

[54] APPLICATION OF DIMENSION INDICIA TO X-RAY EXPOSURE

[76] Inventor: Leslie W. Seldin, 40 E. 66th St., New York, N.Y. 10021

[22] Filed: Apr. 20, 1973

[21] Appl. No.: 353,204

[52] U.S. Cl. .... 250/476, 250/478  
[51] Int. Cl. .... G03b 41/16  
[58] Field of Search ..... 250/476

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Primary Examiner—James W. Lawrence  
Assistant Examiner—C. E. Church  
Attorney, Agent, or Firm—Ostrolenk, Faber, Gerb & Soffen

[57] ABSTRACT  
A substrate, such as paper or the carrying envelope adjacent an X-ray film, or the film itself, carries a dimension grid formed of X-radiation opaque material. X-radiation passing through the grid places a photographic image of the grid on the X-ray film.

18 Claims, 9 Drawing Figures

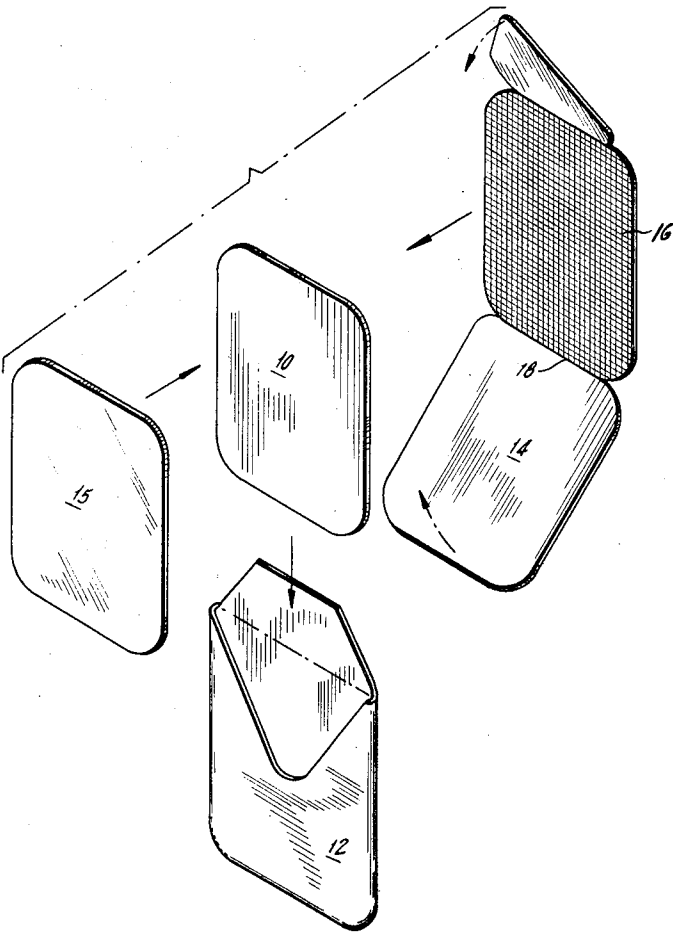


FIG. 1.

