United States Patent [19]

Byler et al.

[11] **3,845,314**

[45] **Oct. 29, 1974**

[54] **X-RAY FILM IDENTIFICATION MEANS**

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[73] Assignee: **United States Radium Corporation**, Morristown, N.J.

[22] Filed: **Sept. 16, 1971**

[21] Appl. No.: **181,060**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 14,024, Feb. 25, 1970, Pat. No. 3,631,243.

[52] **U.S. Cl.** **250/476**, 250/481

[51] **Int. Cl.** **G03b 41/16**

[58] **Field of Search** 250/67

[56] **References Cited**

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3,452,196 6/1969 Gray 250/67

3,466,440 9/1969 Tone 250/67

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Assistant Examiner—C. E. Church
Attorney, Agent, or Firm—Pennie & Edmonds

[57] **ABSTRACT**

In an x-ray cassette into which a flat light-emitting unit can be inserted through a slot to expose identifying markings on film, improved guiding means are provided for locating the marking unit correctly within the cassette. The guiding means include a track with an entry lip for directing the marking unit, a resilient pad supporting the track and being compressible until a stop on the track engages an inner surface of the cassette, and means in the slot which permit entry of the unit but prevent passage of light into the cassette.

7 Claims, 14 Drawing Figures

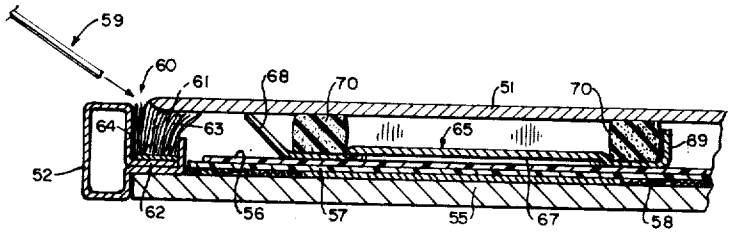


FIG. 1

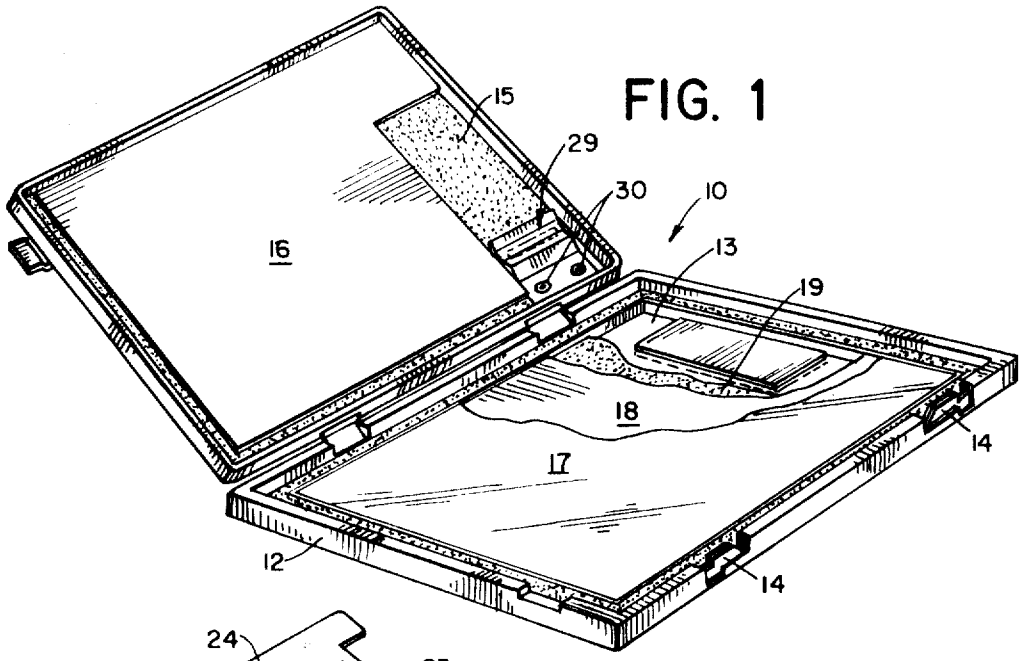
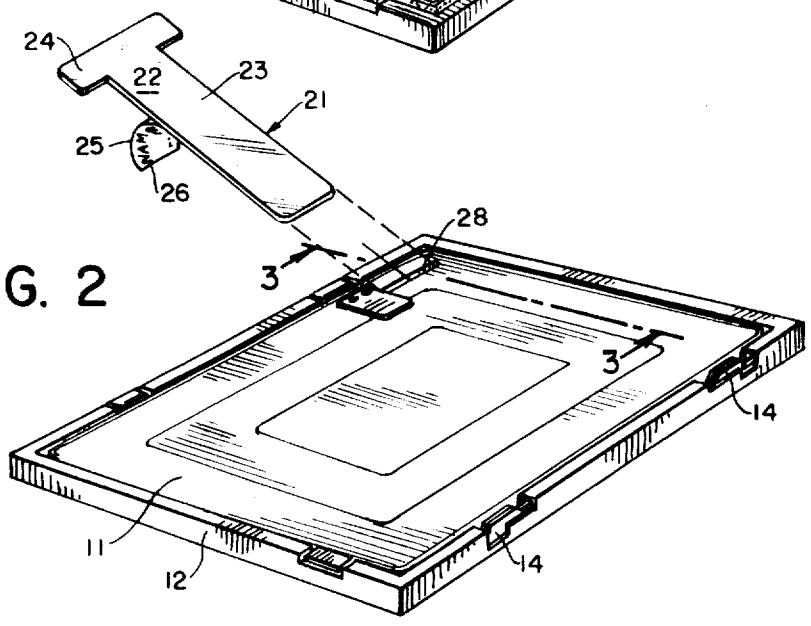


