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APPARATUS FOR PRODUCTION OF MIRRORED SURFACES

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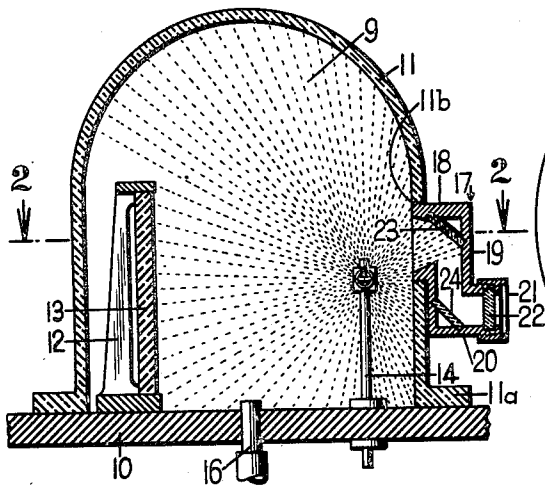


Fig. 1

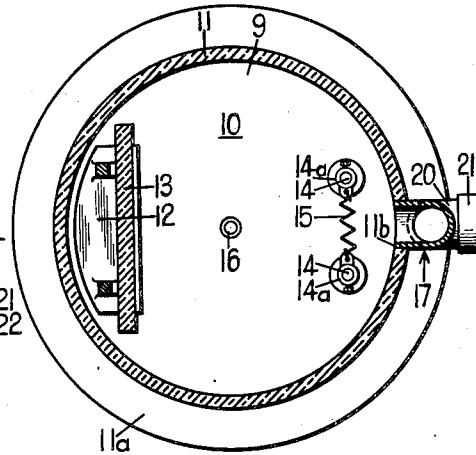


Fig. 2

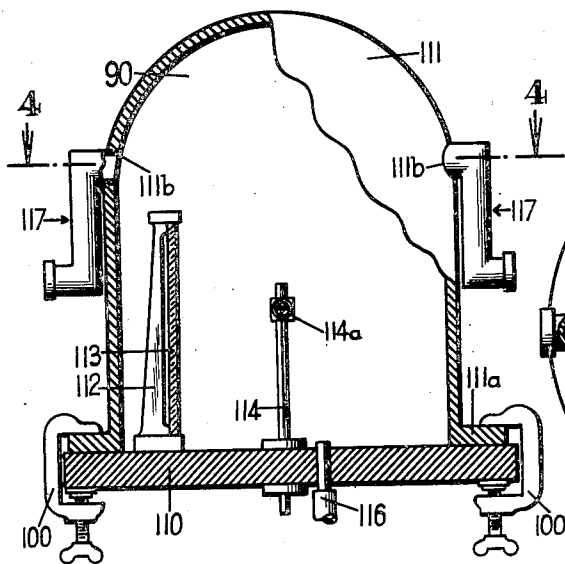


Fig. 3

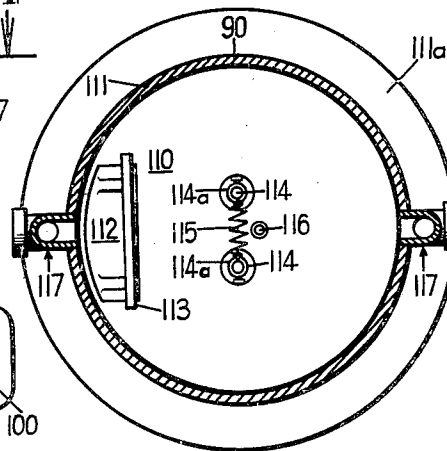


Fig. 4

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APPARATUS FOR PRODUCTION OF
MIRRORED SURFACES

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8 Claims. (Cl. 91—12.2)

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The present invention relates to the apparatus for production of mirrored surfaces. It has to do particularly with an apparatus or device for applying reflective coatings or other coatings by deposition in a vacuum chamber to a surface or surfaces of an article or articles such as plate glass, metal or the like, and to such an apparatus having incorporated therein and forming a part thereof, means for permitting the visual inspection or observation of the article or articles being coated.