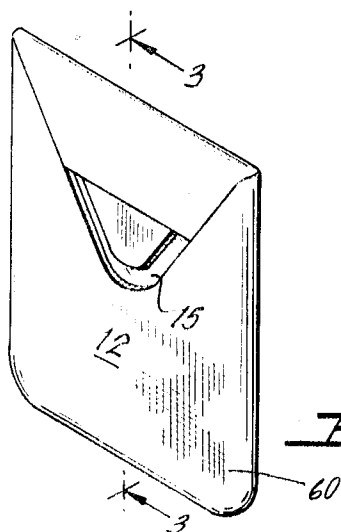
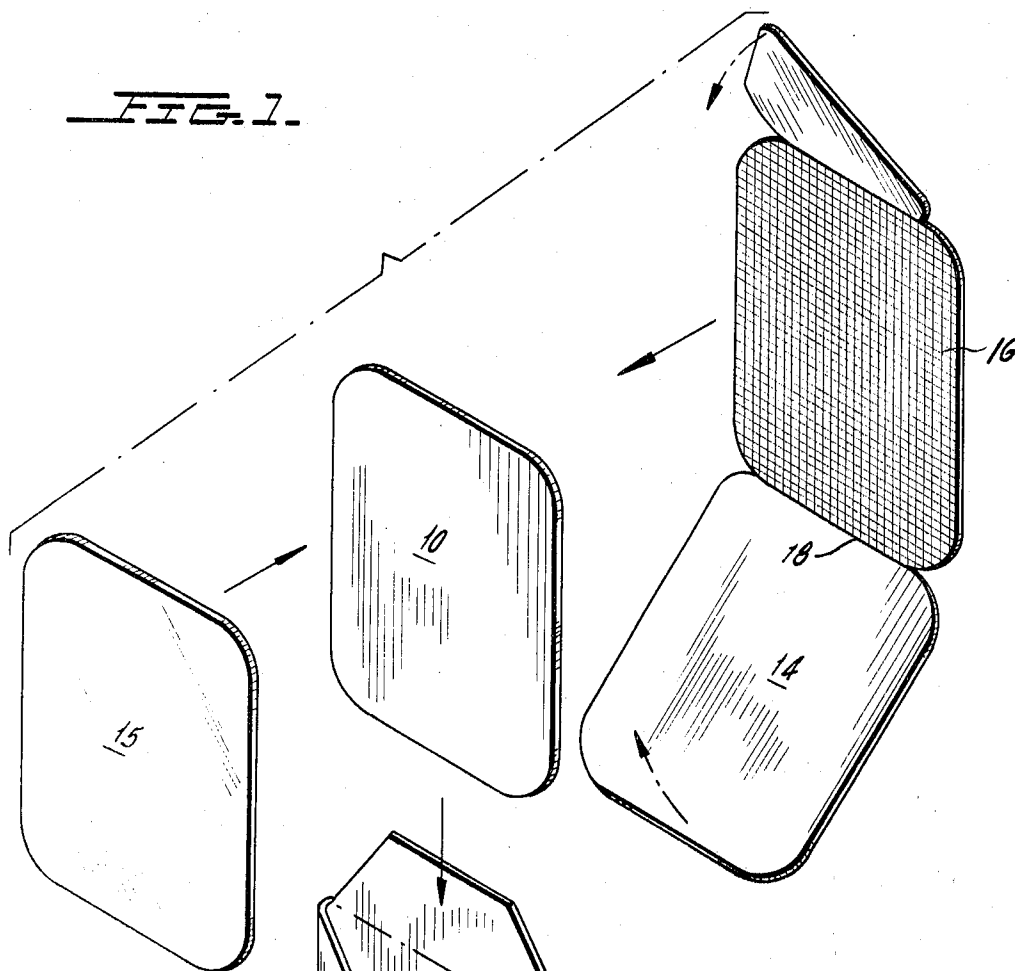
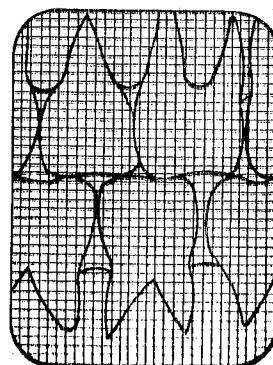


FIG. 2.

FIG. 4.