FIG. 2



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FIG. 3

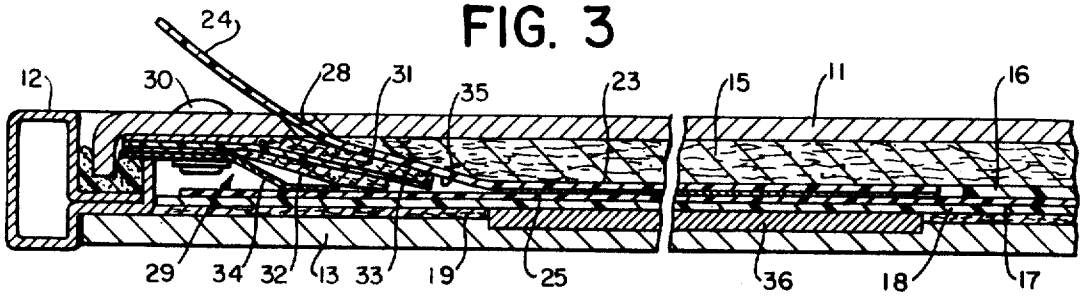


FIG. 5

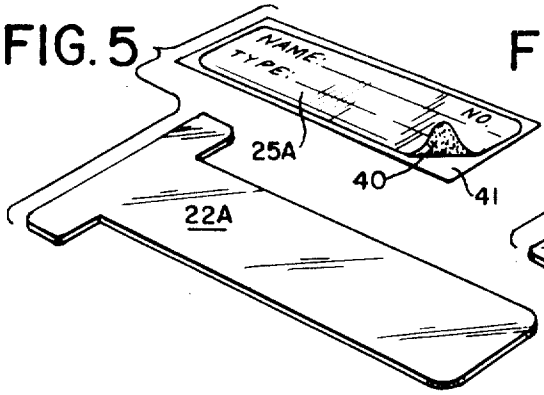
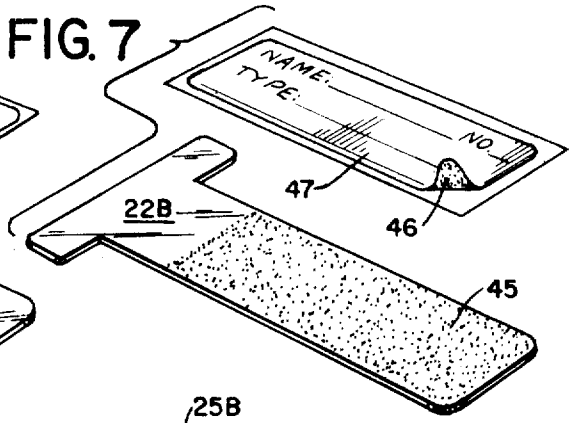