According to the prior art practices, articles have been coated by deposition while positioned or located within a vacuum chamber and various means have been employed, such as photo-electric cells and kindred apparatus or equipment for the purpose of apprising the operator of the progress of the coating by deposition action. Such means have been required since, regardless of the fact that the vacuum chamber was formed by means of an initially transparent glass bell-jar sealingly mounted upon a suitable supporting base, the particles of coating material being diffused or spread and deposited within the chamber settled, not only upon the article to be coated, but also upon the inner walls of the bell-jar, rendering said walls opaque or non-transparent, making it impossible, after the initial action, to view the progress of the work being done from the exterior of the chamber. Thus, the work was done in the dark, so to speak, it being impossible for the operator to view the work and determine the progress of the coating. This could be determined only after the operation had been completed and the work removed from the apparatus.

Previously employed apparatus for checking the progress of the coating by deposition action, such as the photo-electric bell equipment mentioned above, was expensive and greatly increased the cost of the coating apparatus and the process or method of coating the articles.

In accordance with the present invention, I have provided convenient and relatively inexpensive apparatus whereby to permit the coating by deposition of articles whose surfaces are to be mirrored within a highly vacuumized chamber, such apparatus being provided with improved means permitting the visual observation at all times of the article or articles being coated without the danger of said means having its visibility obstructed or blotted out and rendered ineffective during the action of deposition. In other words, by virtue of my invention, the operator can see the work at all times and can thus deter-

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mine whether or not the apparatus is functioning correctly to provide the desired coating.

Generally speaking, the improved apparatus of my invention comprises a dome-like housing such, for example, as a bell-jar which may be formed from any suitable material, such as metal or glass or other transparent or non-transparent material, which is sealingly mounted upon a supporting base or surface to provide a chamber or compartment from which the air may be completely evacuated to produce in said chamber an extremely high vacuum, a support or series of supports located within the chamber and preferably mounted upon the supporting base for holding or supporting articles, such as pieces of glass, or other material, the surfaces of which are to be coated or made reflective, or provided with a low reflection coating, an electric resistance element or elements located within the chamber and supported in suitable and convenient manner above the supporting base for the purpose of dispelling or dispersing and applying, by deposition, a coating of some suitable metal such, for example, as silver, chromium, aluminum, gold, copper, selenium, or the like, or any two or more of these metals, to a surface or surfaces of said articles, said housing being provided with means for permitting the visual observation at all times of the article or articles within the compartment whereby to check and determine the progress of the coating being deposited upon the articles.

One of the objects of my present invention is to provide an apparatus of the foregoing character which is of relatively simple construction, eliminates the use of a photo-electric cell, is relatively inexpensive to manufacture, one which is capable of producing mirrored or other coated surfaces of superior quality quickly and efficiently, and one in which it is possible to observe the progress of the coating action at all times from the exterior of the apparatus.

Another object of the present invention is to provide an improved apparatus of the foregoing character having improved means permitting the visual inspection of the articles being coated by deposition to determine whether or not the apparatus is functioning properly, in which said means has a portion thereof located in the range of the metal being deposited on the articles and at large within the compartment whereby a clear and unimpaired vision of the interior of the apparatus may be had and is maintained at all times.

A further object of my invention is to provide improved visibility or inspection means for an

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apparatus of the foregoing character, which means is of simple construction, is attached to and forms a part of the dome-like housing and whose function, operation and general appearance are generally similar to those of a periscope.

Another object of my invention is to provide improved means or an improved apparatus permitting the operator to see the operational details taking place within the chamber of the apparatus and thus avoid any waste of time resulting from an imperfect product as the result of improper functioning or failure of the apparatus.

The above and other objects and advantages of my invention will appear from the following description and appended claims when considered in conjunction with the accompanying drawing forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

In said drawing:

Figure 1 is a vertical sectional view showing one embodiment of an apparatus embodying the present invention.

Figure 2 is a horizontal sectional view taken substantially along the line 2—2 of Figure 1, looking in the direction of the arrows.

Figure 3 is a vertical sectional view, partly in elevation, and partly broken away, showing a somewhat modified embodiment of my invention; and

Figure 4 is a horizontal sectional view taken substantially along the line 4—4 of Figure 3, looking in the direction of the arrows.

Before explaining in detail my present invention it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawing, since the invention is capable of other embodiments and of being practiced or carried out in various ways. It is to be understood also that the phraseology or terminology employed herein is for the purpose of description and not of limitation, and it is not intended to limit the scope of the invention claimed herein beyond the requirements of the prior art.

Referring now particularly to Figures 1 and 2 of the drawing, there is shown, by way of example, an apparatus embodying the present invention, in one of its forms.

