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(54) **Process for the production of a laminar article.**

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Description

The present invention relates to a process for producing a laminar article incorporating a dye image between heat-sealed elements.

The production of laminar articles comprising a protective cover sheet or layer on an information bearing surface e.g. containing a photograph is well known. For example, identification documents contain a black-and-white or colour photograph sandwiched between a clear plastic protective cover sheet and a rear support sheet. The assembly is laminated together to provide a durable identification document, also called ID card.

The production of the laminar article through the laminating of a protective thermoplastic or thermohardenable sheet covering the information to be protected proceeds advantageously by heating. The heat applied in the lamination of thermoplastic materials makes that the protective sheet forms a sealed edge with a plastic support underneath. Depending on the physical and chemical properties of the protective sheet adhesion can be obtained also to the layer containing the image so that it cannot be stripped off without destroying the image.

The heat necessary for a firm lamination gives rise to a problem, particularly when the imaging substances are organic dyes produced or applied in silver halide photographic materials.

It has been experimentally established by us that said dyes obtain a brown stain on heating and that a white background in the non-image areas looses its off-white appearance probably due to the presence of traces of processing chemicals. Both phenomena are objectionable and their negative influence on image quality and image recognition has to be reduced as much as possible.

Classical dye formation in silver halide emulsion materials is based on chromogenic development wherein oxidized developing agent couples with coupling agents yielding yellow, magenta and cyan dyes.

A more recently developed dye image forming process is based on the image-wise transfer of diffusible dye molecules from an image-wise exposed silver halide emulsion material into a waterpermeable image receiving layer containing a mordant for the dye(s). The image-wise diffusion of the dye(s) is controlled by the development of one or more image-wise exposed silver halide emulsion layers, that for the production of a multicolour image are differently spectrally sensitized and contain respectively a yellow, magenta and cyan dye molecules. A survey of dye diffusion transfer imaging processes has been given by Christian C. Van de Sande in Angew. Chem. - Ed. Engl. 22 (1983) nº 3, 191-209.

In connection with dye stabilization it is known from US-P 3,249,432 to treat a finished colour image with iodide ions serving as stabilizing agent to protect an image obtained by colour diffusion transfer processing from the deleterious colour fading effects of sunlight.

In US-P 4,496,645 the presence of iodide ions in the alkaline processing liquid used for carrying out a dye diffusion transfer process is described for increasing speed and reducing colour fog.

It is an object of the present invention to provide a process for the production of laminar articles incorporating an organic dye image between heat- sealed elements wherein the deleterious influence of heat on the quality of the dye image is strongly reduced.

It is another object of the present invention to provide a laminar article produced by said process.

Other objects and advantages will become apparent from the further description.

In accordance with the present invention a process for the production of a laminar article containing a dye image composed of at least one organic dye produced or applied in silver halide photography in a supported hydrophilic binder layer is provided, wherein at least a part of said hydrophilic binder layer is heated in a lamination procedure and protected with a protective thermoplastic resin layer or sheet that covers said hydrophilic binder layer containing said dye image, characterized in that said hydrophilic binder layer containing said dye image is treated with an aqueous liquid containing iodide ions that remain in said hydrophilic binder layer during the lamination procedure and form part of said binder layer in the laminar article.

The presence of said iodide ions during the heating of the hydrophilic colloid layer containing the dye image counteracts substantially the darkening of the image dye(s) and substantially counteracts the increase of optical density and staining of the whites of the image, i.e. the image background.

In Fig. 1A to 1H the improvement with regard to staining of image background of a dye image receiving material treated as described in Example 1 is illustrated with spectral density (D) versus wavelength (nm) absorption curves.

In Fig. 2A and Fig. 2D the improvement with regard to the counteraction of yellow dye darkening in a dye image receiving material treated as described in Example 2 is illustrated likewise with spectral density (D) versus wavelength (nm) absorption curves.

In Fig. 3 the spectral absorption curve of a cut-off filter used in the exposure of a photographic dye transfer material for releasing and transferring a yellow dye in the dye image receiving material as described in Example 2 is given.

According to a preferred embodiment the free iodide ions are provided by potassium iodide but may stem from any watersoluble metal or onium salt providing iodide ions in aqueous medium.