FIG. 7



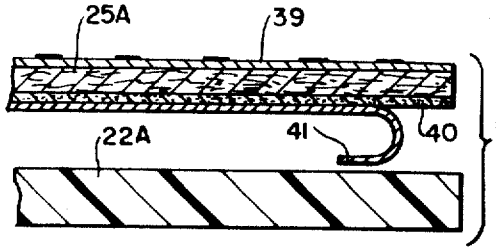


FIG. 6

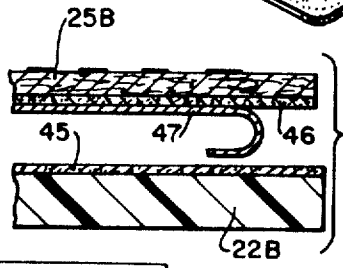


FIG. 8

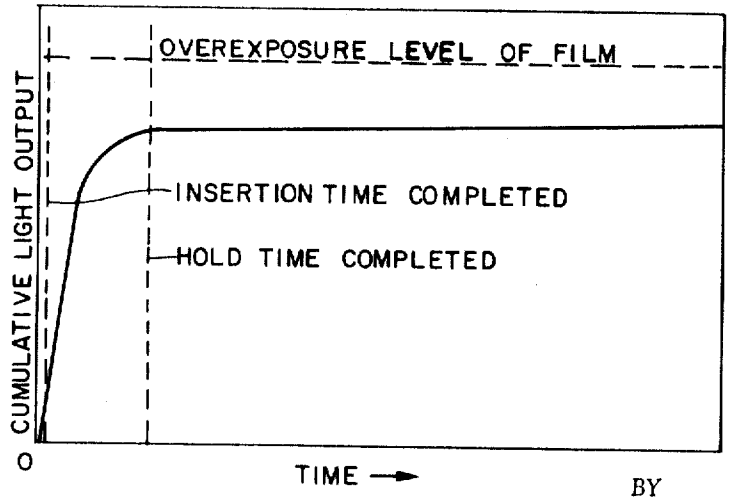


FIG. 4

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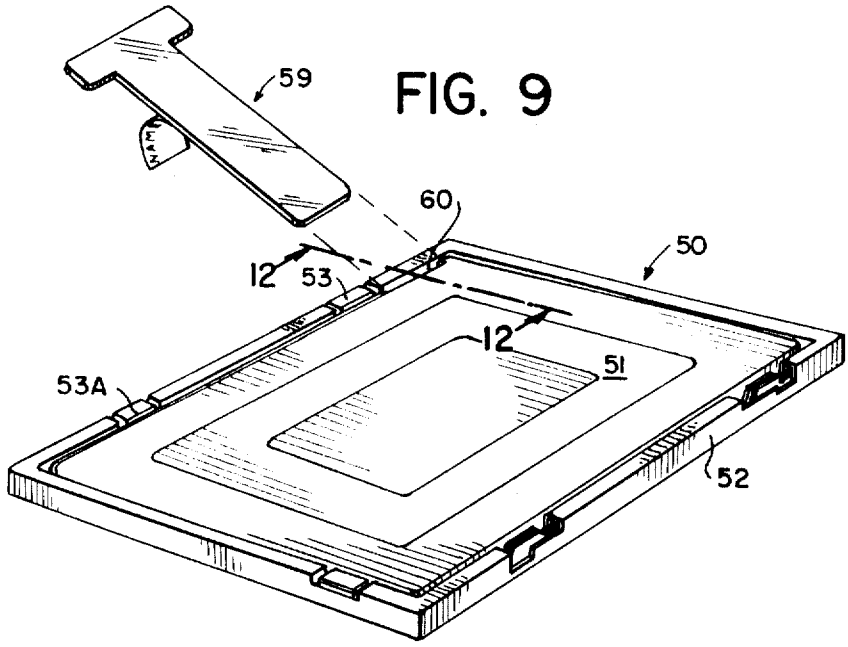