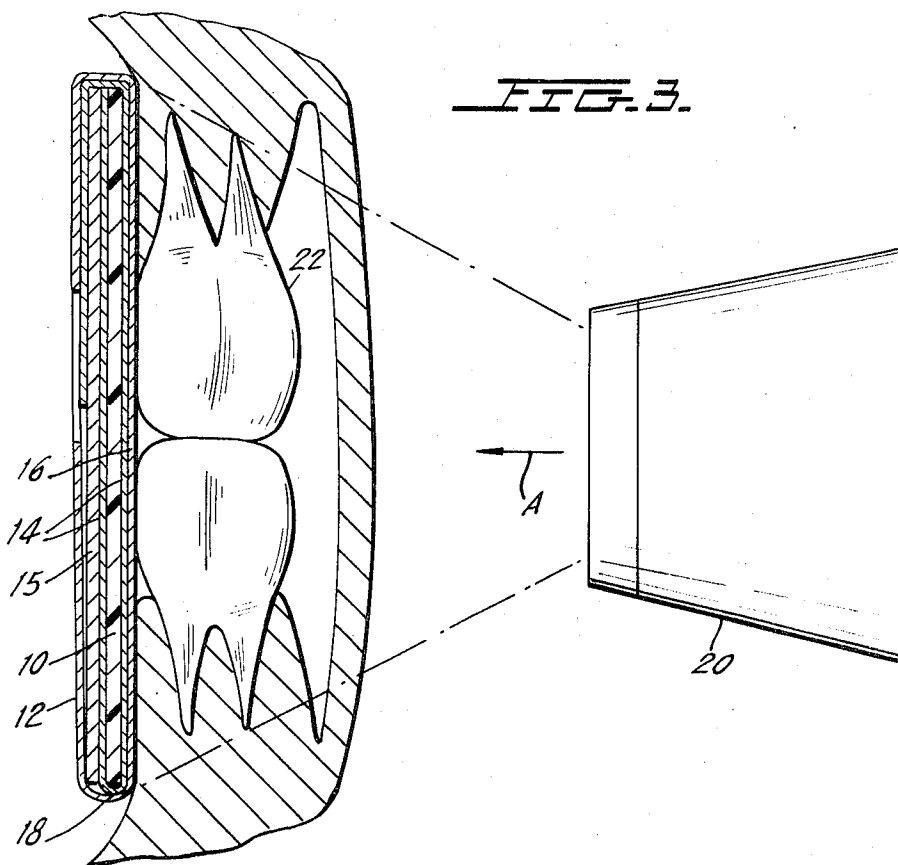


FIG. 5.

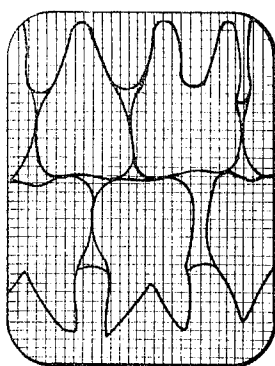


FIG. 6.

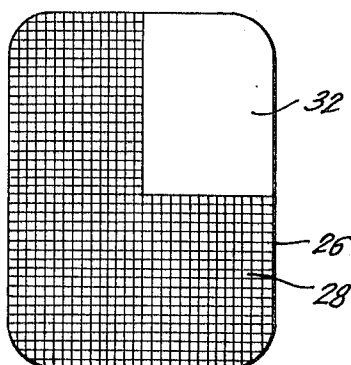


FIG. 7.

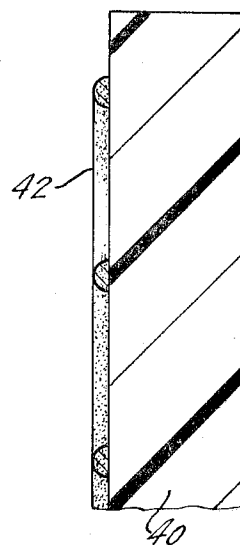


FIG. 8.

