faces **3***a* and **3***b* belong to one and the same article to be treated or to a pair of separate articles arranged in back to back relation.

One or several toothed wheels **5** fast upon a horizontal axis **6** extending at right angle to the rails **4** and revolved by a motor **11**, FIGURE 2 (not visible in FIG. 1) which may be situated inside or outside the bell unit **1** hold the articles in stacked formation and during their rotation release the elements **3** one after the other, each one of said elements being only released when the preceding element has reached the end of the inclined rail **4**.

For that purpose, each element comprises at its upper part a stationary pin **18** which can engage a toothed wheel, thereby hindering said element from rolling down the rail until the toothed wheel, while rotating, releases the pin **18** and permits the element to roll down owing to its own weight.

The rotational speed of the toothed wheel and the slope of the rail are such that the toothed wheel allows more time for releasing one element than the former element needs for rolling down to the lower end of the inclined rail, so that all the elements introduced into the bell and stacked at the upper end of the rail are successively and automatically shifted and exposed one after the other to the evaporation zone according to a regular and predetermined rhythm.

If the enclosure is in the shape of a cylinder having a vertical axis, the possibility is afforded, as shown in FIG. 2, to arrange the supporting elements **3** between side guides **7**, **8** adapted to direct said elements **3** toward the source of heated metal for exposing their faces **3***a* to the required treatment, while their other face **3***b* is exposed to said treatment following a translational and pivotal movement of the elements in the direction indicated by the arrows *f* responsive to the gravitational action caused by ramps **9** provided on the side guides **8**.

In the plant or installation shown in FIG. 3, the supporting elements **3** are suspended by roller bearings from horizontal rails **4** and are mechanically driven by an endless sprocket chain **12** which runs parallel to the rails **4** throughout their length, said chain passing over sprocket pulleys **13**. The endless chain **12** may receive from the outside a reciprocatory motion and is provided at a suitable position with a pivoted catch **14** adapted to rock by 90° in one direction only, for instance, in counterclockwise direction in FIGURE 3, so as to cause its translational motion from the left to the right to take with it the suspended element **3** situated in its path, while moving from the right to the left said catch **14** is withdrawn until it assumes the position permitting it again to drive with it from the left to the right another suspended element **3** and so forth, thereby ensuring the successive translational motion of the suspended elements **3** from one side to the other side of the enclosure **1**. This permits the faces **3***a* and **3***b* to be successively treated owing

to the evaporation of the metal in spray form from the metal sources **2**. As shown in FIGS. 7 and 8 catch **14** is pivotally mounted at **32** between supports **31** which are mounted on chain **12**. The catch **14** rotates counterclockwise upon engaging an element **3** when chain **12** is moved from right to left. When chain **12** is moved from left to right, catch **14** abuts against abutment **33** mounted in supports **31** and carries an element **3** across enclosure **1**.

A dual mechanism of this type may be provided for ensuring on the one hand the successive translational motion of the supporting elements **3** from one side to the other side of the enclosure **1** for exposing them to a magnetic field and on the other hand their successive translational motion in the other direction for exposing them to the evaporating treatment.

In the plant or installation shown in FIG. 4, the same result can be obtained by different means to which preference may be given in some cases. According to this constructional modification, the supporting elements **3** are suspended from inclined rails **4** and are caused owing to their own weight to roll along these rails from one end to the opposite end. A sprocket chain **15** one end of which is secured at a position **16** while its other end is wound upon a winch drum **17** holds all the suspended elements **3** on the upper portion of the inclined rails **4** owing to the provision of pegs or studs **18** respectively provided on each of the elements **3** and which become tucked into the links of the chain **15**. The latter is driven about a stationary sprocket pulley **19** and a movable sprocket pulley **20** the axis of which may be guided by rollers rolling on a pair of rails **30** extending parallel to the rails **4** (FIGURE 4*a*). As it is being wound, the chain **15** has a tendency progressively to bring the movable pulley **20** nearer to the stationary pulley **19**, thus sequentially releasing each suspended element **3** which as it is driven gravitationally runs towards the lower portion of the inclined rails **4**.

The articles to be treated may be received in frame members **21** (see FIGS. 5 and 6) constituted by a pair of cross members **22** having recesses **23** permitting said articles to be held by a clamping action by means of screwed rods **24** and nuts **25**, said articles being for example mirrors **26** arranged in back to back relation. Wedges or shims **27** are provided between each pair of mirrors **26**. A hook **29** permits each frame member **21** to be suspended from a small carriage or trolley or from a roller movable on a rail **4** (FIG. 4*a*). Owing to these frame members, the face **26***a* of one of the mirrors **26** is first exposed to the treatment, whereafter the face **26***b* of the other mirror is exposed to said treatment after a translational movement without any object blanking or screening the same off.

It will be seen from the foregoing that the device according to the invention permits articles such as mirrors arranged in superimposed relation in the bell unit and forming one or several stacks to be treated in a semicontinuous manner, the number of stacks being variable, each mirror or like article being in turn and during a predetermined duration exposed to the treatment without risking to be blanked off by another article in front of it.

Minor constructional details of the device may be varied without departing from the ambit of the invention and the scope of the subjoined claims. Moreover the shape of the bell unit **1** shown in the drawings is purely conventional and might be different.