FIG. 9

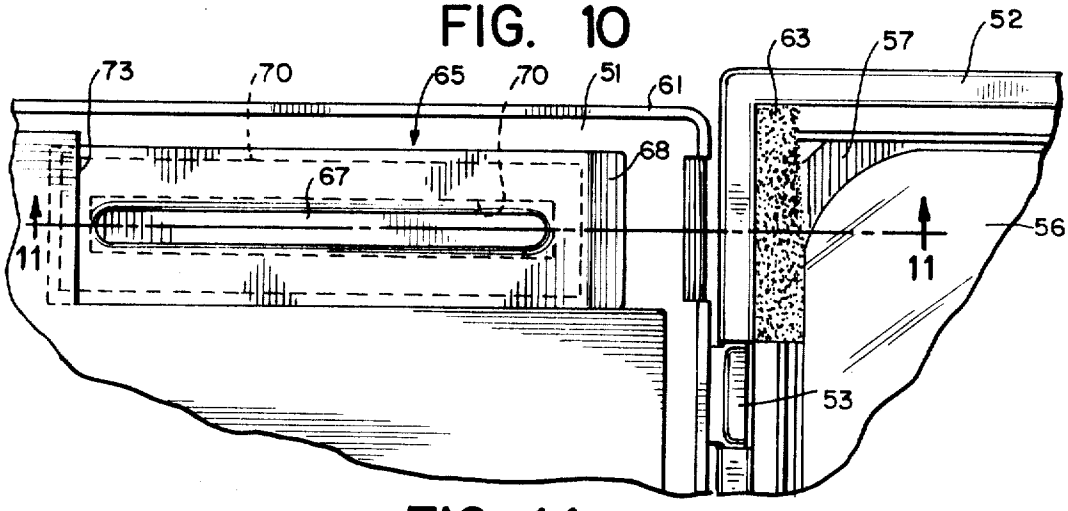


FIG. 10

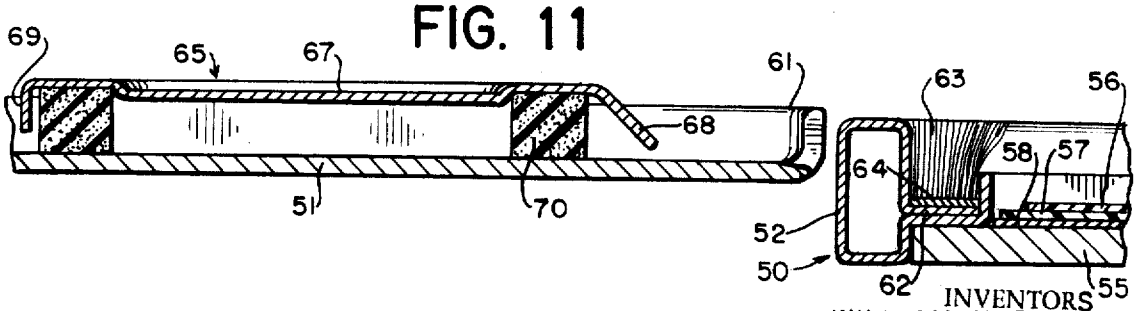


FIG. 11

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FIG. 12

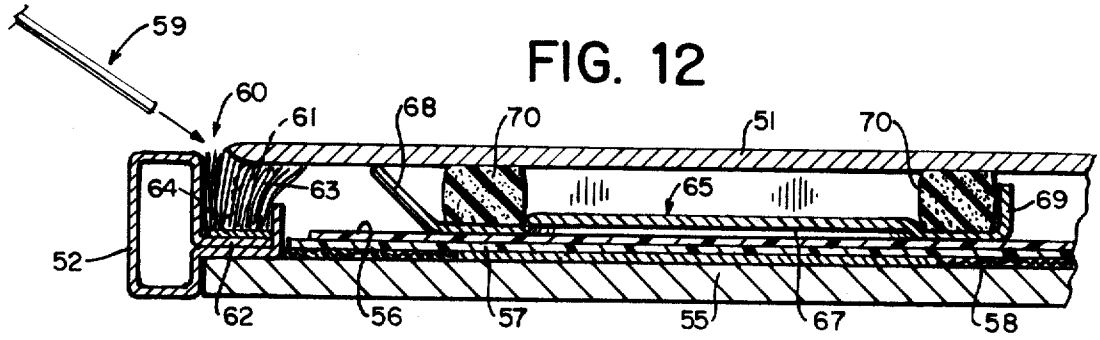


FIG. 13

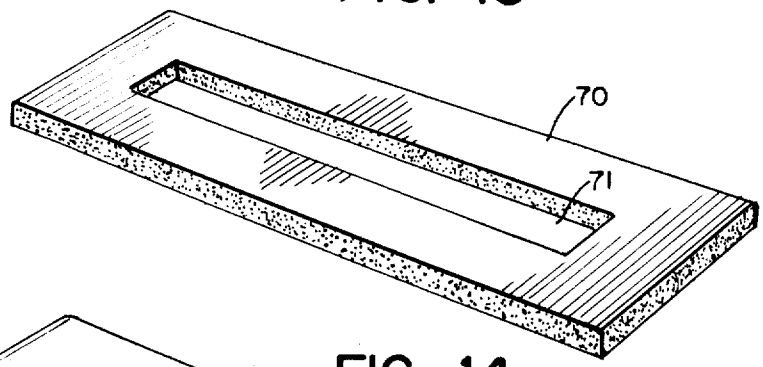
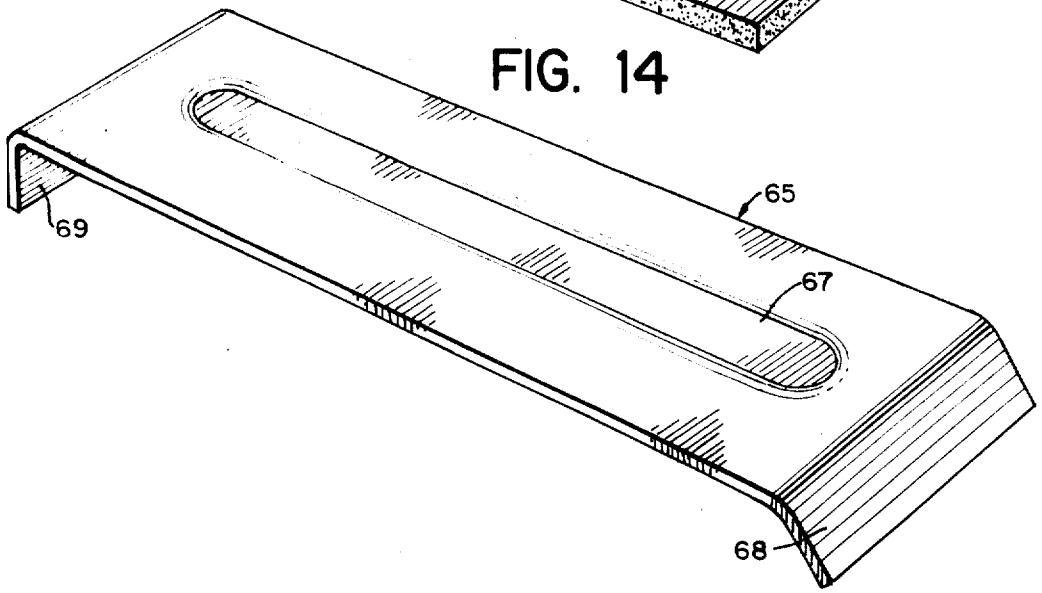


FIG. 14



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X-RAY FILM IDENTIFICATION MEANS

RELATED CASE

This application is a continuation-in-part of our co-pending application Ser. No. 14,024 filed Feb. 25, 1970 for Method And Means For Film Identification and now U.S. Pat. No. 3,631,243.

BACKGROUND OF THE INVENTION

In our co-pending application referred to above, a method and means are disclosed for identifying film exposures in an x-ray cassette or other camera-like housing. The system employs a phosphorescent marking unit activated by incident radiation and inserted through a light-sealed aperture so that its diminishing afterglow casts the silhouette of certain indicia on the film. A particular form of slot in the cassette, the associated light-seal assembly and interior means for urging the inserted marking unit against the film are all shown in the aforementioned co-pending case.

Other forms of guiding means have also been known in the prior art for directing a light-emitting marking unit into proper position with respect to the film. For example F. F. Tone et al. U.S. Pat. No. 3,488,753 describes elements generally of that sort. However, neither that patent nor any other reference prior to our aforementioned co-pending application disclosed or suggested guiding means designed to direct a thin phosphorescent light-emitting unit into place to mark film in an x-ray cassette.

