

United States Patent

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[54] **MEANS FOR EXPOSING NORMALLY COVERED
PLATE WHILE MOVING IT TO EXPOSURE
SITUATION**
4 Claims, 6 Drawing Figs.

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95/24, 95/66
[51] Int. Cl..... **G01n 21/16**
[50] Field of Search..... **356/244-**
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95/66—72, 23—26

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ABSTRACT: A specimen plate having a lengthwise slidable cover is placed on a carriage to move therewith into and out of an isolation chamber. A cover holder, movable in and out both relative to the carriage and with it, detachably retains the cover and prevents it from moving with the carriage beyond predetermined limits, so that the specimen plate is slid out of the cover and exposed while moving into the isolation chamber with the carriage, and is slid back into the cover as it is moved out of the isolation chamber.

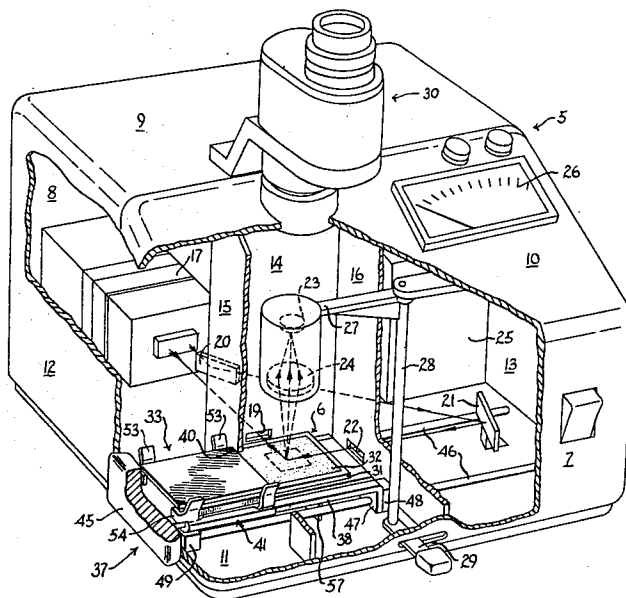


Fig. 1.

