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OPEN CHAIN ACTIVE METHYLENE COLOR COUPLERS

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This invention relates to photography and particularly to compounds which form dyes by coupling with the developing agent to produce colored images.

It is known that colored photographic images may be formed by using a developer which produces a colored compound on development. The colored compound thus formed is deposited adjacent the silver grains of the silver image during the developing. It is also known that a colored image may be formed by adding to certain developer solutions or by incorporating in the silver halide emulsion before or after exposure a compound which couples during development with the oxidation product of the developing agent and forms a colored compound which is likewise deposited adjacent the silver grains of the silver image during development. Such a compound which is employed in conjunction with a developing agent for the silver and which couples with the oxidation product of the developing agent during development is referred to herein as a coupling compound or coupler.

The present invention concerns new or improved color-forming developers comprising primary aromatic amino developing agent and a coupler as hereinafter defined and also includes a new or improved color development process which consists in developing a reducible silver salt image in a photographic element with the aid of a primary aromatic amino developer and in the presence of a coupler as hereinafter defined. It also includes photographic sensitive elements having such coupler in one or more emulsion layers.

We have found that compounds of the following structure are valuable couplers for color photography and produce yellow to red images of high stability on development.

$$R—COCH_2CONHCO—R'$$

where R is an aryl or a benzofuroyl radical and R' is an alkyl or aryl radical.

The substituents R and R' may be varied by the introduction of suitable groups to produce couplers having the desired properties for use either in the developing solution or in the emulsion layer. The substituent groups R and R' may be relatively low in molecular weight, thus making the coupler suitable for use in the developing solution or they may be of such size as to permit the use of these compounds in the emulsion layer of multi-layer photographic coatings.

In the formula above, the substituent R may be an aryl radical such as phenyl or naphthyl or

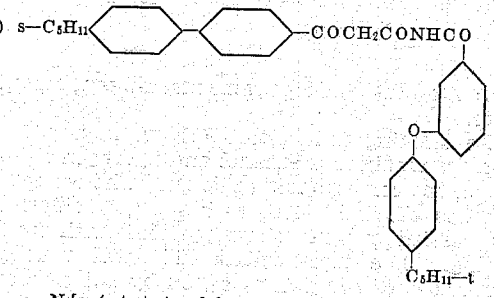
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a substituted aryl radical such as diphenyl or substituted diphenyl, or a benzofuroyl radical such as a 4,5-benzofuroyl radical. The substituent R' may be a lower alkyl radical such as methyl or ethyl or an aryl radical such as phenyl or substituted phenyl.

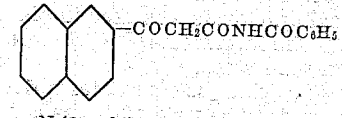
The following compounds illustrate our invention.

(1) $C_6H_5COCH_2CONHCOC_6H_5$
N-(benzoylacetyl)benzamide

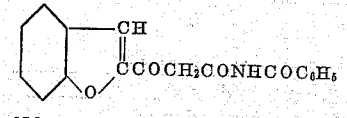
(2) $C_6H_5COCH_2CONHCOCH_3$
N-(benzoylacetyl)acetamide

(3) 

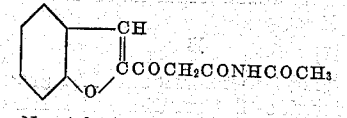
N-[m-(p-tert.-Amylphenoxy)benzoyl]-a-[p-(p-sec.-amylphenyl)benzoyl]-acetamide

(4) 

N-(β-naphthoylacetyl)-benzamide

(5) 

N-benzoyl-a-(4,5-benzofuroyl)-acetamide

(6) 

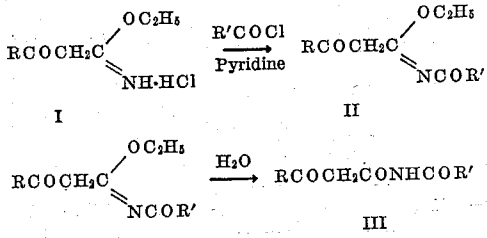
N-acetyl-a-(4,5-benzofuroyl)-acetamide

These compounds contain a coupling function which in this case is a reactive methylene group. By "coupling function" we mean a functional or reactive group common to coupler compounds which react with the development product of a primary aromatic amino developing agent. By "reactive methylene" we mean a methylene group which is reactive in the coupling process, in this case the group present between two negative centers as in the group —CO—CH_2—CO—.

The aromatic amino developing agents used

with the coupler compounds of our invention include the mono-, di- and triaminoaryl compounds and their derivatives formed by substitution in the amino group as well as in the ring such as alkylphenylenediamines and alkyl toluylenediamines. These compounds are usually used in the salt form, such as the hydrochloride or the sulphate, which are more stable than the amines themselves. Suitable compounds are diethyl-p-phenylenediamine hydrochloride, monoethyl-p-phenylenediamine-hydrochloride, dimethyl-p-phenylenediamine-hydrochloride and dimethyl-p-phenylenediamine sulphate. Developing agents containing heterocyclic systems as described in U. S. Patent 2,196,739 are also suitable. The p-aminophenols and their substitution products may also be used where the amino group is unsubstituted. All of these compounds have an unsubstituted amino group which enables the oxidation products of the developer to couple with the color-forming compounds to form a dye image.