The principal object of this invention is to provide simple and reliable guiding means for locating a flat light-emitting unit inside an x-ray cassette to expose identifying markings on the film. This is to be achieved by a combination of elements which function together in an improved manner in comparison to the guiding means shown in our aforementioned application and in the prior art. In particular, it is an object of this invention to control to a large extent the force urging the marking unit against the film within the cassette and also the frictional force resisting movement of the marking unit into and out of operating position.

SUMMARY OF THE INVENTION

Broadly stated, the invention is for use with an x-ray cassette including a shallow body adapted to enclose film and a slot into which a flat light-emitting unit can be inserted to expose identifying markings on the film. Improved guiding means are provided for locating the unit inside the cassette with respect to the film. The guiding means comprise a track within the cassette against which the unit is slideable as it is inserted through the slot. The track includes an entry lip at one end for directing the unit between the track and the film. It also includes stop means. A pad supports the track within the cassette for urging the track resiliently toward the film. The pad is compressible until the stop means engages an inner surface of the cassette. Finally, means are located in the slot to permit entry of the unit but to prevent passage of light into the cassette.

In more specific forms of the improved guiding means, the track includes a central longitudinal indentation and the pad is formed with a central longitudinal cut-out portion. A lid may be hinged to one edge portion of the body and in that case the slot may be defined between the edge portion of the body and part of that edge of the lid which is hinged to the body.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view, partly broken away, of one embodiment of an x-ray cassette adapted to the invention;

FIG. **2** is a perspective of the same cassette fully closed and illustrating the associated insertion unit;

FIG. **3** is an enlarged fragmentary section partly broken away of the cassette taken along the line **3—3** of FIG. **2**;

FIG. **4** is a graph showing the relationship of light output from the insertion unit to film sensitivity against time;

FIG. **5** is a composite perspective showing the label and carrier sheet of one form of the insertion unit;

FIG. **6** is an enlarged fragmentary section of the insertion unit of FIG. **5**;

FIG. **7** is a composite perspective showing the label and carrier sheet of another form of the insertion unit;

FIG. **8** is an enlarged fragmentary section of the insertion unit of FIG. **7**;

FIG. **9** is a perspective view of another embodiment of a closed cassette adapted to the invention and again illustrating the associated insertion unit;

FIG. **10** is a fragmentary enlarged plan view of the cassette of FIG. **9** in the open position showing the improved guiding means;

FIG. **11** is a section taken along the line **11—11** of FIG. **10**;

FIG. **12** is a section similar to that of FIG. **11** but with the cassette closed and illustrating the associated insertion unit;

FIG. **13** is a perspective view of the foam pad of the improved guiding means; and

FIG. **14** is a perspective view of the track of the improved guiding means.

Referring first to FIGS. **1** to **3**, a cassette **10** is shown which includes a lid **11**, a channel frame **12**, and a front panel **13**. The lid, which is in the open position in FIG. **1** and closed in FIGS. **2** and **3**, is hinged to the frame **12** and the front panel **13** is fixed in the frame **12**, all in the conventional manner. Latches **14** on the frame **12** serve to releaseably secure the lid **11** in closed position.

The customary interior elements of the cassette **10** include at least the following: Inside the lid **11** is a felt pressure pad **15** (lead foil may be disposed between them). On the interior side of the pad **15** is a rear intensifying screen **16** of fluorescent material, the function of which is to convert x-ray energy to visible light. Next is photographic x-ray film **17**. Immediately on the other side of the film **17** is a front intensifying screen **18** similar in structure and function to the rear screen **16**. Between the front intensifying screen **18** and the front panel **13** is another pressure pad **19**.

In a typical cassette, the two intensifying screens and the film are removable while the pressure pads are adhered in place. When the lid **11** is closed the interior elements of the cassette are held tightly together due to the resiliency of the pads **15** and **19**. The film **17** is thereby completely enclosed within a tight opaque housing.

In use the subject to be diagnosed is placed before the front panel **13** and x-rays are directed through the

subject and into the cassette **10.** When the x-rays strike the intensifying screens **16** and **18** they cause them to glow and that visible light in turn exposes the film **17.** Those portions of the subject which are less permeable to x-rays cast what is in effect a shadow on the intensifying screens and the image of it is thereby recorded on the film.

The object of the present invention is to record on the film not only the image of the subject being diagnosed but also the image of the patient's name or other identifying data useful in interpreting the x-ray photograph.

For this purpose a light-sealed aperture is provided in the cassette to receive an insertion unit **21.** The insertion unit **21** is generally illustrated in FIGS. **2** and **3** (specific forms are described in detail hereinafter). It includes a plastic carrier sheet **22** which is flexible but sufficiently rigid to be pushed into the cassette without buckling. The carrier sheet includes an insert portion **23** and a wider tab portion **24** so that its overall configuration is T-shaped. A translucent label **25** is adhered to the insert portion **23** of the unit and indicia **26** setting forth the desired information are typed on the face of the label. Somewhere behind the typed indicia **26** the insertion unit includes phosphorescent material which is activated by incident radiation to emit light, and that light silhouettes the typed indicia **26.**