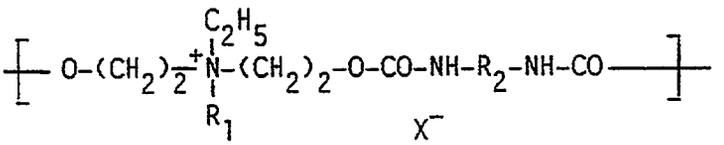
The treatment with iodide ions proceeds preferably with an aqueous liquid containing dissolved potassium iodide in a concentration of 1 to 150 g per liter.

The process according to the present invention is not restricted to the production of laminates by heat sealing of a hydrophilic colloid layer containing a dye image produced by a dye diffusion transfer process, but equally applies for dye images obtained by chromogenic development of silver halide using a p-phenylene diamine type developing agent and coupler therefor.

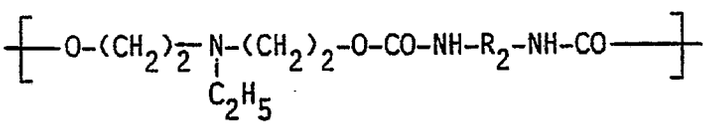
When forming the dye image in a dye image receiving layer by a dye diffusion transfer process the image-receiving layer can form part of a separate image-receiving material or form an integral combination with the light-sensitive layer(s) of the photographic material. Where the image-receiving layer applied on a transparent resin support after processing of the photosensitive material remains associated with the silver halide emulsion layer(s) an alkali-permeable light-shielding layer, e.g. containing white pigment particles is applied between the image-receiving layer and the silver halide emulsion layer(s).

For use in diffusion transfer colour photography any hydrophilic binder can be employed as the image-receiving layer as long as the desired function of mordanting or otherwise fixing the diffused dye will be obtained. The particular material chosen will, of course, depend upon the dye to be mordanted. If acid dyes are to be mordanted, the image-receiving layer can be composed of or contain basic polymeric mordants such as polymers of amino-guanidine derivatives of vinyl methyl ketone such as described in U.S. Patent Specification 2,882,156, and basic polymeric mordants and derivatives, e.g. poly-4-vinylpyridine, 2-vinylpyridine polymers in salt form and similar compounds described in U.S. Patent Specification 2,484,430, the compounds described in the published German Patent Application 2,200,063 filed January 11, 1971 by Agfa-Gevaert A.G. Suitable mordanting binders include, e.g. guanylhydrazone derivatives of acyl styrene polymers, as described e.g. in published German Patent Specification 2,631,521. Other effective mordanting compositions are long-chain quaternary ammonium or phosphonium compounds or ternary sulphonium compounds, e.g. those described in US Patent Specifications 3,271,147 and 3,271,148. Certain metal salts and their hydroxides that form sparingly soluble compounds with the acid dyes may be used likewise as mordants. The dye mordants are dispersed in one of the usual hydrophilic binders in the image-receiving layer, e.g. in gelatin, polyvinylpyrrolidone or partly or completely hydrolysed cellulose esters.

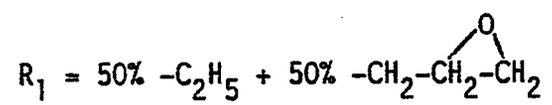
Preferred polymeric mordants for use in combination with gelatin on a vinyl chloride polymer support are cationic polymeric mordants containing free glycidyl groups that can react with free hydrogen atoms present in gelatin. Such polymeric mordants are described and prepared according to US-P 4,186,014. The following mordant A is a representative thereof :

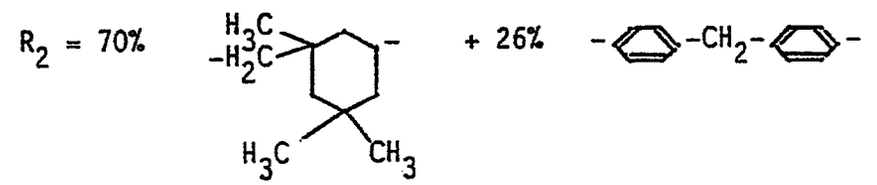


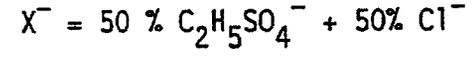
(80 %)



(20 %)







Generally, good results are obtained when the image-receiving layer, which is preferably permeable to alkaline solution, is transparent and about 2 to about 10 um thick. This thickness, of course, can be modified depending upon the result desired. The image-receiving layer may also contain ultraviolet-absorbing materials to protect the mordanted dye images from fading, brightening agents such as the stilbenes, coumarins, triazines, oxazoles, dye stabilizers such as the chromanols or alkyl-phenols.