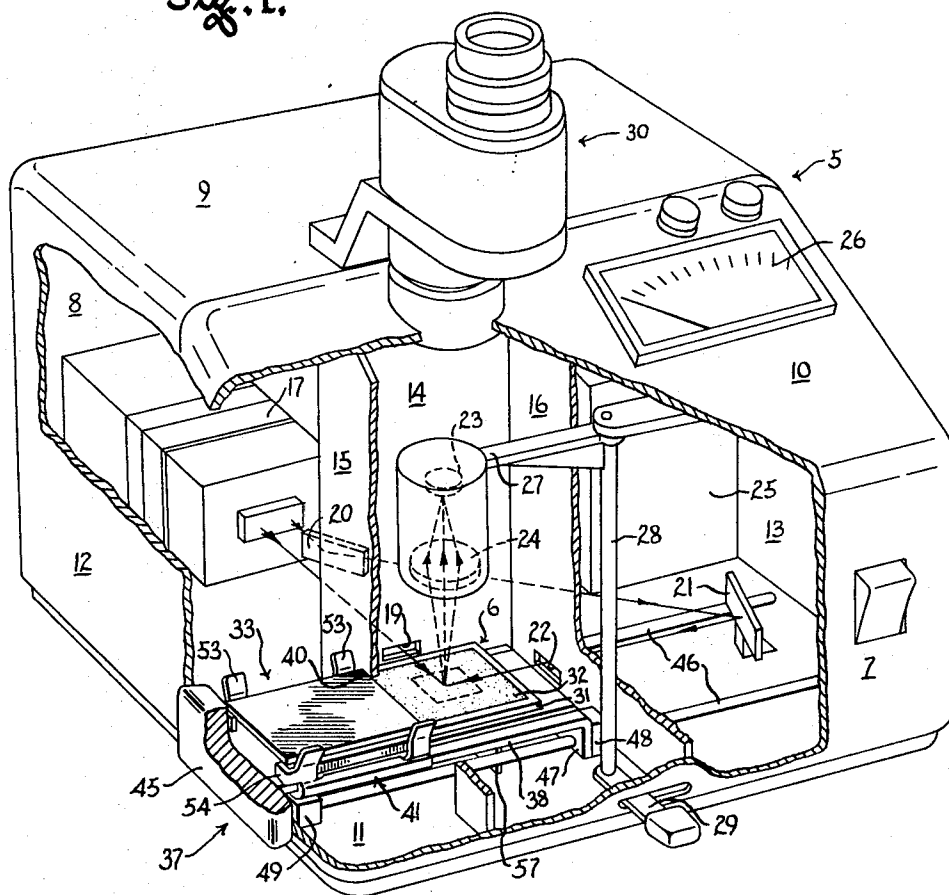
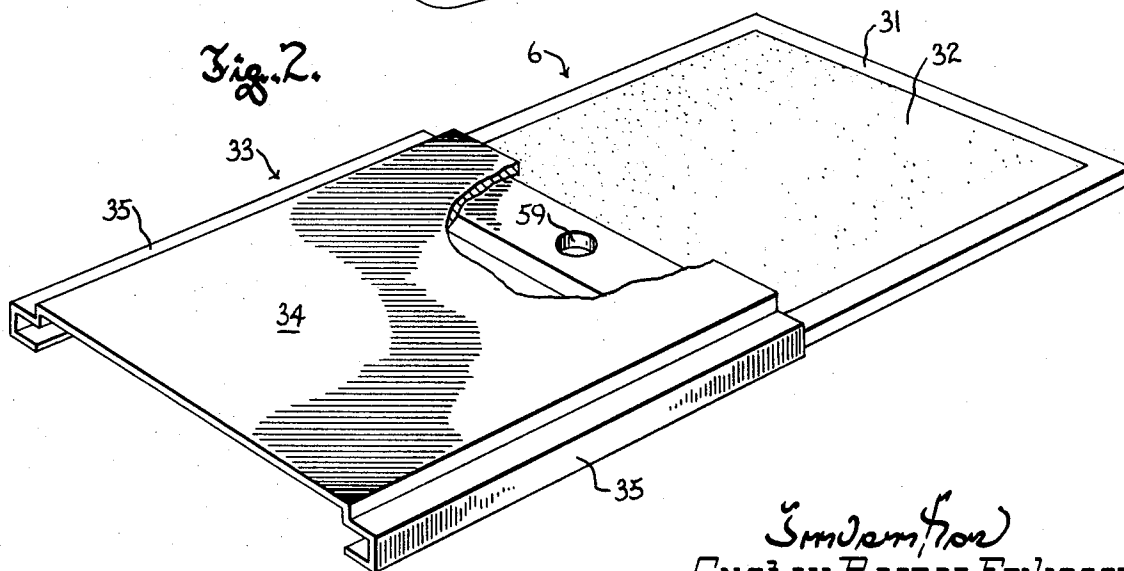


Fig. 2.



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Fig. 3.

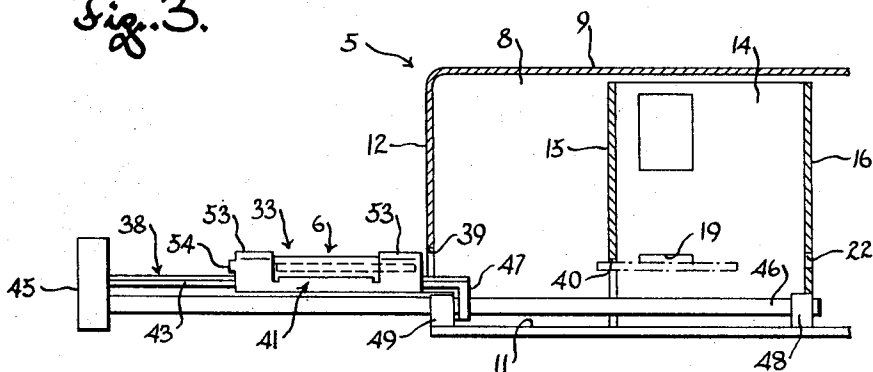


Fig. 4.