What is claimed is:

1. In a bell unit for heat evaporation under vacuum for the treatment of sundry articles, for example for metallizing the surfaces of reflecting mirrors, displaceable means by which said articles arranged in stacked formation are so mechanically shifted as to expose them successively to the treatment without any article being blanked off by another one during the duration of the exposure to the treatment, said means including upstanding stacked

supporting elements for holding said articles, slightly inclined rail means from which said articles and said displaceable means are suspended so that their own weight causes them to roll from one end to the other end of said rail means, a revoluble toothed wheel fast upon a horizontal axis and extending at right angles to said rail means for holding the supporting elements, and means connected to said horizontal axis for driving said toothed wheel for releasing said supporting elements successively, each element being only released when the preceding element has reached the end of the inclined supporting element from which it is suspended.

2. In a bell unit for heat evaporation under vacuum of a metal for the treatment of sundry articles, for example for metallizing the surfaces of reflecting mirrors, displaceable means by which said articles arranged in upstanding stacked formation are mechanically shifted so as to expose them successively to the treatment without any article being blanked off by another one during the exposure to the treatment, said means including upstanding stacked supporting elements holding said articles, slightly inclined overhead rail means from which said supporting elements and the articles held thereby are suspended so that by gravitation they roll down from the upper end to the lower end of the rail means, at least one revoluble toothed wheel fast upon a horizontal axis mounted at right angles to the rail means and cooperating with said elements, and power means for intermittently rotating said wheel for releasing said elements one by one to roll down said rail means.

3. In a bell unit for heat evaporation under vacuum of a metal for the treatment of sundry articles, for example for metallizing the surfaces of reflecting mirrors, displaceable means by which said articles arranged in upstanding stacked formation are mechanically shifted so as to expose them successively to the treatment without any article being blanked off by another one during the exposure to the treatment, said means including upstanding stacked supporting elements holding said articles, substantially horizontal overhead rail means from which said supporting elements and the articles held thereby are suspended, reciprocative endless chain means having a pivotal catch engageable with the respective elements, and power means for actuating said chain means and sequentially moving each element from one position to another position along said rail means in the bell unit.

4. In a bell unit for heat evaporation under high degree vacuum of a metal for the treatment of sundry articles, for example for metallizing the surfaces of reflecting mirrors arranged in upstanding stacked formation, upstanding stacked supporting elements having clamping frame members for holding said articles, side guides associated with said elements, ramps on said guides, overhead rail means extending across the bell unit and from which said elements are suspended, means including driving abutments and pegs on said elements for shifting the latter one by one from one position to another along said rail means in the bell unit, said means comprising a movable chain, and power means including a winch on whose drum said chain is intermittently wound for being driven thereby and for shifting said supporting elements and the elements being treated held therein.

5. A device for vapor metallizing articles under vacuum comprising a bell unit, metallizing means disposed in said bell unit for applying a deposit of metal on said articles, rail means mounted in said bell unit in a substantially horizontal manner, supporting elements for supporting the articles to be metallized movably mounted on said rail means for causing said supporting elements to be said rail means causing said supporting elements to be shifted one at a time from one end of said rail means to the other end so that said articles are metallized therealong by said metallizing means.

6. A device according to claim 5 in which said rail means are mounted in an inclined manner, said supporting elements are stacked at the upper inclined end of said rail means, and said operating means consist of holding and releasing means to hold the stacked supporting elements in their stacked position and release said supporting elements one at a time so that said supporting elements slide down said rail means under their own weight.

7. A device according to claim 6 in which said holding means comprises a stationary pulley mounted adjacent said rail means, a movable pulley mounted on said rail means, a chain having one end secured to said rail means and passing over said pulleys, the other end of said chain connected to a winch, operating means to take up said chain to move said movable pulley along said rail means, and said releasing means comprises pins mounted on said supporting elements which are engaged by said chain and individually released thereby when said movable pulley is moved along said rail means opposite the direction which said supporting elements move as the articles supported thereon are being individually metallized.

8. A device according to claim 6 in which said holding and releasing means comprises a driven toothed wheel mounted on said rail means, means to drive said toothed wheel along said rail means, pins mounted on said supporting elements which are engaged by said toothed wheel thereby individually releasing said supporting elements when said toothed wheel is moved along said rail means in a direction opposite the direction said supporting elements move during metallization of the articles supported thereon.

9. A device according to claim 5 wherein said rail means are horizontally disposed, said operating means comprises pulleys mounted on each end of said rail means, an endless chain mounted on said pulleys having means to drive said chain in both directions, catch means pivotally mounted on said chain, said catch means when said chain moves in one direction being pivoted by said supporting elements and when said chain moves in the other direction said catch means engages said supporting elements to move said supporting elements one at a time along said rail means from one end to the other end thereof.

10. A device according to claim 5 in which said supporting elements are pivotally mounted on said rail means, guiding means provided in the path of the vertical edges of said supporting elements for pivoting them as they are moved from one end of said rail means to the other end.

11. A device according to claim 5 in which said supporting elements consist of frames in which the articles to be metallized are clamped therein.

12. A device according to claim 11 in which each frame carries a single article which is to be metallized on both surfaces.

13. A device according to claim 11 in which each frame carries two articles to be metallized, wedges mounted on said frames so that said articles are mounted in said frames in back-to-back relation whereby only one surface of each article is metallized.

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