One form of guiding means is shown in FIGS. **1** to **3** for permitting the unit **21** to be inserted into the cassette and withdrawn during operation. Such means include a slot **28** formed in the lid **11** and angling inwardly as shown in FIG. **3.** The pressure pad **15** inside the lid **11** is cut away as shown in FIGS. **1** and **3,** and so also is the intensifying screen **16** on the interior surface of the pad **15.** A resilient light-seal assembly **29** attached by rivets **30** occupies the cut-out area of the pad **15.** It is composed of two felt-like flaps **31** and **32** separated by a flexible tongue **33,** all biased together by a leaf spring **34** so that the entire assembly presses resiliently toward an opposed bevelled surface **35** on the pad **15** to seal the interior of the cassette against entry of ambient light. These parts of the apparatus provide guiding means in the cassette for properly positioning the insertion unit **21.**

To the other side of the front intensifying screen **18** from the light-seal assembly is a rectangular lead blocker **36** of approximately the same width as the cut-out portion of the screen **16.** As shown the blocker **36** is seated in the inner face of the front panel **13** and occupies a cut-out area in the pressure pad **19.** As an alternative, the screen **18** may be formed with a cut-out area coincident with the area shown to be covered by the blocker **36,** or an opaque layer may be deposited on the screen **18** in that area on the side thereof facing the film **17.** If the x-ray intensity is relatively high, the blocker may be used together with a cut out in the screen **18.** These represent several methods which may be used for preventing x-ray activated illumination from exposing the film **17** in the region thereof coincident with the cut-out area of the screen **16** to the right of the light-seal assembly **29** as seen in FIG. **3.**

By this construction the insertion unit **21** can be gripped manually at its tab portion **24** and the insert portion **23** thereof can be directed through the slot **28** in the closed lid **11** of the cassette **10.** The end of the insert portion **23** is thus forced past the flap **31** and bends around the beveled surface **35** on the pad **15** so that it can slide fully into the cut-out area of the screen **16** along the rearward face of the film. The insertion unit is oriented during this procedure so that its label **25** will face forward in contact with the film **17** in the inserted position.

In the inserted position, the phosphorescent material incorporated in the insertion unit (in a manner described hereinafter) casts the silhouette of the indicia **26** on the surface of film **17** in the rectangular area of the film **17** which is protected by the blocker **36** or other means and hence is otherwise unexposed. The afterglow from the insertion unit thereby exposes the image of the indicia on the film.

The phosphorescent material is preferably a phosphor such as copper-activated zinc sulfide. Its light output should be sufficiently limited so that it does not expose the film during the brief period the unit **21** is moving into position during insertion. The output of light should be great enough, however, so that during the hold period the film becomes legibly exposed with the image of the indicia. Many phosphors can be matched with most x-ray films to achieve these objects. There is another characteristic of phosphors which can be selected to produce one of the most significant advantages of the invention, and that is the property of afterglow decay rate. After excitation by exposure to incident light, a phosphorescent material glows but at a diminishing level. After a short time it emits virtually no light at all.

FIG. **4** is a graph showing the cumulative light output of a representative phosphor plotted against time. It will be seen that during the brief period required for inserting the unit the light output is quite low (e.g. 0.4 seconds) and hence does not cause smearing of the film while the indicia are in motion. It is also apparent that the hold time (e.g. 4 or 5 seconds) for achieving proper exposure is relatively short. Finally the FIG. **4** graph shows the diminishing afterglow from the phosphor does not add significantly to the cumulative light output after the recommended hold period is complete, and hence no matter how long the unit is left in place it will not reach the over-exposure level of the film. In practice this means that even though an insertion unit may be left inside a cassette too long by mistake, the film therewithin will still be legibly printed with the identifying data. Timely withdrawal after the specified hold period is not critical, and the chance of error in the identification process is greatly reduced.

A phosphor which exhibits a so-called "power law" or hyperbolic brightness decay rate is preferred for this purpose. In addition to copper-activated zinc sulfide, silver-activated zinc sulfide or zinc cadmium sulfide and copper-activated zinc cadmium sulfide also can be employed. By varying such properties as emission color, these phosphors may be adapted for use with film of different speed or sinsitivity.

In the form of insertion unit shown in FIGS. **5** and **6,** the carrier sheet **22A** is of a plastic such a polytetrafluorethylene. While it is flexible, it has sufficient column strength to penetrate the light-sealed aperture of the cassette without buckling. A label **25A** is employed which is of paper, plastic or other suitable material. Covering one surface of the label **25A** is a layer **39** of uniformly dispersed fine crystals of a phosphor such as copper-activated zinc sulfide. Typed, printed or otherwise marked on the exposed face of the layer **39** is all the identifying data desired. This may include not only

the patient's name and so on but also the time of the x-ray, an important item of information in many x-ray techniques where progressive change is to be observed. The label could be automatically stamped with the time by means of an appropriate clock-printer into which the radiologist may insert the unit.

On the surface of the label **25A** opposite the phosphor layer **39** is a coating **40** of pressure-sensitive adhesive. The label **25A** may advantageously be torn along perforation lines from a larger sheet containing many labels, and the coatings of pressure-sensitive adhesive and phosphor may cover the entire sheet. Prior to the use of the label **25A**, its adhesive coating **40** is protected by a strip sheet **41** which can be discarded after it is removed.