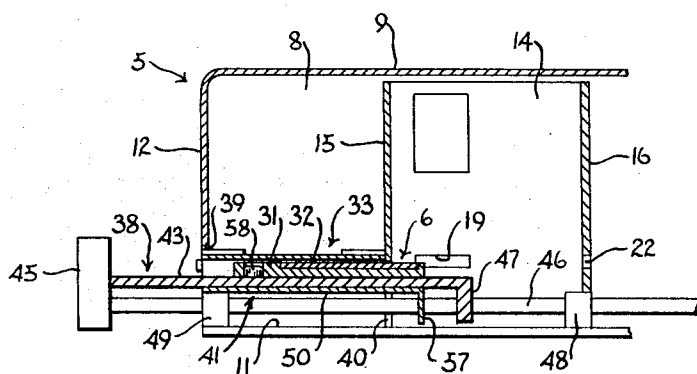
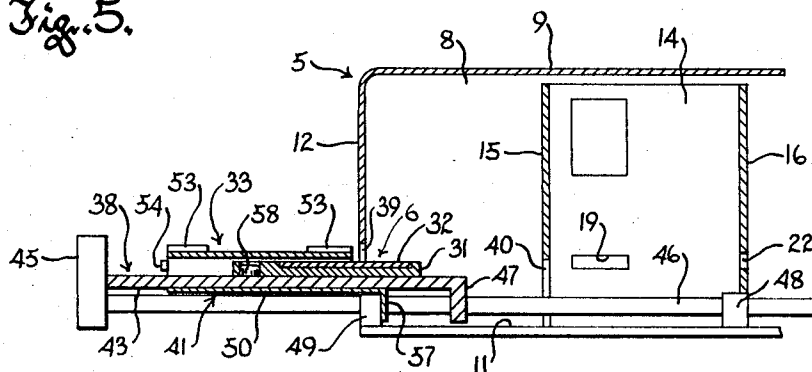
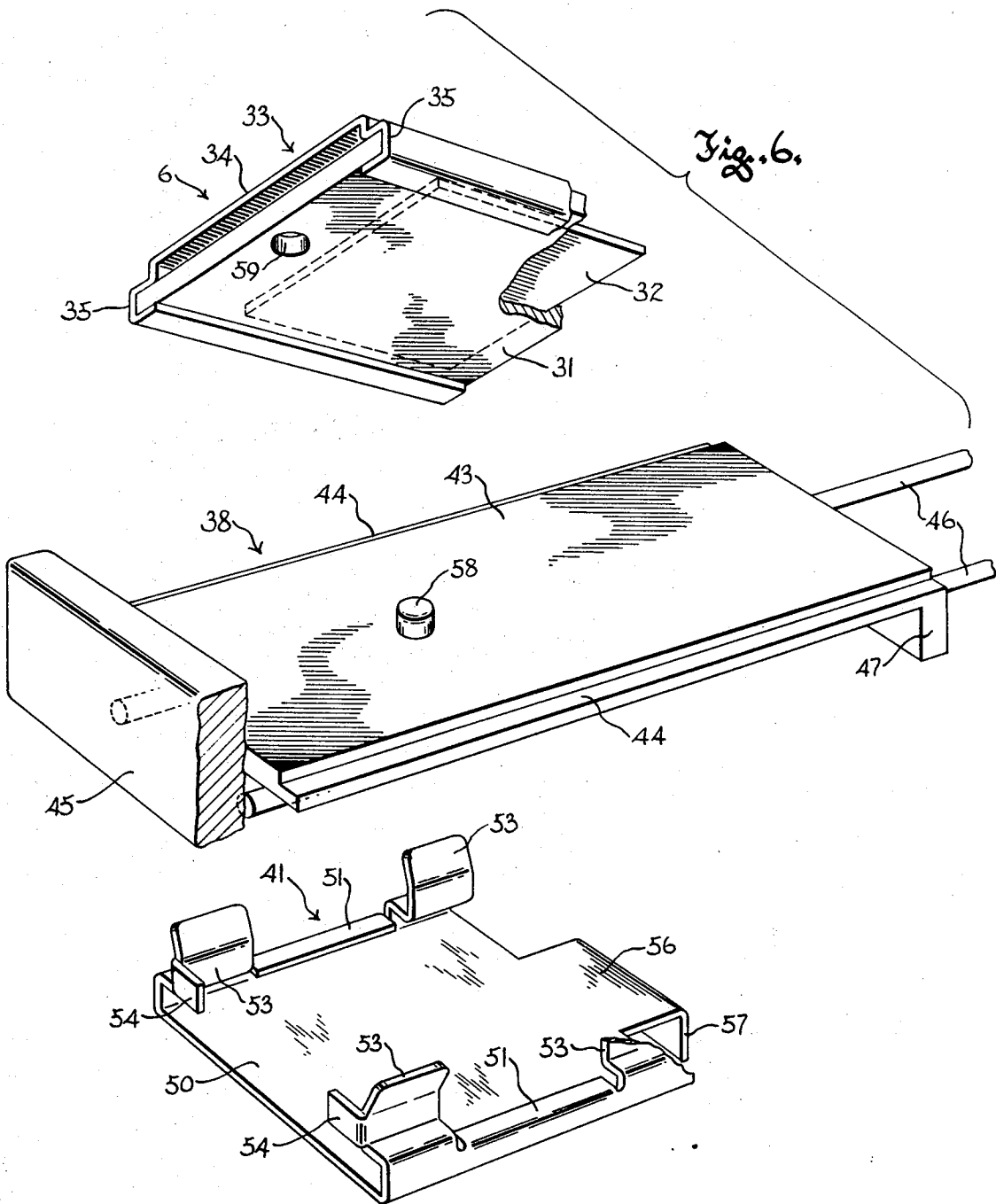


