

[54] **METAL SCREENS USED FOR INDUSTRIAL RADIOGRAPHY**

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[63] Continuation of Ser. No. 205,567, Dec. 7, 1971, abandoned.

[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **250/323; 250/482; 250/485; 250/510**

[51] **Int. Cl.** **H01j 1/54**

[58] **Field of Search** **250/315, 321-323, 250/482, 503, 510, 485; 252/478**

[56] **References Cited**

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[57]

ABSTRACT

A front screen is placed in contact with a film adapted for being exposed in industrial radiographic uses, the rear of the film being in contact with a rear lead screen. The front screen can be nickel, zinc, or alloys thereof with one another or copper. A lead or mercury coating can be placed on the screen in contact with the film. When a coating is employed the screen may also be made of pure copper. The front screen is intended to improve the quality of the image on the film with little sacrifice in exposure time.

10 Claims, 3 Drawing Figures

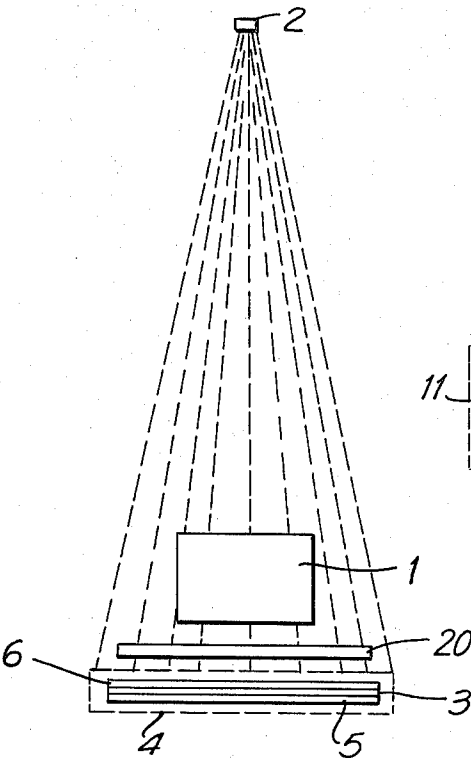


FIG. 1

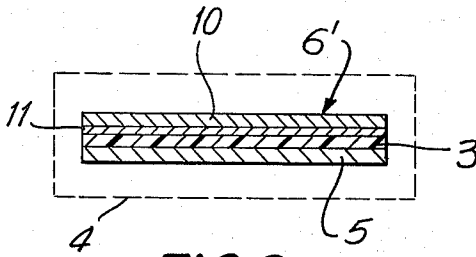


FIG. 2

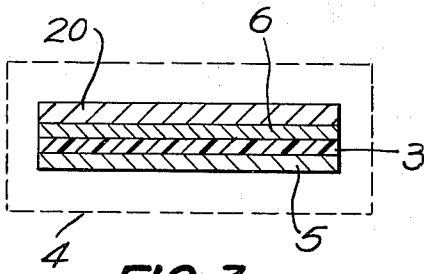


FIG. 3

METAL SCREENS USED FOR INDUSTRIAL RADIOGRAPHY

CROSS-RELATED APPLICATION

This application is a continuation of our earlier Application Ser. No. 205,567, filed Dec. 7, 1971 now abandoned and claims the priority of our Application filed in France on Dec. 8, 1970.

BACKGROUND OF THE INVENTION

a. Field of the Invention

This invention relates to industrial radiography and more particularly to the construction of a screen placed in front of a radiographic film.

b. Description of the Prior Art

It is known that the quality of the image obtained from an industrial monitoring radiograph determines to a considerable extent the value of such monitoring, since it constitutes a more or less fine appreciation by means of which the radiographic or gammagraphic examination concerned is able to reveal the defects in the object being examined. Considerable progress in such appreciation has been achieved by the employment of image quality indicators (IQI) either of the perforated step type, or of the filament type (standard NF A 04-304 and DIN 54109).

The image quality, measured with the aid of the IQI, is affected advantageously or disadvantageously by specific factors such as the nature of the emulsion on the radiographic film, the radiation utilized and also the conditions selected for the exposure of the film. All these factors act antagonistically on the image quality and the exposure times. Thus, an increase in the distance from the source to the film, for example, does improve up to a certain limit the image quality, but it also requires exposure times directly proportional to the square of said distance. The selection of exposure conditions by a technician embodies a compromise which he deems to be the optimum between the desired image quality and an acceptable duration of exposure.

The exposure conditions, such as the nature of the radiation end of the radiographic emulsion, the distance from the source to the film, etc., having been determined, there exists a lower limit for the exposure duration, with a given image quality, or an upper limit for the image quality, with a given exposure duration. Attempts have been made, all other factors remaining unchanged, to reduce the exposure time (the image quality remaining constant) or to increase the image quality (the exposure time remaining constant).

It is known to dispose metal screens, made from lead of approximately selected thickness and having a surface condition of suitable quality, on either side of, and in intimate contact with, the film. This reduces the exposure time necessary for the optical density of the film to attain the selected value for a given source of radiation. Screens utilized in this manner are known as intensifiers.

This intensifying effect is achieved to the detriment of the image quality as soon as the mean energy of the radiation utilized exceeds approximately 1 MeV, this being notably the case with linear accelerators, betatrons, and radioactive sources utilizing the radioisotope, cobalt 60. In order to obtain, under these conditions, radiographs of good quality, the International Welding Institute recommends the elimination of the front screen (the screen placed in contact with the film

on the face receiving the radiation from the source). The rear screen is retained, since its intensifying effect is not accompanied by any appreciable loss of image quality.

The interposition between the object to be examined and the film of a heavy metal screen, such as a lead or tungsten screen, whose thickness has been judiciously selected, permits the achievement of an improvement in the image quality of the film subjected to radiation of medium or high value energy, substantially higher than 300 keV, by means of an increase, which is frequently considerable, of the exposure times. Such screens, whose thickness may be approximately 5 to 20 times greater than that of an intensifier screen and which are neither necessarily nor generally disposed in contact with the film, are known as filters. A judicious combination of the intensifier effect of certain metal screens and the filtration effect of other screens may be useful.

Quite recently a new type of metallic screen has been proposed. Hereby, a front screen made of copper is disposed in intimate contact with the front surface of the film i.e., the surface facing towards the object to be examined. The surface state of the copper screen must be as good as possible. This screen, utilized jointly with a conventional rear lead screen, affords a very substantial improvement in the image quality with exposure times substantially the same as those conventionally obtained only with a rear lead screen.

SUMMARY OF THE INVENTION

The invention is directed to novel types of metal screens, optionally combining the advantages of the screen described hereinabove while at the same time eliminating one or more of the disadvantages thereof.

It has been noted hereinabove that the copper screen must exhibit excellent surface quality in order that its effect on the image quality shall be optimum. Since copper is a soft metal, the surface of a copper screen is not able to withstand, without damage, the numerous manipulations which are indispensable for carrying into effect the radiographic techniques in current industrial utilization.

According to the present invention there is provided a film for exposure in radiography and a screen which is in contact with the front surface of the film, said screen being formed of:

- a. an alloy of copper with nickel and/or zinc, the alloy containing not more than a total of 4% of any other element or elements,
- b. nickel or zinc,
- c. an alloy of nickel and/or zinc, the alloy containing not more than a total of 4% of any element or elements other than nickel, zinc or copper; or
- d. copper having on the face of the screen which contacts the front surface of the film, an additional thin metallic layer.

Thus, by way of example, the present invention contemplates the utilization of a screen made from alloys such as cupronickel, brass and nickel silver.

A screen of copper alloy, the thickness of which is judiciously selected and does not exceed 1 mm, affords, when employed jointly with a conventional rear lead screen, a similar improvement in the image quality as a copper screen, while requiring the same exposure times. It suffices to select the copper alloy which is best adapted to give the desired mechanical characteristics.

The use of a screen which comprises an alloy based on nickel or zinc, as defined hereinabove, permits obtaining an image quality which is an improvement when the thickness of the screen is not above the predetermined maximum (1 mm), but the mechanical strength of the screen may not be equally satisfactory.

In a preferred embodiment of the invention, an intensifying effect is obtained by means of a thin metallic layer deposited on the face of the screen contacting the film. This thin metallic layer is constituted, according to the invention, of lead or mercury deposited by any appropriate means, whether electrolytic or of some other nature. The thickness of the deposited lead or mercury layer is generally substantially smaller than that of the base alloy and, it is never greater than a quarter thereof. It should be noted that, if strictly necessary, if the lead does not combine chemically with the base alloy at least a portion of the mercury deemed to be "deposited" is combined in the form of an amalgam with the base alloy. However, this distinction has no effect on the results obtained.

The results of the intensifying effect of a thin metallic layer are as follows: the image quality is superior to that obtained without a front screen, without entirely attaining the image quality obtained with a screen which does not have a thin metallic layer, but the exposure times are very close to those obtained with a lead front screen. Thus, the degree of progress achieved relative to this latter arrangement is very clear.

In a further embodiment of the invention, there is provided a supplementary filter constituted by a heavy metal whose atomic number is between 74 and 82 inclusive, or an alloy of these metals, the supplementary filter being of small thickness (less than 1 mm), contrary to the conventionally employed filters. The supplementary filter, which in some cases may be secured to the screen but which may also be arranged some distance forward of the screen, e.g., outside a cassette containing the film and screen, improves the image quality at the cost of a small increase in the exposure duration.

Thus, purely by way of example, a tungsten screen 0.2 mm thick arranged before a nickel screen 0.7 mm thick and covered with a 0.05 mm layer of lead in intimate contact with the film, increases the exposure times only by approximately 10%, this being very much less than in the case of the conventional filters for equal image quality.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a diagrammatic illustration of radiographic apparatus according to the invention;

FIG. 2 is an enlarged cross-sectional view of a modified portion thereof; and

FIG. 3 is an enlarged cross-sectional view of another modification of said portion.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, herein is shown apparatus for the radiographic investigation of a specimen 1, the apparatus comprising a radiation source 2 such as an X-ray source or the like adapted to expose an image of the specimen on an X-ray film 3. The film 3 is mounted in a cassette 4 and a back screen 5 composed of lead is in contact with the rear surface of the film. The construction described up to this point is conventional.

The cassette also contains a screen 6 in contact with the front surface of the film, and in accordance with the invention, the screen 6 is of particular construction to provide improved image quality without substantial increase of exposure time.

The screen 6 has a thickness less than 1 mm.

The screen 6 can be an alloy of copper with nickel and/or zinc. Examples of such alloys are brass (copper base alloy with 5-45% zinc), cupro-nickel alloys (copper alloy with less than 50% nickel) or cupro-nickel-zinc alloys of the following compositions, 52-67% Cu, 6-30% Ni, and 13-35% Zn. The alloys may contain additional elements in a total content less than 4%. Such additional elements may be present for reasons independent of their radiographic use or they may be impurities whose elimination is unnecessary nor useful.

The screen 6 can also be composed of pure nickel or zinc with less than 4% other elements.

FIG. 2 shows another embodiment of the front screen 6' and herein the screen is composed of a base 10 and a thin layer 11 on base 10 and in contact with film 3. The base 10 may have the composition as indicated above for screen 6 or it may be made of pure copper with less than 4% other elements. The layer 11 may be composed of lead or mercury and is not greater than one-quarter of the thickness of screen 6'.

Placed in front of the front screen is a filter 20 whose thickness is less than 1 mm. The filter 20 may be a metal of atomic number between 74 and 82 inclusive of alloys thereof. Such metals are 74 Tungsten, 75 Rhenium, 76 Osmium, 77 Iridium, 78 Platinum, 79 Gold, 80 Mercury, 81 Thallium, 82 Lead.

The filter 20 has been illustrated in FIG. 1 as being outside the cassette, however, it is also possible to incorporate the filter within the cassette in contact with the front screen 6 or 6' as shown in FIG. 3.

What is claimed is:

1. A cassette for use in radiographic investigation of a specimen, in order to improve the image quality, the specimen being located between a radiation source of X or γ rays, said cassette comprising inside a body, a radiographic film, a front screen in contact with the front surface of the film facing said specimen, a back screen in contact with the rear surface of the film, said back screen being constituted of lead, said front screen being constituted of elemental nickel or an base copper alloy containing nickel, the elemental nickel screen or alloy containing not more than a total of 4% of any other element.

2. A cassette as claimed in claim 1 in which the thickness of said front screen is not greater than 1 mm.

3. A cassette as claimed in claim 1 comprising an additional thin metallic layer on the face of said front screen which contacts the front surface of the film.

4. A cassette as claimed in claim 3 in which said thin metallic layer is a layer of lead or mercury.

5. A cassette as claimed in claim 4 in which the thickness of the thin metallic layer is not greater than one quarter of the thickness of said screen.

6. A cassette as claimed in claim 1 comprising an additional screen in contact with the rear surface of the radiographic film to act as an intensifier.

7. A cassette as claimed in claim 6 in which said additional screen is made of lead.

8. A cassette as claimed in claim 1 comprising a filter in contact with the front screen, said filter being com-

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posed of a metal or an alloy of a metal whose atomic number is in the range of from 74 to 82 inclusive.

9. A cassette as claimed in claim 8 in which said filter has a thickness not greater than 1 mm.

10. A method of radiographic or gammagraphic examination of a specimen comprising exposing the specimen to radiation and producing an image of the specimen on a radiographic film, said method including the

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improvement comprising interposing a screen between the specimen and the film and in contact with the front face of the latter and forming said screen from elemental nickel or a copper base alloy containing nickel, the elemental nickel screen or alloy containing not more than a total of 4% of any other element.

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