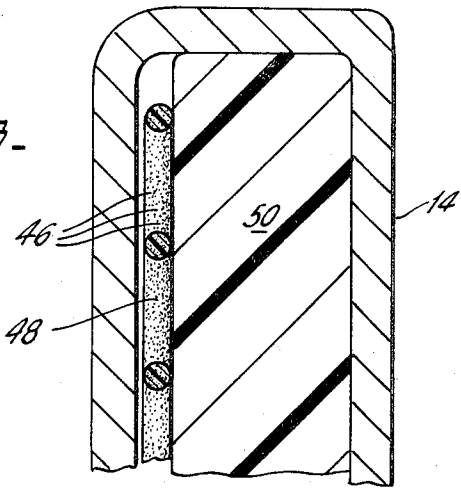
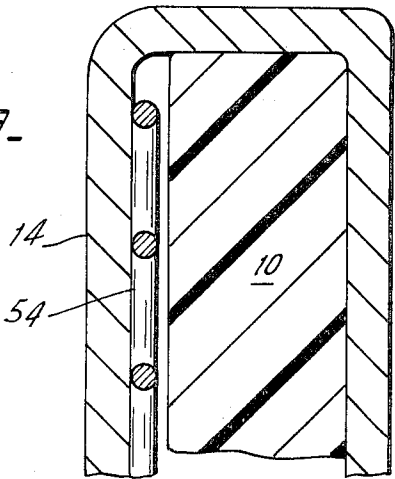


FIG. 9.



## APPLICATION OF DIMENSION INDICIA TO X-RAY EXPOSURE

This invention relates to applying dimension indicia or a dimension grid to an X-ray film at the time that the film is exposed. The invention has particular application in the dental X-ray field, to films of the type shown in U.S. Pat. No. 3,443,093, although use of the invention is not limited to any particular type of X-ray film.

### BACKGROUND OF THE INVENTION

It is helpful to have information as to the dimensions of an X-rayed object when an X-ray photograph of the object is viewed. For example, in performing a dental procedure on a tooth, it is quite helpful to be able to readily determine the precise location of the work area in the tooth with respect to a visible exterior surface and to determine the size of the work area.

At present, if a dental X-ray indicates the presence of periodontal bone erosion, in order to determine the exact amount of deterioration, the dentist relies upon his sense of feel and approximate markings on dental instruments. It would be beneficial for him to additionally be able to readily ascertain from a radiograph exactly how many millimeters of bone had been eroded.

Also, if a second X-ray photograph were taken some time later, comparisons of the two radiographs would show what changes had occurred.

Based upon the foregoing examples, if the X-ray photograph of the tooth also carried dimension indicia, the dentist could more easily make location, size and change determinations.

In the prior art, various X-radiation opaque material dimension indicia carrying constructions are interposed between the X-ray source and the film in order to cause dimension indicia to appear upon the exposed and developed X-ray film. These known systems require a special X-radiation opaque material carrying unit or plate that is separate from the film.

It would be desirable to provide a simple, compact, inexpensively manufactured, easily and conveniently handled means for using X-radiation opaque material to cause dimension indicia to appear upon exposed and developed X-ray film.

### SUMMARY OF THE INVENTION

In accordance with the invention, dimension indicia or, more particularly, a grid of dimension indicia, formed of X-radiation opaque material is positioned near the X-ray film to be exposed such that X-rays produce an image of the indicia or grid upon the film.

In a preferred form of the invention, the radiation opaque material is in the form of an X-radiation opaque ink, e.g., a suspension of radiation opaque metallic particles such as lead or iron, in a conventional ink carrier. Alternatively, the opaque material could be filaments of X-radiation transparent material, e.g., plastic, carrying or having metal particles embedded in them. As a further alternative, it could be metal wires. Other appropriate X-radiation opaque materials and arrangements including such materials will be apparent to persons skilled in the art.

In one embodiment, X-radiation opaque material, such as ink, is applied to the surface of the film itself. The ink is soluble in photographic developing fluids or

water and is subsequently washed away during the process of developing the X-ray photograph.

Certain X-ray films, e.g., dental X-rays, are usually encased in light and stray radiation excluding or shielding coverings and may additionally be protected by another covering layer. The radiation opaque material, e.g., ink, could be carried on the covering, preferably upon the surface of that covering which is facing toward and more preferably the surface contacting the surface of the film that is to be exposed.