As shown, the apparatus of Figures 1 and 2 comprises a supporting base or surface 10 whose top or upper surface is preferably ground, polished and lapped to receive and supports a similarly ground, polished and lapped surface of a peripheral flange or outward projection 11a formed on the bottom or lower end of a dome-like housing or shell 11. If desired, the housing 11 may be a bell-jar formed from glass or other suitable transparent or non-transparent material. By having the adjacent surfaces or faces of the supporting base member 10 and the external flange 11a ground, polished and lapped, it will be understood that these abutting surfaces provide an air-tight joint between the base and the housing and that the housing thus provides a sealed compartment or chamber 9 within which the coating of articles by deposition takes place.

Located on the top surface of the supporting base 10, as shown, is a suitable support 12 provided for the purpose of supporting an article to be coated by deposition, such as a piece of clear glass, metal, or the like 13. The support 12 and its supported article 13 are, as shown, located adjacent the inner surface of one of the dome-

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like housing walls. Located adjacent an opposite wall and also supported by the base 10 is a pair of electric filament supports 14 for the purpose of supporting at or adjacent their upper ends a filament 15. The position of the filament or radiating element 15 may be varied with relation to the supporting base 10, if desired, by virtue of vertically adjustable supporting members or blocks 14a which are adjustably connected to the filament-supporting members 14 in any suitable manner. The filament 15 is preferably formed from tungsten wire in the form of a coil to which has been previously applied a suitable metal, such as aluminum, or any of the other metals referred to above, so that when the filament is energized, the evaporation of the coating metal applied thereto will take place. It will be understood that the filament 15 is suitably electrically connected to a source of current supply in any conventional manner.

Prior to the operation of depositing metal from the filament 15 onto a surface or surfaces of the article 13, the chamber 9 provided by the housing and supporting base is completely and entirely evacuated of air, a suitable pump (not shown) being connected in any suitable manner to an outlet pipe or conduit, shown as a whole at 16 and located, for convenience, as shown, at substantially the center of the supporting base 10 and being in communication with the chamber 9 above the base. The pump is actuated so as to create an extremely high vacuum within the chamber.

One wall of the housing 11 is preferably provided with a hole or opening 11b which, as shown, is disposed substantially in line horizontally with the filament 15 although, if desired, the hole or opening 11b may be disposed within the wall at any suitable or desirable level with relation to the filament and supporting base 10. Since, when the generation of heat occurs in the filament 15, the metal originally deposited on the filament is evaporated and diffused and deposited upon the exposed surface or face of the article 13 and is also dispersed or diffused in all directions within the chamber 9, it will be understood that the inner surfaces of the walls of the housing 11 will be likewise coated by deposition. Heretofore, sight openings have been provided in a wall of the housing for the intended purpose of permitting the visible inspection or observation of the work pieces within the chamber to determine the progress of the deposition of metal thereupon. However, as the action of deposition occurs, such sight openings have become likewise coated with the diffused substance or substances, rendering the interior of the housing invisible.

In accordance with the present invention, I have provided improved clear vision inspection means shown as a whole at 17, adapted to be associated with the housing 11 and particularly with the opening 11b formed in the housing wall which cannot be rendered incapable of permitting the visual observance of the interior of the housing. Such means, as shown merely by way of example, comprises a relatively small casing having an inwardly extending offset horizontal upper portion 18 adapted to be sealingly connected to the housing 11 and fitted within the opening 11b, a depending preferably tubular portion or extension 19 and an outwardly projecting substantially horizontal lower portion or extension 20. The outer end portion of the extension 20 is provided with a lens or clear glass peep-sight 22 which is held in place by a securing or

clamping ring or the like 21. Disposed at an angle within the upper end of the member 17 and fitting within a suitable recess formed in the portions 18 and 19, is a primary mirror or reflector or glass member 23. A somewhat similar secondary mirror or reflector 24 is angularly disposed at the juncture of the upright and transverse walls of the portions 19 and 20, respectively. Thus, it will be seen that by looking through the lens 22 the reflection of the article or object, such as the work piece 13, and of the filaments and general interior, can be seen in the mirror or reflector 24.

It is to be noted that as the particles of metal are dispersed or diffused by the coil 15 during the deposition process, some of these particles will be deposited upon the upper mirror or other reflective surface 23, as clearly seen in Fig. 1. It is to be noted further, however, that the second mirrored surface 24 is disposed at the lower end of the portion 19 of the sight or inspection device and out of range of the metallic particles being thrown off or dispersed by the coil 15. Likewise, the lens 22 or peep-sight is located well out of range of the particles of metallic substance being dispersed and thus will remain clear and unobstructed at all times permitting visual observation of the interior of the housing at all times.