In operation, the label **25A** is typed or stamped directly on its phosphor layer **39** as desired, its strip sheet **41** is removed to expose the pressure sensitive adhesive **40** and it is then applied to the insert portion of the carrier sheet **22A**. Just before or after the patient's x-ray is taken, the phosphor on the label is made to flow by exposure to incident radiation, which may be simply the ambient light in the room. The carrier sheet **22A** is then thrust into the cassette **10** through the aperture **28** and held there for a count of four seconds. During this time the afterflow from the phosphor casts the silhouette of the indicia on the film **17**, with little penumbra effect since the phosphor layer and indicia are in direct contact with one another and with the film. After this hold period the operator pulls out the insertion unit and identification is complete.

The unit can be used again for any number of additional x-rays the patient may have taken. (As the x-rays are taken, the area of the film reserved for the identification is isolated by the blocker **36** from any light emitted by the intensifying screens **16** and **18**.) Before each insertion, proper charging of the phosphor by exposure to incident light should be insured. After the film in all the cassettes is marked, the label **25A** is removed from the carrier sheet **22A** and discarded.

In the form of insertion unit illustrated in FIGS. **7** and **8**, a carrier sheet **22B** is provided with a dry coating **45** of phosphor. A label **25B** used therewith has only pressure-sensitive adhesive **36** disposed on the side opposite the indicia. To protect the adhesive prior to use a disposable strip sheet **47** is provided. This embodiment differs from that of FIGS. **5** and **6** in that the phosphor is on the carrier sheet rather than the label before the two are brought together. In the assembly there is less close spacing between the phosphor and the indicia than in the prior embodiment because here the adhesive and the label stock lie between. Hence, there is a theoretically greater chance of some slight fogging due to a larger penumbra.

Many variations can be made in the procedures and devices described above without departing from the essential concept of the invention. Rather than use a label, indicia could be placed directly on a phosphor-coated element similar to the carrier sheet **22B**. It is conceivable to mix the phosphor with the adhesive or apply it as a coating on the carrier sheet, or the phosphor could be uniformly dispersed in the body of the carrier sheet or of the label, or the carrier sheet could be made translucent and the phosphor disposed on the side thereof opposite the label. Adhesive can be located on the carrier sheet rather than the label and it need not be pressure sensitive. It is also possible that the insertion unit be a shape other than flat, in order to be used with film-containing housings other than x-ray cassettes.

An improved form of guiding means is provided by the invention as illustrated in FIGS. **9** to **14**. Referring first to FIG. **9**, a cassette **50** is shown in closed position. It includes a lid **51** and a channel frame **52** to which the lid is joined by hinges **53** and **53A**. Latches **54** and **54A** serve to secure the lid **51** releasably in closed position.

As shown in FIGS. **11** and **12**, the cassette includes a front panel **55**. Inside the lid is a felt pressure pad and a rear intensifying screen similar to the pad **15** and screen **16** of FIGS. **1** and **3**. Adjacent to the rear screen is photographic x-ray film **56** and on the other side of the film is a front intensifying screen **57**. Between the front intensifying screen **57** and the front panel **55** is another pressure pad **58**.

The procedure for insertion and withdrawal of a marking unit with the cassette of FIGS. **9** to **14** is similar to that described in relation to the embodiments of FIGS. **1** to **8**. A marking unit **59** is therefor shown in FIGS. **9** and **12** in position to be inserted into the cassette.

In the preferred form of the improved guiding means, the cassette includes a slot **60** defined between an edge of the lid **51** adjacent the hinge **53** and the adjoining edge portion of the channel frame **52**. The slot **60** is made simply by removing part of an inwardly directed flange **61** formed around the perimeter of the lid **51**.

As shown particularly in FIGS. **11** and **12**, the channel frame **52** includes an inwardly projecting flange **62** which underlies the lid flange **61** on the lid **51** when the lid is in closed position. In the region of the slot **60**, this flange **62** on the channel frame provides a support for a light-seal formed of a brush **63** with polyethylene bristles. When the lid **51** is closed, the underside of the lid adjacent the slot **60** engages the outer end of the bristles **63** as shown in FIG. **12** and prevents passage of light into the cassette. At the same time the bristles **63** can be displaced to permit insertion of the unit **59**. The bristles may be mounted on a plastic backing **64** which in turn is secured by adhesive to the flange **62** of the channel frame **52**.

After the unit **59** has passed the light-seal during its insertion, it next encounters a metal track **65** which is designed to direct the unit into proper position with respect to the x-ray film **56**. The track **65** is shown assembled with the other parts in FIGS. **10** to **12** and individually in FIG. **14**. It includes a central portion divided by a longitudinal indentation **67** formed so that the unit **59** slides only against that portion of the track to each side of the indentation **67**. As a consequence the frictional resistance of the track to movement of the unit **59** is reduced. Another function of the indentation **67** is that it serves to strengthen the track and make it more rigid. This is of importance because the track should be as flat as possible to maintain an even bearing pressure on the insertion unit **59**.

At the end of the track **65** nearest the slot **60**, an entry lip **68** is formed for guiding the unit **59** between the track and the film **56**. The opposite end of the track **65** is formed with a turned-in edge which serves as a stop projection **69**.