Using the procedure of applying ink to the film or to a protective covering over the film has the advantages of savings in separate parts needed, expenses of manufacture and it enables simplicity of manufacture. For example, if the covering over the film is a particular paper or thin plastic sheet, as is used in dental X-rays, before the cutting or shaping of this covering, indicia or a grid of X-radiation opaque ink is applied to its surface. Then after the covering has been shaped, it is positioned so that its radiation opaque ink carrying surface is in contact with the film.

In another embodiment of the invention X-radiation opaque material particles are embedded in X-radiation transparent filaments positioned near the film.

Being observable on the developed film, the dimension indicia or grid might obstruct part of the viewed image. The indicia should be designed to preclude or minimize such obstruction. One way to accomplish this is to arrange the X-radiation opaque material to provide a blank area on the developed film where the image of the X-rayed object will appear. However, where precise measurements are desired, it is helpful to have the image of the dimension indicia pass through the image of the subject being X-rayed.

When radiation opaque ink is used to create the indicia or grid, the indicia or grid lines can be made quite thin, without any concern about their being bent, shifted or distorted during use. X-radiation opaque wires can also be made quite thin. But, with thin inherently flexible wires, there is always a possibility of distortion.

As an alternative to or in addition to using thinner lines of X-radiation opaque material, the concentration of X-radiation opaque material in the indicia or grid can be diluted, so as to cause the X-ray photograph image of the indicia or grid to be faint and to reduce its opacity, thereby minimizing its obscuring effect. With X-radiation opaque ink, for example, the concentration of X-radiation opaque particles in the ink can be appropriately controlled to create the desired opacity of the lines of the indicia or grid, and to make the grid lines darker or fainter, as desired. With X-radiation opaque material carrying filaments particle concentration can be similarly controlled with similar results.

As yet a further alternative, it is conventional, especially in the dental X-ray field, to provide a single use film packet including two juxtaposed X-ray films that are simultaneously exposed in a single X-ray procedure, whereby both films carry the same photographed image. In this film arrangement, a substrate carrying the radiation opaque indicia or grid is interposed between the two X-ray films, such that the image on one of the films is free of the indicia to preclude any obscuring of the image of the subject being viewed while the image on the other film carries the indicia or grid.

With the X-radiation opaque material for producing the indicia or grid being directly applied to the film or

located on that surface of the covering over the film or a substrate that is adjacent the surface of the film, the photographic image of the indicia or grid will be in focus on the film, will be quite fine, and will thereby not be undesirably defocused or needlessly broad, as might occur if the radiation opaque material were far from the surface of the film.

Accordingly, it is the primary object of the present invention to provide dimension indicia or a dimension grid on a developed X-ray film.

It is another object of the invention to have such indicia or grid interfere minimally with the image being viewed.

It is yet another object of the invention to provide an X-ray film packet capable of applying such indicia or grid to a film without requiring additional objects to carry the indicia or grid image forming means.

These and other objects of the invention will become apparent from the following description of the accompanying drawings.

### DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded perspective view of a film packet incorporating one embodiment of the invention;

FIG. 2 is a perspective view of the packet of FIG. 1 in assembled condition;

FIG. 3 is a cross-sectional view through the packet of FIG. 2 along the line and in the direction of arrows 3—3, and showing the packet in use during X-raying;

FIG. 4 is a representation of a developed X-ray photograph of teeth wherein the invention was used during the photographing;

FIG. 5 is the same type of representation as FIG. 4 but with the photograph having been made using different style indicia;

FIG. 6 is an elevational view of a modification of an element of the packet of FIG. 1; and

FIGS. 7-9 are enlarged fragmentary cross-sectional views through X-ray films provided with alternate embodiments of the invention.

### DESCRIPTION OF THE PREFERRED EMBODIMENTS

The following detailed description of a number of embodiments of the invention relates to dental X-ray film. It should be understood, however, that the invention is adaptable for use with any X-ray film or plate wherein dimension indicia or grids on the developed film are desired.

Referring to FIGS. 1-3, conventional dental X-ray film 10 is comprised of conventionally manufactured photographic film cut to the desired size for a dental X-ray photograph.

In order to protect the film from exposure to light, it is enclosed within an envelope 12 which is sealed around its edges to preclude the entry of light. To further shield the film from light, within the envelope is a separate strip of light opaque paper 14 which is folded or wrapped about the film. An additional light protective strip 15 blocks light from entering the envelope flap.

In accordance with a preferred embodiment of the invention, the surface of paper 14 carries a dimension line grid 16 of X-radiation opaque material. The lines of grid 16 may be spaced one millimeter apart, al-

though the particular dimensions of the grid are a matter of choice.

The X-radiation opaque material is comprised of a conventional ink carrier which has conventionally suspended in it a fine, radiation opaque powder of metal, e.g., lead or iron particles, or the like. When the carrier dries, it leaves grid 16 remaining. The radiation opaque lines are only on one surface of paper 14 and may extend across the entirety of that surface, only the part thereof which faces one surface of film 10 or any other part of that surface. Paper 14 is folded at 18 such that the grid faces inward toward the surface of film 10 to be exposed. With the enclosing and sealing of envelope 12, grid 16 is in contact with the surface of film 10 and is, in effect, upon that surface.

When X-radiation travels from conventional X-radiation source 20 in direction A, it passes through radiation opaque teeth 22 being photographed, X-radiation transparent envelope 12, X-radiation transparent sheet 14, and X-radiation opaque grid 16 and impinges upon film 10. Radiation opaque teeth 22 and grid 16 produce a composite image upon film 10, as in FIG. 4, of a tooth overlaid with a dimension grid.

Because grid 16 is made from radiation opaque ink, the thickness of the lines of grid 16 are controllable by the means used for printing such lines, by the flowability of the ink, and by the absorbency and capillary action of the sheet or substrate 14 to which the ink is applied. In accordance with conventional ink application techniques, the lines of grid 16 can be made quite thin, so as to not obscure any significant portion of the image of teeth 22.

The concentration of radio opaque particles suspended in the ink carrier can be varied to make the grid appear more or less opaque upon film 10. Compare FIG. 4, which shows an image with a more opaque grid 23, with FIG. 5, which shows an image with a fainter grid 24. Selection of the desired ink concentration determines the extent of the opacity of the image of the grid. Conventional techniques of varying color intensity of ink can be used for varying the concentration of the radiation opaque particles, for example.

Referring to FIG. 6, the indicia or grid need not be spread across the entire substrate. If sheet 26 is substituted for strip 14, for example, grid 28 only occupies a portion of the surface of sheet 26, leaving clear space 32. This will provide a correspondingly sized and positioned unobscured area in the image of the grid upon developed film 10.

In accordance with a further alternative shown in FIG. 7, instead of being applied to a substrate or sheet positioned next to the surface of film 10, film 40 has an X-radiation opaque ink grid 42 applied directly upon its own surface. Such application of the grid could occur, for example, while larger sheets or rolls of film are being unwound and individual films are being cut to size. The ink is soluble in conventional film developing solvent or in water, so that after the image of the grid is applied to the photographic image on the film the radiation opaque material which produces the grid is washed from the film during the developing process.

As a further alternative, the radiation opaque material could be on the outer surface of the sheet 14, or the surface away from film 10, if it were desired to separate the film from the radiation opaque ink. Alternatively, the radiation opaque grid 60 could be on either the interior or the exterior surface of envelope 12 as illus-

trated in FIG. 2. Since the envelope and sheet 14 are rather thin, there would only be minimal defocusing of the image of the grid as a result of the separation of the radiation opaque material from the film.

In FIG. 8 is shown an arrangement wherein particles of X-radiation opaque material 46 are embedded in radiation transparent plastic filaments 48. A latticework of filaments 48 is applied to film 50 or is separately supported next to that film. The opacity of the image of grid 46, 48 is determined by selective variation of the concentration of particles 46 in filaments 48.

In the further alternative arrangement of FIG. 9, grid 54 of X-radiation opaque material is comprised of a grid of metal wires, carried upon strip 14 or upon film 10 or it is otherwise supported as described in the embodiments herein.

Although preferred embodiments of this novel invention have been described, many variations and modifications will now be apparent to those skilled in the art. Therefore, this invention is to be limited, not by the specific disclosure herein, but only by the appended claims.

I claim:

1. An X-ray film package for applying dimension indicia on the developed X-ray film, comprising:  
a sealable, light excluding, thin envelope, having a pocket defined therein and having a first surface;

an X-ray film having a first surface which is to be exposed to X-radiation; said film being positioned in said envelope pocket and said film first surface facing said first surface of said envelope; said envelope first surface being comprised of X-radiation transparent material;

X-radiation opaque material arranged to define dimension indicia and supported in position near said film first surface and on the side of said first film surface that faces toward an X-ray source; whereby exposure of said X-ray film package to X-radiation impinging upon said envelope first surface produces a photographic image of the dimension indicia on said film first surface.

2. The X-ray film package of claim 1, wherein said X-radiation opaque material is positioned in said envelope.

3. The X-ray film package of claim 2, wherein said radiation opaque material comprises filaments of X-radiation transparent material which carry particles of X-radiation opaque material in predetermined concentration with respect to said radiation transparent material.

4. The X-ray film package of claim 2, wherein said radiation opaque material comprises fine metal wires; said wires being carried by a carrier arranged such that said wires are adjacent said film surface.

5. The X-ray film package of claim 1, wherein said

indicia are in the form of a grid of lines spaced apart predetermined distances; said grid being designed to provide an area therein which is clear of said indicia, thereby to cause an area clear of dimension indicia to appear in the image of said film.

6. The X-ray film package of claim 1, wherein said radiation opaque material comprises an ink which is comprised of a suspension of particles of X-radiation opaque material in a carrier; said ink being carried on a means inside said envelope.

7. The X-ray film package of claim 6, wherein said indicia are in the form of a grid of lines spaced apart predetermined distances.

8. The X-ray film package of claim 6, wherein said inked indicia are applied to said film first surface.

9. The X-ray film package of claim 8, wherein said ink is soluble in a liquid that is used during a photographic film developing process, thereby to enable the ink to be dissolved off said film during the film developing process.

10. The X-ray film package of claim 6, wherein the concentration of said X-radiation opaque particles in said ink is preselected to provide predetermined opacity for the image of said indicia on said film as compared with the opacity of the image of the object being X-ray photographed appearing on said film.

11. The X-ray film package of claim 10, wherein said indicia are in the form of a grid of lines which are spaced apart predetermined distances.

12. The X-ray film package of claim 6, wherein said X-radiation opaque material is positioned in said envelope.

13. The X-ray film package of claim 12, further comprising a separate surface near said film first surface; said linked indicia being applied to said separate surface.

14. The X-ray film package of claim 13, wherein said separate surface carrying said inked indicia is positioned adjacent and opposed to said film first surface.

15. The X-ray film package of claim 6, wherein said X-radiation opaque material is applied to and supported on said envelope.

16. The X-ray film package of claim 15, wherein said X-radiation opaque material is applied to said envelope first surface.

17. The X-ray film package of claim 6, wherein there is an indicia producing means carrying surface within said envelope and said X-radiation opaque material is applied to said surface in said envelope.

18. The X-ray film package of claim 17, wherein said indicia producing means carrying surface in said envelope is on a protective sheet placed in said envelope between said envelope first surface and said film first surface.

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