The deposition of metallic particles upon the mirror or other surface 23 or even upon the second mirror 24 would continue to offer reflective characteristics with these members and would in no wise interfere with the perfect visibility of the interior of the housing. The original reflectivity of mirror 23 will depend upon the original mirror coating thereon, this being about 95% if silver and if a plain glass is used as 23 the original reflectivity will be something above 4%. As deposition proceeds the reflectivity of mirror 23 will change and approach that of a coating of the material being deposited, for example, 89% in depositing aluminum and somewhere between 95% and 5% in depositing magnesium fluoride or other low reflection or semi-transparent materials.

By virtue of the foregoing structure, it will be seen that the dome-like housing may be formed of any suitable material and regardless of the quantity of metal deposited upon its inner wall surfaces, the interior of the housing will be visible at all times, thus permitting an accurate inspection and check on the progress of the deposition of metal and other essential operations to produce the reflective surface coatings on the articles located within the chamber.

In Figures 3 and 4 I have shown a somewhat modified embodiment of my present invention in which, as shown, the base 110 is provided with a similar dome-like housing or shell 111 having an external out-turned flange 111a whose outer surface rests upon the adjacent surface of the supporting base 110. The engaging surfaces of the base and flange are preferably ground, polished and lapped so as to provide a tight fit and seal between the casing 111 and the supporting surface 110. If desired, and to enhance the tight joint or seal between the parts, a plurality of suitable clamping devices, such as those shown at 100, may be provided.

In the present form of my invention, as shown, I have provided an article support 112 similar to the support 12 of the preceding form of the invention. As best seen in Figure 4, this support is preferably arranged adjacent the inner wall surface of the dome-like shell or housing 111. The

support is adapted to receive and support an article 113, such as a piece of glass or the like whose surface is to be coated. In the present form of the invention I have provided, as shown, a pair of filament-supporting means or posts 114 similar to those of the preceding form for the purpose of supporting a substantially horizontally disposed coiled filament or element 115, preferably formed from tungsten wire. As in the preceding form of the invention, the filament 115 is preferably vertically adjustable with relation to the supporting base 110 in the same manner as in the preceding form. Additional supports and filaments may be provided in any suitable arrangement, if desired.

Means for evacuating the air from within the chamber 90 formed by the association of the supporting base and dome-like housing or shell 111, is provided in the form of a suitable outlet pipe or conduit 116 which is attached to a suitable pump (not shown) for the purpose of evacuating the chamber and creating an extremely high vacuum therein.

As shown, I have provided more than one of the clear vision inspection devices for permitting the visual observation of the interior of the apparatus and the work piece at all times. Merely by way of example, I have shown two such devices each of which is designated as a whole at 117. The observation or inspection devices are sealingly applied to suitable openings 111b formed in the walls of the housing 111 and function in the same manner as does the observation device 17 of Figures 1 and 2. The device 117 at the right of Figure 3 permits the ready observation of an article which may be disposed at the opposite side of the housing, whereas the observation device 117 at the left of Figure 3 permits the ready observation of an article which may be disposed at the opposite side of the chamber.

It will be understood that the metal to be dispersed and thus deposited upon articles located within the housings 11 and 111 may be applied to the filaments 15 or 115 in any suitable manner known to the art. They may be dispersed and deposited, for example, by evaporation as shown or by sputtering within a vacuum.

By virtue of the foregoing I have provided an apparatus for forming reflective coatings upon the surfaces of articles which are located in a highly vacuumized chamber and have also provided novel means permitting the progress of the deposition to be observed and checked at all times. Moreover, by virtue of my relatively simple apparatus, I have made it possible to follow the operation of the deposition and check upon its progress from the exterior of the apparatus, thus eliminating certain previously necessary, time-consuming steps according to prior practice, such, for example, as the necessity of breaking the vacuum and removing the housing to permit inspection of the work before its completion, or the necessity of providing the apparatus with expensive means or equipment, such, for example, as a photoelectric cell and kindred mechanism which has been employed in an effort to check the progress of the deposition within the vacuumized chamber. Moreover, work which is not progressing satisfactorily in the apparatus can be quickly detected and time saved by stopping early in such operations, to make the necessary corrections, etc.

While I have described my improved apparatus for use in connection with the coating by

deposition of articles to produce reflective surfaces thereon, it will be understood that the improved clear vision inspection means or device embodying my invention may be applied to and used with any vacuum chamber in which a reflective coating operation or an evaporation of metals or other materials is being performed, wherein the walls of the chamber are opaque or non-transparent, and wherein it is desirable to observe the progress of the operation being performed within the chamber.