Use of pH-lowering material in the dye-image-receiving element of a film unit according to the invention will usually increase the stability of the transferred image. Generally, the pH-lowering material will effect a reduction of the pH of the image layer from 13 or 14 to 11 or lower, preferably to a ph of 5 to 8 within a short time after treatment. For example, polymeric acids as disclosed in US Patent Specification 3,362,819 of Edwin H.Land, issued January 9, 1968 or solid acids or metallic salts, e.g. zinc acetate, zinc sulphate, magnesium acetate as disclosed in US Patent Specification 2,584,030, my be employed with good results. Such the pH of the film unit after development to terminate development and substantially reduce further dye transfer and thus stabilize the dye image.

According to a particularly preferred embodiment before or during the treatment with iodide ions the hydrophilic colloid layer containing the dye image is treated with an aqueous liquid containing a dissolved surfactant. Said liquid has a cleaning effect and removes organic chemicals stemming from the photographic processing from the dye image containing layer. In this connection it has been established experimentally by us that residual silver halide developing agent, e.g. hydroquinone, whether it stands in reduced or oxidized state, prohibits a perfect lamination of thermoplastic hydrophobic materials, e.g, in stacking thin layers of such materials forming one thick sheet, more particularly when at least one of these materials is on the basis of of a vinyl chloride polymer.

Although any commercial surfactant called detergent can be used for said purpose, e.g. a detergent described in the book : "McCutcheon's Detergents & Emulsifiers 1978 North American Edition - McCutcheon Division, MC Publishing Co. 175 Rock Road, Glen Rock, NJ 07452 USA, preference is given to anionic and non-ionic surface-active agents containing a polyethyleneoxide chain in their structure. Examples of such agents are described in US-P 3,663,229.

A useful concentration of surfactant for the intended purpose of removing residual organic developing agent is in the range of 5 to 50 g per liter.

The layer containing the dye image may be present on any type of support known in photographic materials, e.g. paper, metal or resin support.

According to a preferred embodiment for use in the production of laminates by heat and pressure sealing said layer is present on a thermoplastic polyvinyl chloride support.

The term "polyvinyl chloride" includes the homopolymer, as well as any vinyl chloride copolymer containing at least 50 % by weight of vinyl chloride units and including no hydrophilic recurring units.

Said vinyl chloride copolymer may contain one or more of the following comonomers : vinylidene chloride, vinyl acetate, acrylonitrile, styrene, butadiene, chloroprene, dichlorobutadiene, vinyl fluoride, vinylidene fluoride, trifluorochloroethylene, and tetrafluoroethylene.

The vinyl chloride polymer serving as the support may be chlorinated to contain 60-65 % by weight of chlorine.

Many properties of polyvinyl chloride and its copolymers are improved by plasticization and their stability can be improved by stabilizers well known to those skilled in the art (see, e.g., F.W.Billmeyer, Textbook of Polymer Chemistry, Interscience Publishers, Inc., New York (1957) p. 311-315)).

A corona-discharge surface-treated polyvinyl chloride material serving as a support in the production of a laminated identification card (I.D. card) containing photographic information in a hydrophilic colloid layer is described in US-P 4,429,032.

The vinyl chloride polymer support may contain pigments or dyes as colouring matter e.g. in an amount up to 5 % by weight. An opaque white appearance may be obtained with e.g. titanium dioxide particles.

Usually several sheets of matted polyvinyl chloride having a thickness of only 0.150 to 0.75 mm are stacked and united by lamination so as to reach a sufficient thickness and rigidness suited for introducing the document without distortion in the slot of an electronic identification apparatus.