Fig. 5.



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MEANS FOR EXPOSING NORMALLY COVERED PLATE WHILE MOVING IT TO EXPOSURE SITUATION

This invention relates to apparatus for exposing in an isolation chamber a specimen plate that is normally kept covered as it is brought to and from the isolation chamber, and the invention has more particular reference to means for substantially simultaneously moving a specimen plate out of a protecting cover and into an isolation chamber and for again covering the specimen plate substantially simultaneously with its removal from the isolation chamber.

An example of one type of isolation chamber with which the apparatus of this invention has utility is disclosed in the copending application of B. O. Lindahl, Ser. No. 633,124, filed Apr. 24, 1967, assigned to the assignee hereof which relates to means for determining the cleanliness of air in a so-called clean room. In a clean room, which is a controlled environment enclosure wherein high-precision instruments are assembled, it is customary to monitor the cleanliness of air by exposing a slide or plate for a certain interval and then checking the dust accumulation on the slide to obtain an evaluation of the amount of dust present in the air of the clean room.

According to the teachings of the Lindahl application, the slide has a perfectly flat, black-top surface, and the isolation chamber in which it is examined has means associated therewith for directing light across the top surface of the slide, parallel thereto, from one or more directions. The clean surface of the slide itself, being flat and black, reflects none of the light; but every dust particle on it reflects a small beam upwardly from the surface. The isolation chamber therefore has in it a photosensitive element and a lens, and the beams reflected upwardly by the dust particles are focused upon the photosensitive element by means of the lens. The response of the photosensitive element affords a measure of the amount of dust collected on the surface of the slide and hence of the quantity of dust present in the air of the clean room during the interval that the slide was exposed.

Such an inspection device, comprising an isolation chamber and its associated optical and measuring equipment, constitutes a rather expensive and delicate piece of apparatus, so that in a plant having more than one clean room (as is often the case) it is not practical to provide a separate inspection device for each clean room, nor to move the device about from one clean room to another for inspection of the slides exposed in each. On the other hand, to carry an exposed slide out of the clean room and through portions of the plant that do not have a controlled environment, in order to take it to a central inspection device, would subject the slide to a substantial dust accumulation that would invalidate the inspection results.

With the foregoing considerations in mind, it is the general object of this invention to provide, in combination with an isolation chamber such as that in an inspection device of the above-described character, a cover for protecting a slide as it is carried to and from the isolation chamber, and means for readily moving the slide to and from a predetermined situation in the isolation chamber, for automatically uncovering the slide as it is moved into the isolation chamber, and for automatically restoring it to its covered condition as it is withdrawn from the isolation chamber.

With these observations and objects in mind, the manner in which the invention achieves its purpose will be appreciated from the following description and the accompanying drawings. This disclosure is intended merely to exemplify the invention. The invention is not limited to the particular structure or method disclosed, and changes can be made therein which lie within the scope of the appended claims without departing from the invention.