Having thus described my invention, what I claim is:

1. An apparatus for depositing a coating of metal upon an article to produce a mirrored surface thereon, said apparatus comprising a vacuum-tight sealed housing, means within said housing for supporting an article to be coated, means communicating with the interior of said housing for evacuating the air therefrom to create a high vacuum therein, electrical means located within the housing in spaced relation to said article support for projecting a coating material onto the article, and means carried by a wall of said housing permitting visual observation at all times of an article carried by said article support from the exterior of said housing, said means comprising a tubular casing having an offset upper end portion sealingly fitted within an opening formed in the housing and a depending portion having an outwardly offset end portion provided with a closed sight opening out of range of the material being deposited and a pair of angularly disposed reflective members mounted in the depending portion of said casing.
2. Apparatus for producing a reflective coating on the surface of articles, comprising a vacuum chamber, and a periscope-like member comprising a casing having a pair of spaced mirrors therein associated with said chamber and having a clear lens providing a sight opening at the outer end of said member, said sight opening and the mirror adjacent thereto being out of range of the material being deposited whereby to provide at all times an unobstructed sight opening permitting visual observation of the article located within the chamber.
3. Apparatus for producing a reflective coating on the surface of an article, comprising a housing providing a sealed chamber in which the article to be coated is located, means located within said chamber for applying a deposit of coating material upon the surface of the article, means for evacuating the air from within the chamber to create a high vacuum therein, and a periscope-like member comprising a casing having spaced mirrors therein, said member being sealingly connected to a wall of said housing and having a clear lens providing a sight opening at the outer end of said member, said sight opening and the mirror adjacent thereto being out of range of the material being deposited whereby to provide at all times an unobstructed sight opening permitting visual observation of the article located within the housing.
4. An apparatus for applying mirrored surfaces to articles, comprising a supporting base, a bell-jar mounted upon said base in sealing relation thereto, a support for an article mounted upon said base adjacent a wall of said bell-jar, electrical

heating means also mounted on said base adjacent an opposite wall of said bell-jar for effecting the deposition of a coating of metal upon a surface of the article, means for evacuating air from within the bell-jar, and means carried by the wall of the bell-jar adjacent said electrical means and in substantial alignment with the article to be coated, said last-named means having a lens-closed sight opening out of range of the material being deposited upon said article whereby to permit the visual observation at all times of the article being coated to determine the progress of the coating operation.

5. An apparatus for applying coating to articles, comprising a closed vacuum chamber within which the articles are coated, said chamber having non-transparent walls one thereof being provided with an opening, and a clear vision inspection device having a portion sealingly mounted within said opening and a depending portion terminating in an offset end portion, a pair of spaced reflectors angularly disposed and mounted in said device, and a lens carried by the offset end portion whereby to permit the observation of articles located within the chamber and reflected by said spaced reflectors.
6. An apparatus for comprising a high vacuum chamber for the deposition of materials therein and a periscope sight thereinto permitting the continuous observation throughout deposition operations being carried on within the vacuum chamber, said periscope sight comprising a casing having a pair of spaced mirrors therein and a clear lens adjacent the mirror most remote from the chamber, said lens and said adjacent mirror being out of range of material being deposited within said chamber.
7. An apparatus comprising a high vacuum chamber for the deposition of materials therein and a periscope sight thereinto permitting the continuous observation throughout deposition operations being carried on within the vacuum chamber, said periscope sight comprising a casing having a pair of spaced mirrors therein, one facing towards the interior of the chamber and the second facing away from the interior of the chamber, and a clear lens adjacent said second mirror, said lens and said second mirror being out of range of the material being deposited within said chamber.
8. An apparatus comprising a high vacuum chamber for the deposition of materials therein and a periscope-like member attached thereto permitting the continuous observation throughout deposition operations being carried on within the vacuum chamber, said periscope-like member comprising a pair of angularly disposed spaced reflectors one of which faces towards the interior of the chamber, the reflective surface of the second reflector facing away from the interior and being arranged to receive images from the first reflector, and a transparent window adjacent said second reflector through which the images therein may be viewed, said transparent window being sealingly mounted in a wall of said chamber and the second reflector further being arranged to shield the transparent window with respect to the depositing material to thereby maintain said transparent window out of range of the material being deposited within the chamber.

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