The cover sheet used in the lamination process is transparent when the support does not has that property and may be made of any suitable rigid, semirigid or flexible plastic such as a cellulose acetate butyrate, a cellulose triacetate, a polyvinyl chloride, a polymerized polyethylene glycol ester or a polyolefin, or polyolefin-coated polyester, preferably polyethylene-coated polyethyleneglycol terephthalate sheet forming a particularly wear resistant outermost member.

The lamination of thermoplastic sheets may be carried out with hot rollers or plates pressing together the elements to be laminated.

According to an embodiment as described e.g. in US-P 4,429,032 the lamination proceeds by introducing the elements to be assembled between flat steel plates under a pressure of 4.9 to 9.81 bar (5 to 10 kg per cm2) at a temperature of e.g. from 100 to 150 °C.

The laminate may contain the hydrophilic binder layer including the dye image over the whole area of the support or in a part thereof, e.g. leaving free the edge areas as described in US-P 4,101,701 and US-P 4,425,421.

The following comparative examples 1 and 2 illustrate the present invention.

All parts, ratios and percentages are by weight unless otherwise stated.

EXAMPLE 1

A photographic dye diffusion transfer material as described in the Example of US-P 4,496,645 was exposed with white light through a grey wedge having a constant 0.1 and thereupon contacted for 1 minute with an image receiving material having the composition described hereinafter in a diffusion transfer apparatus COPYPROOF CP 38 (trade name of Agfa-Gevaert N.V. Belgium)) having in its tray a basic processing liquid of the following composition :

sodium hydroxide 25 g
sodium orthophosphate 25 g
cyclohexane dimethanol 25 g
2,2'-methylpropylpropane diol 25g
N-ethylbenzene-pyridinium chloride 0.5 g
distilled water up to 1000 ml

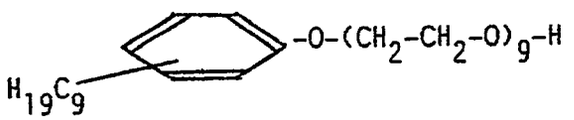
- Composition of the image receiving material

To an opaque polyvinylchloride support having a thickness of 200 um and containing titanium dioxide in the polymer mass to give it a white appearance a dye image receiving layer was coated having in dry state the following composition per sq.m :
gelatin 0.5 g
mordant A 2.5 g

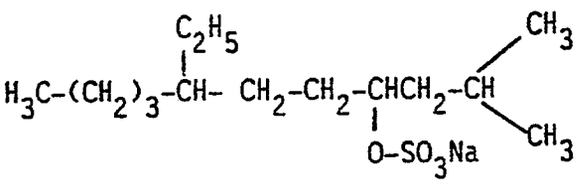
After leaving the processing tray identical test strips of the image receiving material were led through a second tray containing in the following comparative tests 1) to 8) the following liquid compositions :

(1) plain water.
(2) an aqueous solution containing 50 g/l of surfactant X (structural formula is given hereinafter).
(3) an aqueous solution containing 1 g/l of KI and 50 g/l of W surfactant X.
(4) an aqueous solution containing 25 g/l of KI and 50 g/l of surfactant X.
(5) an aqueous solution containing 150 g/l of KI and 50 g/l of surfactant X.
(6) an aqueous solution containing 25 g/l of KI.
(7) an aqueous solution containing 25 g/l of KI and 50 g/l of a 26 % solution of surfactant Y (structural formula is given hereinafter).
(8) an aqueous solution containing 38 g/l of tetraethyl ammonium iodide and 50 g/l of surfactant X.

Surfactant X



Surfactant Y



After drying the thus treated test materials were laminated with a transparent cover sheet which is a polyethylene terephthalate sheet having a thickness of 100 um being coated at one side with a thermoadhesive layer of polyethylene having a thickness of 30 µm. The lamination was carried out between flat steel plates pressing the layers together for 5 minutes using a pressure of 9.81 bar (10kg/cm2) at a temperature of 135 °C. Said pressure was maintained during cooling to reach room temperature (20 °C) again.