The drawings illustrate one complete example of the physical embodiment of the invention constructed according to the best mode so far devised for the practical application of the principles thereof, and in which:

FIG. 1 is a perspective view of an inspection device for determining the amount of dust that has been accumulated on

a specimen plate exposed in a clean room, with portions of the device broken away to show details of its construction and a specimen plate situated in it for inspection;

FIG. 2 is a perspective view, on a larger scale, of a typical specimen plate with its cover, a portion of the cover being shown broken away;

FIG. 3 is a vertical sectional view through the inspection device, showing the carriage in position for placement of a covered specimen plate thereon and for removal of the same therefrom;

FIG. 4 is a view generally similar to FIG. 3 but illustrating conditions that obtain during movement of the specimen plate to its situation for inspection in the inspection device;

FIG. 5 is a view generally similar to FIG. 3 but showing conditions that obtain during withdrawal of the specimen plate from the inspection device; and

FIG. 6 is a group perspective view of the specimen plate and its cover, the carriage and the cover holder.

Referring now more particularly to the accompanying drawings, the numeral 5 designates generally an inspection device of the type disclosed in the above-identified application, for measuring the accumulation of dust on a specimen plate 6 that has been exposed in a clean room for a prescribed interval, and thereby obtaining an evaluation of the cleanliness of air in the clean room. The inspection device comprises, in general, a housing having a front wall 7, a rear wall 8, a top wall 9, a bottom wall 11 and opposite sidewalls 12 and 13. Inside the housing, cooperating with the top and bottom walls 9 and 11 and with the front wall 7 to define an isolation chamber, are a rear partition wall 14, which extends parallel to the front and rear walls and is spaced from them, and a pair of side partition walls 15 and 16 which are spaced from and respectively parallel to the sidewalls 12 and 13.

It will be understood that the inspection device 5 is merely illustrative of a type of isolation chamber means in which a specimen plate is intended to be exposed and to and from which the specimen plate must be brought in a covered, protected condition.

Within the housing, to the rear of the isolation chamber, is a light source 17 which sends a beam of light directly through a slotlike aperture 19 in the rear partition wall, across and parallel to the top surface of the specimen plate 6. By means of obliquely arranged mirrors 20 and 21 in the housing, another portion of the light emitted from the light source is directed through a slotlike aperture 22 in the side partition wall 16, likewise across and parallel to the top surface of the specimen plate 6 but at right angles to the beam that comes directly from the light source.

Light will be reflected upwardly only by dust particles on the inspection plate, and such upwardly reflected light is concentrated upon a light-responsive element 23, located above the specimen plate, by means of a lens 24 that is between the specimen plate and the light-responsive element. In this case the light-responsive element 23 is illustrated as a sensitive photoelectric cell connected with an amplifier 25 in the housing, and the amplifier is in turn connected with a meter 26 that is visible at the exterior of the housing and can be calibrated in terms of number of dust particles.

The photoresponsive element 23 and the lens 24 are mounted in a suitable holder to be carried on the free end of a swingable arm 27 which projects from an upright rotatable post 28. A lever 29, anchored to the bottom of the post 28 and projecting through the front wall 7 of the housing, provides for rotation of the post 28 to swing the photoresponsive element and lens between the operative position shown in FIG. 1 and an inoperative position well to one side of the axis of a microscope 30 that is mounted in the top wall 9 of the housing. The microscope can be used for visual inspection of dust particles on the specimen plate, so that the nature of any contaminants present in the air of the clean room can be ascertained.

The specimen plate 6 can comprise a rectangular tray 31, having a shallow rectangular depression in its top surface, and

a slide 32 which fits closely in the depression and which has a suitable top surface. For protection of the specimen plate at times when it is not intended to have it exposed, it is provided with a removable cover 33. The cover has a medial portion 34 that is adapted to overlies the slide 32, and has opposite marginal portions 35 that are channel shaped, opening toward one another, for slidably engaging opposite marginal edge portions of the tray 31. Thus when a specimen plate is picked up in a clean room, it and a cover 33 are immediately slid lengthwise into assembled relationship so that the cover protects the specimen plate from further accumulation of dust en route to the inspection device.

The inspection device has means, generally designated 37, for receiving a covered specimen plate at the exterior of the housing 5, for removing the specimen plate from the cover while moving it into the situation in the isolation chamber that establishes it in the proper relationship to the light apertures 19 and 22 and the optical apparatus 23, 24 and 30, and for replacing it in the cover while withdrawing it from the isolation chamber back to the exterior of the housing.