As shown in FIG. **12**, a foam pad **70** supports the track within the cassette (in FIG. **13** the pad is shown in full perspective). The function of the pad is to urge

the track **65** resiliently toward the film **56.** A central cut-out portion **71** is formed in the pad **70** to control the amount of resilient spring force it exerts on the track, i.e. the larger the area of the cut-out portion **71,** the less spring force exerted by the pad **70** on the track **65,** and vice versa. The thickness of the pad **70** is such that the stop projection **69** on the track **65** is spaced from the inside surface of the lid **51** as shown in FIG. **12** when the lid **51** is closed and the track and film are in face-to-face engagement. When the insertion unit **59** is directed between the track **65** and the film **56,** the track is moved upwardly as shown in FIG. **12** to compress the pad **70.** Such compression of the pad cannot go beyond the point where the stop projection **69** contacts the underside of the lid **51.** The preferred material for the pad **70** is relatively soft silicone foam.

As in the embodiment of FIGS. **1** to **3,** the felt pad **58** is cut away and a lead blocker **72** is positioned in the region where the unit **59** is to be inserted. The function of the blocker is to prevent x-rays from energizing the intensifying screen **57** in the area where the identifying markings are to be placed in the film. As shown in FIG. **10,** a cutout **73** is formed in the corner of the rear intensifying screen so that the track **65** may directly contact the film **56** when the lid **51** is closed.

In operation, the film **56** is loaded within the cassette in the usual manner and the light-emitting phosphorescent insertion unit **59** is prepared with its identifying data as described in relation to FIGS. **1** to **8.** When the lid **51** is closed, the track **65** is thereby brought down resiliently against the corner area of the film **56** where the identifying markings are to be placed. The unit **59** is then inserted through the slot **60** and past the bristles of the light-seal assembly **63.** The forward end of the unit **59** then reaches the entry lip **69** at the end of the track **65,** and the lip **68** guides the unit **59** between the track and the film. Further movement of the unit **59** causes it the slide over the surface of the track (except in the area of the indentation **67**) and to force the track **65** against the resilient pad **70.** The pad **70** in turn compresses but not beyond the point determined by the stop projection **69.** Under the force of the pad **70** acting through the track **65,** the insertion unit is held flat against the film **56.** In this manner, an image of the indicia on the unit is exposed on the film with a minimum of blurring.

We claim:

1. In an x-ray cassette including a shallow body adapted to enclose film and a slot into which a flat flexible light-emitting unit can be inserted to expose identifying markings on the film; improved guiding means for locating the unit inside the cassette with respect to the film comprising

a. a rigid track within the cassette against which the unit is slideable as it is inserted through the slot,
   i. said track facing the enclosed film and lying in a plane parallel thereto, and
   ii. said track including an entry lip at one end for directing the unit between the track and the film

b. a resilient pad supporting the track within the cassette for resiliently urging the track against the unit to hold the latter flat against the enclosed film, and

c. means located in the slot to permit entry of the unit but to prevent passage of light into the cassette.

2. The combination according to claim **1** wherein the track includes a central longitudinal indentation.

3. The combination according to claim **1** wherein the pad is formed with a central longitudinal cut-out portion.

4. The combination according to claim **1** wherein the cassette includes a lid hinged to one edge portion of the body, the slot being defined by the edge portion of the body and a cutout in the edge of the lid.

5. In an x-ray cassette including a shallow body adapted to enclose film and a slot into which a flat flexible light-emitting unit can be inserted to expose identifying markings on the film; improved guiding means for locating the unit inside the cassette with respect to the film comprising:

a. a rigid track within the cassette against which the unit is slideable as it is inserted through the slot,
   i. said track facing the enclosed film and lying in a plane parallel thereto,
   ii. said track including an entry lip at one end for directing the unit between the track and the film,
   iii. a central longitudinal indentation, and
   iv. a stop projection at the end opposite the entry lip;

b. a resilient pad supporting the track within the cassette for resiliently urging the track against the unit to hold the latter flat against the enclosed film independently of any pressure means for holding the film in place in the cassette,
   i. said pad being compressible until the stop projection engages an inner surface of the cassette,
   ii. said pad being formed with a central cutout portion; and

c. a brush located in the slot to permit entry of the unit but to prevent passage of light into the cassette.

6. In an x-ray cassette including a shallow body adapted to enclose film, a lid hinged to one edge portion of the body and a slot in the cassette into which a flat flexible phosphorescent light-emitting unit can be inserted to expose identifying markings on the film; improved guiding means for locating the unit inside the cassette with respect to the film comprising

a. a metal track within the cassette against which the unit slides as it is inserted through the slot, said track including
   i. an entry lip at one end which directs the unit between the track and the film,
   ii. a central longitudinal indentation, and
   iii. a stop projection at the end opposite the entry lip;

b. a foam pad supporting the tract within the cassette and urging it resiliently toward the film,
   i. said pad being compressible until the stop projection engages an inner surface of the cassette,
   ii. said pad being formed with a central cut-out portion; and

c. a brush located in the slot to permit entry of the unit while preventing passage of light into the cassette;

d. said slot being defined between an edge portion of the body and part of that edge of the lid which is hinged to the body.

7. The combination according to claim **6** wherein the pad is of silocone foam and the brush is formed with polyethylene bristles.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,845,314 Dated October 29, 1974

Inventor(s) William H. Byler, Halsey L. Raffman and Frank Masi

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Title Page, under heading "Inventors," "Frank Mast," should read --Frank Masi--.

Column 5, line 44, "adhesive 36" should read --adhesive 46--.

Column 7, line 38, "causes it the" should read --causes it to--.

Signed and sealed this 7th day of January 1975.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents