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PHOTOGRAPHIC FILM PACKAGE

The present invention relates to a lens-fitted photographic film package having a simple exposure function, and more particularly to a lens-fitted photographic film package which is capable of providing
5 pictures having a high image quality.

It is heretofore usual to take pictures by using a camera and a film which are sold separately. Ordinarily, it is quite seldom that amateur photographers always take their cameras with them. Therefore,
10 there are many chances that one who takes no camera along wants to take pictures. From this point of view, the conventional camera/film systems are inconvenient.

Accordingly, it is considerably convenient
15 to provide a lens-fitted film package provided with simple exposing means which can be sold at a low cost, comparable to that of a conventional film, and can be available wherever ordinary photographic film is sold. Such a lens-fitted film package,
20 after the exposure of all frames of the film, can be forwarded to a photo-shop without removing the exposed film. Some photographic products that may be considered to be similar to such a lens-fitted film package having exposing means are proposed
25 in, for example, U.S. patent 2,933,027 and Japanese Utility Model Publication Number 39 - 33, 924. However, film packages such as are taught by either of the above-mentioned U.S. Patent or Japanese Utility Model Publications have by no means been
30 successfully put into practical use. Because of the need for the lens-fitted film package to be sold at a cost comparable to that of conventional photographic film, the film package is provided with low cost exposure means which comprise a simplified

taking lens and shutter and their associated elements. Therefore if such a film package with simplified exposure means is used in combination with conventional photographic film without any further consideration,
5 it is quite hard to provide pictures of a favorable image quality.

There is therefore a need for a lens-fitted film package which can provide pictures of an improved image quality and which can be produced at low
10 cost.

We have now found that satisfactory image quality can be produced using lens-fitted film packages in which the modulation transfer function (hereinafter MTF) values of both the taking lens
15 and the film are selected to meet certain criteria. (It may be noted that the terms MTF, optical transfer function and contrast transfer function are occasionally used synonymously).

According to the invention we therefore provide
20 a photographic film package comprising a film container provided with a taking lens and containing a film, said taking lens being so mounted as to permit exposure of said film, said film having an MTF value of above 1.1 for a spatial frequency
25 in the range of 5 to 10 lines/mm and said taking lens having an MTF value between 0.47 and 0.73 for a spatial frequency of 20 lines/mm.

Thus with the required combination of film and taking lens, a lens-fitted film package according
30 to the invention having a simplified exposure means can provide pictures of a satisfactory image quality and can be put into practical use at a low cost. Conveniently, the lens-fitted film package according to the present invention comprises a film having
35 an MTF value of above 1.1 for 5 to 10 lines/mm in spatial frequency contained in a light-tight container provided with an optical lens having an MTF value between 0.47 and 0.73 for 20 lines/mm

in spatial frequency, the lens being so arranged in combination with any associated exposure elements (for example shutter means and shutter actuating means) as to enable exposure of the film to be made. Within the container, the film will of course preferably be provided with frame advancing means, for example winding spools, to permit exposure of separate frames.

It is well known to use MTF value as an indicator of image definition. It is also known that the MTF value of a picture image can be approximated by the product of the MTF values of the lens and of the film on which the picture image is formed by the lens. However, this approximation is often at variance with the actual picture image. In addition, it has not been fully clarified as to what MTF values of images are considered favourable.

Furthermore, it has not been clear as to which are the properties of films and taking lenses that are essential to satisfy the requirement not only for the taking lens for the lens-fitted film package to be of low cost but also for a good picture image quality to be attainable. Our investigations, using various combinations of films having different properties and lenses available at a reasonably low cost, have lead us to conclude that, as previously described, pictures with a satisfactory image quality can be provided by a lens-fitted film package comprising the combination of a film having an MTF value of above 1.1 for 5 to 10 lines/mm in spatial frequency and a taking lens having an MTF value of between 0.47 and 0.73 for 20 lines/mm in spatial frequency.

An embodiment of the lens package of the invention will now be described with reference to the accompanying drawings, in which:-

Figures 1(a) to 1(c) are graphs showing the results of evaluations of image quality of pictures

taken using lens-fitted film packages comprising combinations of films having particular MTF values and taking lenses having particular MTF values;

Figures 2a and 2b are respectively an exploded
5 perspective frontal view and a rear perspective view of a lens-fitted film package according to the present invention, in the case of Figure 2b with the film and the back cover removed; and

Figures 3(a) and 3(b) are graphs showing
10 relationships between MTF value and spatial frequency for the photographic color films and the taking lenses, respectively, used in the image quality evaluations shown in Figs. 1(a) to 1(c).

Referring to Figures 2a and 2b, there is shown
15 a lens-fitted photographic film package 1 comprising a film container 3 having front and rear portions 32 and 31. A roll of photographic film 2 is loaded in the light-tight film receiving cavity of rear container portion 31. The cavity is provided with
20 a cover the removal of which permits the unloading of the film. The cavity is shown in Figure 2b with the cover removed.

The front and rear portions of the film container are arranged to receive a taking lens 4 and its
25 associated exposure elements 5,6 (e.g. shutter means, etc), and the rear container portion 31 is provided with frame defining means 7 to permit separate frames of the film roll to be exposed.

For the sake of clarity, conventional components
30 such as film advancement means, shutter actuation means and the like are omitted from the Figures.

Figs. 1(a) to 1(c) show the results of evaluation of image quality of pictures resulting from various combinations of films and lenses. For the evaluation
35 of image quality, sample color prints of E-size (82.5 x 120mm) are made from a 110-size colour negative film and enlarged 6.7 times as large as an image frame of the 110-size color negative film.

The sample pictures are rated by five evaluators as belonging to one of five grades, namely excellent, fine, fair, failure, and poor, according to their image qualities. In each of Figs. 1(a), 1(b) and 1(c), average image qualities are shown for pictures taken by taking lenses having various MTF values, namely 0.40, 0.47, 0.58, 0.65, 0.73, and 0.80 for a spatial frequency of 20 lines/mm. However, the MTF value of the color negative film used in combination with each taking lens is between 1.1 and 1.2 in Fig. 1(a), between 1.0 and 1.05 in Fig. 1(b), and between 1.2 and 1.3 in Fig. 1(c), for a spatial frequency between 5 and 10 lines/mm, respectively.

It is noted that the MTF values are measured in such a way that a 110 size color film with a film speed of ASA 100 is contact-exposed to an MTF measuring optical wedge by using an illumination light of color temperature, 4800 K, through a green filter, and then processed according to Fuji Film Color Negative Processing CN-16; the finished color film is measured with a microphotometer having a measuring slit of 2 micrometer x 100 micrometer and an illumination slit of 20 micrometer x 150 micrometer.

The sample pictures are prepared by photographing the same subject in the fine open air three times for each taking lens using a film package as shown in Fig. 2 containing the above-mentioned color films. The color film was, after exposure, subjected to an ordinary color film photofinishing.

The taking lenses, with a few exceptions, were of the type comprising a single plastics lens having a focal length of 25.6 mm. The exposure of the sample film was made under a condition of an aperture, F:11 and a shutter speed, 1/100 sec.

As a result of the evaluation of the prepared sample pictures, it was generally concluded according to the pictures rated fair which are considered to have at least a satisfactory image quality that good image quality depends on contrast and sharpness.

It is apparent from the graph shown in Fig. 1(a) that pictures having at least a satisfactory image quality can be obtained by using a taking lens having an MTF value of above 0.47. The taking lens used to give the results shown in Fig. 1(a) is a single plastics lens having a focal length of 25.6mm.

From the graph shown in Fig. 1(b), it is apparent that the taking lens having an MTF value of 0.8 can provide pictures which are evaluated as having an at least satisfactory image quality. However, in this case, each taking lens comprises not a single lens but a single group of three lens component elements. Therefore, if the taking lens having an MTF value of 0.8 is used in combination with the color negative film having an MTF value between 1.0 and 1.05, it is generally difficult to provide the taking lens at a low cost because the number of component lens elements of a taking lens which can be supplied at a low cost may be limited to up to three. If the number of component lens elements becomes more than three, the cost of the taking lens will often increase sharply.

Fig. 1(c) exhibits the results of evaluation of pictures made from a color film having an MTF value of 1.2 to 1.3 for a spatial frequency between 5 to 10 lines/mm, which is exposed through taking lenses having the same MTF values as the taking lenses in the cases shown in Fig. 1(a) and 1(b). From the graph shown in Fig. 1(c), it is apparent that pictures having at least a satisfactory image quality can be obtained using the taking lenses having an MTF value of above 0.47.

Figs. 3(a) and 3(b) show curves of the relationship between MTF value and spatial frequency. Specifically the curves shown in Fig. 3(a) are drawn for the films used in the respective experiments of Figs. 1(a), 1(b), and 1(c). The curves shown in Fig.

3(b) are drawn for the taking lenses. The upper curve is drawn for the taking lens which comprises a single aspherical lens having an MTF value of 0.73 for a spatial frequency of 20 lines/mm. The lower curve is drawn for the one having an MTF value of 0.47.

The color negative film used for the experiment of which the result is shown in Fig. 1(c) comprises a multi-layer structure. The color negative film has basically the same layer arrangement as the photographic film ISO (International Standardization Organization) 100. The color negative film comprises fourteen layers (as listed below) coated, in sequence, on a cellulose triacetate film having a subbing layer.

First Layer (Antihalation Layer)

A gelatin layer containing black colloidal silver and ultraviolet absorbing agent.

Second Layer (Intermediate Layer)

A gelatin layer containing magenta-colored cyan-dye-forming coupler for printing adjustment.

Third Layer (Slow-Speed Red-Sensitive Emulsion Layer, Silver: 0.4g/m^2)

A gelatin layer containing an emulsion of silver iodobromide (containing 2 mol % of silver iodide) of mean grain size of 0.3 micrometer which is red-sensitized with cyanine type sensitizing dyes, 2-ureido-5-acylamino-substituted phenol couplers, and naphthol type coloured coupler capable of splitting off a magenta dye.

Fourth Layer (Medium-Speed Red-Sensitive Emulsion Layer, Silver: 0.7g/m^2)

A gelatin layer containing an emulsion of silver iodobromide (containing 5 mol % of silver iodide) of mean grain size of 0.5 micrometer which is red-sensitized with cyanine type sensitizing dyes, 2-ureido-5-acylamino-substituted phenol type couplers, and naphthol type colored coupler capable of splitting off a magenta dye.

Fifth Layer (High-Speed Red-sensitive Emulsion Layer, Silver: 1.0g/m^2)

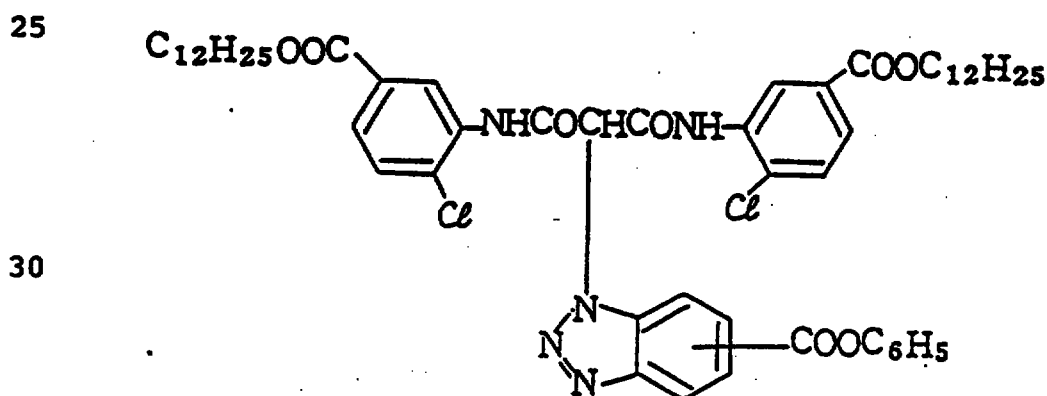
A gelatin layer containing an emulsion of silver iodobromide (containing 10 mol % of silver iodide) of mean grain size of 0.7 micrometer which is red-sensitized with cyanine type sensitizing dyes, ureido substituted phenol type couplers capable of splitting off a phenoxy group, and high reactive naphthol type couplers.

10 Sixth Layer (Intermediate Layer)

A gelatin layer containing 2-hexadecyl-5-sulfohydroquinone.

Seventh Layer (Slow-Speed Green-Sensitive Emulsion Layer, Silver: 0.3g/m^2)

15 A gelatin layer containing an emulsion of silver iodobromide (containing 4 mol % of silver iodide) of mean grain size of 0.3 micrometer which is green-sensitized with cyanine type sensitizing dyes, a yellow-colored magenta-dye-forming coupler, 20 a polymer coupler of the pyrazolone type capable of splitting off a pyrazole group, and a diffusible DIR (Development Inhibitor-Releasing) coupler having the following structural formula:



35 Eighth Layer (Medium-Speed Green-Sensitive Emulsion Layer, Silver: 0.4g/m^2)

The same gelatin layer as the seventh layer but with the emulsion substituted by an emulsion of

silver iodobromide (containing 5 mol % of silver iodide) of mean grain size of 0.5 micrometer which is green-sensitized with cyanine type sensitizing dyes.

5 Ninth Layer (High-Speed Green-Sensitive Emulsion layer, Silver: 0.9g/m^2)

A gelatin layer containing an emulsion of silver iodobromide (containing 6 mol % of silver iodide) of mean grain size of 0.7 micrometer which is green-sensitized with cyanine type sensitizing dyes, 2 equivalent pyrazolone type coupler (which is capable of splitting off a phenylmercapto group or a pyrazole group), a non-diffusible DIR coupler of the pivaloyl type capable of splitting off a 5- or 6- (N-methyl benzothiazolyldene amino) - 1- benzo triazolyl group.

Tenth Layer (Yellow Filter Layer)

A gelatin layer containing yellow colloidal silver and dialkylhydroquinone.

20 Eleventh Layer (Low-Speed Blue-Sensitive Emulsion layer, Silver: 0.4g/m^2)

A gelatin layer containing an emulsion of silver iodobromide (containing 4 mol % of silver iodide) of mean grain size of 0.3 micrometer which is sensitized with cyanine type sensitizing dyes, and benzoyl couplers capable of splitting off hydanthoin.

Twelfth Layer (High-Speed Blue-Sensitive Emulsion layer, Silver: 0.5g/m^2)

A gelatin layer containing an emulsion of silver iodobromide (containing 10 mol % of silver iodide) of mean grain size of 1.5 micrometer which is sensitized with cyanine type dyes, and benzoyl coupler capable of splitting off hydanthoin.

Thirteenth Layer (First Protective Layer)

35 A gelatin layer containing an ultraviolet absorbing agent.

Fourteenth Layer (Second Protective Layer)

A gelatin layer containing fine silver iodide of grain size of 0.07 micrometer, formaldehyde scavenger, a gelatin hardner, and a matting agent.

5 The above photographic color film is described in more detail in, for example, Japanese Patent Unexamined Publication No. 61-258,250.

10 Although main factors on which the MTF value of photographic film depend are the thickness of each layer, the silver halide grain size, etc, to produce film which can provide pictures with a good image quality when used in combination with a low cost taking lens it is preferable to use a non-diffusible DIR coupler capable of splitting
15 off a diffusible development restrainer (which is sometimes referred to as a diffusible DIR coupler) or a diffusible DIR hydroquinone having a similar capability. For the diffusible DIR coupler, it is effective to use a timing type DIR coupler capable
20 of splitting off 1-phenyl-5-mercaptotetrazole having a water-soluble group such as a p-hydroxy group or a diffusible DIR coupler capable of splitting off 2-mercapto-5-methyl-1, 3, 4-oxadiazole. In particular, as is disclosed in U.S. Patent No.
25 4,477,563, DIR couplers capable of splitting off a restrainer having hydrolysis groups may be preferably used.

As is described above, according to the present invention, the lens-fitted film package which comprises
30 a film and a taking lens both having a particular MTF values can provide pictures with a favourable image quality, in particular an excellent sharpness. Moreover, color films which contain the above described DIR couplers are generally improved as to MTF property,
35 in particular for low spatial frequencies. Due to the improved MTF of the film, prints made from the film generally cause amateur photographers to feel that an improved image quality is obtained.

Where film containing the above described DIR couplers is used, a reduction of flare is exhibited in addition to the improved MTF property. Due to this reduction of flare, the costs of providing the lens fitted film package with flare preventing means (such as an anti-reflection coating applied to a taking lens, a diaphragm, or the like) can be cut. Therefore, the usage of film containing the above described DIR couplers is noticeably contributive to the lens-fitted film package which is required to be manufactured at low cost.

In the above described embodiments, the evaluation was conducted on sample pictures made from 110-type color photographic film. However, as long as prints to be evaluated have the same enlargement ratio, for example 6.7 times as large as an original negative as in this embodiment, the result of evaluation of image quality is independent of negative size.

Apart from the above cases, similar evaluations were conducted with sample films exposed using taking lenses of F:8 and F:5.6 - as a result of this evaluation, the same effect was confirmed as long as the sample films and lenses have MTF values similar to those of the above described sample films and lenses. However, in view of the lens components, depth of focus, and the like of the F:5.6 taking lens, such taking lenses may be considered to be less suitable from the economical point of view for the lens-fitted film package of the invention.

Although the above description has been directed to lens-fitted film packages containing color film, it is to be noted that black-and-white films can be used as long as they have MTF values similar to those of the above described sample films. Furthermore, although the lens-fitted film package has been described constructed in the form shown in Figures 2a and 2b, it may be constructed in

any appropriate way, for example as taught by the
above mentioned U.S. Patent No. 2,933,027 or Japanese
Utility Model Publication No. 39-33,942.

Although the present invention has been fully
5 described by way of the preferred embodiments thereof
with reference to the accompanying drawings, it
is to be understood that various changes and modifications
might be apparent to those skilled in the art. Therefore,
such changes and modifications should be construed
10 as being included within the scope of the invention.

CLAIMS:

1. A photographic film package comprising a film container provided with a taking lens and containing a film, said taking lens being so mounted as to permit exposure of said film, said film having
5 an MTF value of above 1.1 for a spatial frequency in the range of 5 to 10 lines/mm and said taking lens having an MTF value between 0.47 and 0.73 for a spatial frequency of 20 lines/mm.
- 10 2. A photographic film package as claimed in claim 1, wherein said taking lens is a single plastics lens.
3. A photographic film package as claimed in
15 either one of claims 1 and 2, wherein said taking lens is a single aspherical lens.
4. A photographic film package as claimed in any one of claims 1 to 3, wherein said film incorporates
20 a development inhibitor-releasing (DIR) coupler.
5. A photographic film package as claimed in any one of claims 1 to 4, wherein said taking lens has an F value of at least 8.
25
6. A lens-fitted photographic film package as claimed in claim 1 as herein described with reference to the accompanying drawings.