In general, said means 37 comprises a carriage 38 which is constrained to motion in opposite directions into and out of the housing through an aperture 39 in the sidewall 12 and an aligned aperture 40 in the side partition wall 15, and a cover holder 41 which is so mounted on the carriage that it can partake of a portion of such in-and-out carriage motion but can also be confined against motion at certain times without interfering with the remaining movement of the carriage. The cover holder 41, as explained hereinafter, detachably holds the cover 33 of a specimen plate, while the specimen plate rests directly upon the carriage and is constrained to move therewith.

Specifically, the carriage 38 comprises a rectangular platelike body member 43 having a reduced thickness, as at 44, along each of its longer marginal edge portions, to define a raised central portion which has a width about equal to that of a specimen plate and upon which a specimen plate is adapted to rest. Attached to the front end of the platelike body member 43 is a handle 45 that projects above and below the body member. A pair of guide rails 46 extend rearwardly from the handle through and beyond a downwardly projecting flange portion 47 on the rear of the body member 43. The handle 45 and the flange portion 47 cooperate to hold the guide rails 46 parallel to one another and to the longer side edges of the platelike body member, and the rails 46 are slideable in inner and outer bearing brackets 48 and 49, respectively, that are secured to the bottom wall 11 of the housing and project upwardly therefrom. The inner bearing bracket 48 is located at the side partition wall 16, while the outer bearing bracket 49 is at the sidewall 12 of the housing. The inner portions of the rails extend beyond the side partition wall 16.

Note that the flange portion 47 of the carriage cooperates with the inner bearing bracket 48 to define the innermost limit of carriage motion (compare FIGS. 1 and 4), and cooperates with the outer bearing bracket 49 to define the outer limit of carriage motion.

The cover holder 41 has a flat platelike body portion 50 that flatwise underlies the body portion 43 of the carriage, and it has upwardly and inwardly projecting opposite flange-like marginal portions 51 that engage around the reduced thickness marginal edge portions 44 of the carriage body member 43 to connect the carriage and the holder in a manner that provides for relative lengthwise sliding motion between them. Projecting upwardly from each of these flange portions 51, near the front and rear ends of the cover holder, are fingers 53 that engage the opposite longitudinal side edges of a cover 33 to readily detachably secure it to the cover holder. Other fingers 54 on the cover holder, projecting toward one another across the top of the body portion of the carriage, engage the front edge of the cover to locate it relative to the cover holder and confine it against forward displacement relative thereto.

The body portion of the cover holder has an inward projection 56 that terminates in a downwardly projecting flange 57.

The flange 57 cooperates with the outer bearing bracket 49 to define the outer limit of motion of the cover holder, in which a cover thereon is wholly disposed just outside the sidewall 12 of the housing. Inasmuch as the aperture 40 in the partition sidewall 15 is just large enough to clear the carriage and a specimen plate thereon, the inner edges of the inner upright fingers 53 on the cover holder, and also the front edge of the cover thereon, engage the front surface of said partition wall to define the inner limit of motion of the cover holder.

For loading with a covered specimen plate, the carriage is of course situated in its outermost position, illustrated in FIG. 3. As the specimen plate is moved flatwise downwardly onto the carriage, its cover 33 engages between the upstanding fingers 53 on the cover holder, and an upwardly projecting pin or boss 58 on the body portion of the carriage engages in a closely fitting hole 59 in the tray 31 to constrain the specimen plate to motion with the carriage.

As the carriage is then moved inwardly, a point is reached where the cover holder and cover plate are brought into engagement with the side partition wall 15, as above described, and the cover therefore remains in a sort of anteroom to the isolation chamber, between the sidewall 12 and the side partition wall 15, where it is protected from dust and foreign matter. As the carriage continues to be moved inwardly (the condition illustrated in FIG. 4), it of course carries the specimen plate along with it, until the carriage is stopped when the specimen plate is fully out of its cover and is situated in the isolation chamber between the side partition walls 15 and 16.

When inspection of the specimen plate is completed, the carriage is drawn outwardly by means of the handle 45, and the cover holder, with the cover 33 thereon, moves with the carriage until it reaches the position in which the whole cover is just outside the sidewall 12, at which point outward movement of the cover and cover holder terminates. The specimen plate, of course, also moves with the carriage. Upon continued outward movement of the carriage after the cover holder and cover have reached the position just mentioned, the specimen plate is drawn into the cover, and when the carriage has attained its outermost position, the specimen plate is once again wholly inside the cover and the assembled cover and specimen plate can be lifted flatwise off the carriage and out of the cover holder.

From the foregoing description taken with the accompanying drawings it will be apparent that this invention provides means for protecting a specimen plate against undesired exposure, and means for automatically exposing the specimen plate while moving it into a situation in which its exposure is desired and for withdrawing it from said situation while automatically restoring it to its protected condition.

What I claim as my invention is:

1. In combination with a plate having a surface to be exposed when the plate is in a defined exposure zone and which should be protected from exposure at certain other times:

- A. a cover for the plate movable parallel to said surface to and from a position covering said surface;
- B. a carriage having a portion on which the plate, with the cover thereon, can be supported, said carriage being movable back and forth to carry its said portion between the exposure zone and a defined loading zone, through an intermediate zone;
- C. cooperating means on said portion of the carriage and on the plate, operative when the plate is on said portion of the carriage to constrain the plate to move with the carriage;
- D. means connected with the cover providing a first abutment engageable with a fixed part upon movement of the carriage to carry its said portion to the intermediate zone from the loading zone, and by which the cover is restrained against further motion with the carriage that carries the plate to the exposure zone and out of underlying relationship to the cover; and

- E. means connected with the cover providing a second abutment engageable with a fixed part upon movement of the carriage that carries its said portion to the intermediate zone from the exposure zone, and by which the cover is restrained against further movement with the carriage that carries the plate back to the loading zone and to underlying relationship with the cover.
2. The combination of claim 1, further characterized by:
- A. means defining an isolation chamber in which said exposure zone is situated, said means comprising a wall with an aperture therein through which the carriage is slidable and which provides the fixed part engageable with said first abutment; and
- B. means fixed with respect to said wall and spaced from it in the direction that the carriage moves to carry its said portion from the exposure zone to the intermediate zone, the last-mentioned means providing a stop engageable with said second abutment.
3. In combination with a plate having a surface intended to be exposed only under prescribed conditions, and means defining an isolation chamber in which the plate is intended to be exposed,
- means for moving the plate to and from a predetermined situation in said chamber,
- for protecting the plate against undesired exposure when it is out of said chamber, and
- for exposing it when it is in said situation, said last-named means comprising:
- A. a cover member lengthwise slidable to and from an assembled relationship with the plate in which the cover member protectively overlies said surface of the plate;
- B. a carriage confined to motion in opposite directions along a defined path to carry a portion of the carriage between said situation in the isolation chamber and a loading zone outside the chamber through an intermediate zone, the isolation chamber having an aperture through which said portion of the carriage passes in so moving;
- C. a holder supported by the carriage for motion relative to the carriage in said directions of carriage motion;
- D. means on the holder for detachably securing the cover member thereto to constrain the cover member to move with the holder and by which the cover member is disposed lengthwise parallel to said directions of carriage motion;
- E. cooperating means on the plate and on said portion of the carriage for constraining the plate to move with the carriage, the last-mentioned means being engageable upon securement of the cover member to the holder with the plate in assembled relationship to the cover member; and
- F. cooperating abutment means on the holder and on the isolation chamber means for restricting motion of the holder relative to the chamber means and with the carriage said abutment means being arranged
1. to confine the holder against movement with said portion of the carriage as the same is moved from the intermediate zone to said situation, to effect exposure of the plate, and
 2. to confine the holder against movement with said portion of the carriage as the same is moved from the intermediate to the loading zone, to effect recovering of the plate.
4. The combination of claim 3 further characterized by:
- A. the carriage comprising an elongated platelike member having an upper surface which the specimen plate can flatwise overlie and which comprises said portion;
- B. the holder having
1. a medial portion which flatwise underlies said platelike member,
 2. marginal portions which embracingly slidably engage longitudinal edge portions of the platelike member, and
 3. finger portions which project above the platelike member to engage the cover and releasably confine the same against motion relative to the holder.

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