The compounds of our invention may be prepared according to the following general reactions:



I II

III

where R and R' have the same meanings as stated above.

The starting imidoesters (1) were prepared from the reaction of ethanol and hydrogen chloride on the corresponding nitriles. The condensation of the imidoester with the acid chloride was carried out in excess pyridine with mild heating. The intermediate (II) was usually thrown out of solution as an oil by addition of water, and hydrolyzed directly to the amide derivative (III). In the case of the N-acetyl derivatives, the acid anhydride was used in place of the chloride, and the intermediates (II) were readily isolated in a pure state.

The following example illustrates a developing solution which may be used with the compounds of our invention.

A

	grams
p-Amino-diethylaniline sulfate	2
Sodium sulfite (anhydrous)	5
Sodium carbonate (anhydrous)	20
Potassium bromide	2
Water to 1 liter.	

B

N-(Benzoylacetyl) benzamide	grams	2
Sodium hydroxide (2% solution)	cc	50

For use, B is added to A.

Our development process may be employed for the production of colored photographic images in layers of gelatin or other carrier for the silver halide such as collodion, organic esters of cellulose or synthetic resins. The support for the emulsion may be a transparent material such as glass, cellulose ester or a nontransparent reflecting material such as paper or an opaque cellulose ester. The emulsion may be coated as a single layer on the support or as a superposed layer on one or both sides of the support. The superposed layer may be differentially sensitized to record natural color photographic images in the well-known manner.

The examples and compounds set forth in the present specification are illustrative only and it is to be understood that our invention is limited only by the scope of the appended claims.

We claim:

1. A color-forming photographic developer comprising a primary aromatic amino developing agent and a coupler compound having the formula

R—COCH$_2$CONHCO—R'

where R is selected from the class consisting of aryl and benzofuroyl radicals and R' is selected from the class consisting of alkyl and aryl radicals.

2. A color-forming photographic developer comprising a primary aromatic amino developing agent and a coupler compound having the formula

R—COCH$_2$CONHCO—R'

where R is an aryl radical and R' is an aryl radical.

3. A color-forming photographic developer comprising a primary aromatic amino developing agent and a coupler compound having the formula

R—COCH$_2$CONHCO—R'

where R is a phenyl radical and R' is a member of the group consisting of alkyl and aryl radicals.

4. A color-forming photographic developer comprising a primary aromatic amino developing agent and N-(benzoylacetyl) benzamide.

5. A color-forming photographic developer comprising a primary aromatic amino developing agent and N-benzoyl-a-(4,5-benzofuroyl) acetamide.

6. The method of producing a colored photographic image in a silver halide emulsion layer which comprises exposing said layer and developing it with a primary aromatic amino developing agent in the presence of a coupler compound having the formula

R—COCH$_2$CONHCO—R'

where R is selected from the class consisting of aryl and benzofuroyl radicals and R' is selected from the class consisting of alkyl and aryl radicals.

7. The method of producing a color photographic image in a silver halide emulsion layer which comprises exposing said layer and developing it with a primary aromatic amino developing agent in the presence of a coupler compound having the formula

R—COCH$_2$CONHCO—R'

where R is an aryl radical and R' is an aryl radical.

8. The method of producing a color photographic image in a silver halide emulsion layer which comprises exposing said layer and developing it with a primary aromatic amino developing agent in the presence of a coupler compound having the formula

R—COCH$_2$CONHCO—R'

where R is a phenyl radical and R' is a member of the group consisting of alkyl and aryl radicals.

9. The method of producing a colored photographic image in a gelatino silver halide emulsion layer which comprises exposing said layer and developing it with a primary aromatic amino

developing agent in the presence of N-(benzoyl-acetyl) benzamide.

10. The method of producing a colored photographic image in a gelatino silver halide emulsion layer which comprises exposing said layer and developing it with a primary aromatic amino developing agent in the presence of N-benzoyl-a-(4,5-benzofuroyl) acetamide.

11. A photographic emulsion for forming colored images comprising a silver halide emulsion having incorporated therein a coupler compound having the formula

$$R—COCH_2CONHCO—R'$$

where R is selected from the class consisting of aryl and benzofuroyl radicals and R' is selected from the class consisting of alkyl and aryl radicals.

12. A photographic emulsion for forming colored images comprises a gelatine silver halide emulsion having incorporated therein N-[m-(p-tert.-Amylphenoxy) benzoyl]-a-[p-(p-sec.- amyl-phenyl) benzoyl]acetamide.

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