Measurements

With a spectrodensitometer optical density (D) versus wavelength (nm) of the white areas of the samples (1) to (8) was measured and recorded yielding before lamination the correspondingly numbered curves 1 to 8 in the accompanying Fig. 1A to 1H, and the curves 1' to 8' after lamination.

From the comparison of these curves can be learned that there is no substantial darkening of the image background areas when the materials are treated according to the invention, and that even an improvement of whiteness can be obtained by applying composition (5).

EXAMPLE 2

The exposure of the photographic material was carried out as described in Example 1, but using instead of a grey wedge a filter transmitting yellow light and having the optical density (D) versus wavelength (nm) characteristics given in Fig. 3. In the development and dye transfer the yellow dye of the photographic material was transferred into the image receiving layer being present on a white pigmented polyvinyl chloride support.

From the laminated and non-laminated samples optical density (D) versus wavelength (nm) curves as represented in Fig. 2A and 2D were recorded. The curves Y1 and Y1′ relate to the samples treated with composition (1) of Example 1, i.e. plain water, before and after lamination respectively. The curves Y4 and Y4′ relate to the samples treated with composition 4 of Example 1 before and after lamination respectively.

From said curves can be learned that there is a substantial counteraction of dye degradation by applying a treatment according to the present invention.

Claims

1. A process for the production of a laminar article containing a dye image composed of at least one organic dye produced or applied in silver halide photography in a supported hydrophilic binder layer, wherein at least a part of said hydrophilic binder layer is heated in a lamination procedure and protected with a protective thermoplastic resin layer or sheet that covers said hydrophilic binder layer containing said dye image, characterized in that said hydrophilic binder layer containing said dye image is treated with an aqueous liquid containing iodide ions that remain in said hydrophilic binder layer during the lamination procedure and form part of said binder layer in the laminar article.

2. A process according to claim 1, wherein the free iodide ions are provided by potassium iodide.

3. A process according to claim 1 or 2, wherein the treatment with iodide ions proceeds with an aqueous liquid containing dissolved potassium iodide in a concentration of 1 to 150 g per liter.

4. A process according to any of claims 1 to 3, wherein the dye image in the laminated article is produced in a silver halide emulsion layer or in an image receiving layer.

5. A process according to any of claims 1 to 4, wherein the dye image is formed by dye diffusion transfer into said hydrophilic binder layer acting as image receiving layer containing a mordant for the dye(s), said transfer being controlled by silver halide development.

6. A process according to any of claims 1 to 4, wherein the dye image is formed in said hydrophilic binder layer by chromogenic development of silver halide using a p-phenylene diamine type developing agent and coupler therefor.

7. A process according to any of claims 1 to 6, wherein before or during the treatment with iodide ions the hydrophilic colloid layer containing the dye image is treated with an aqueous liquid containing a dissolved surfactant.

8. A process according to claim 6, wherein the surfactant is an anionic or a non-ionic surface-active agent containing a polyethyleneoxide chain in its structure.

9. A process according to any of claims 1 to 8, wherein the support of the hydrophilic colloid layer containing the dye image is a thermoplastic vinyl chloride polymer support.

10. A process according to any of claims 1 to 9, wherein the laminar article contains a cover sheet for said hydrophilic colloid layer containing the dye image and said cover sheet is transparent and made of cellulose acetate butyrate, a cellulose triacetate, a polyvinyl chloride, a polymerized polyethylene glycol ester or a polyolefin, or polyolefin coated polyester.

11. A process according to any of claims 1 to 10, wherein the lamination proceeds by introducing the elements to be assembled between flat steel plates under a pressure of 4.9 to 9.81 bar (5 to 10 kg per cm2) at a temperature in the range of 100 to 150 °C.

Patentansprüche

1. Verfahren zur Herstellung eines Laminarartikels, das ein Farbstoffbild enthält, das aus wenigstens einem, in der Silberhalogenid-Photographie hergestellten oder angewandten organischen Farbstoff in einer auf eine Unterlage aufgetragenen, hydrophilen Bindemittelschicht besteht, wobei mindestens ein Teil der hydrophilen Bindemittelschicht in einem Laminierungsvorgang erhitzt und mit einer schützenden thermoplastischen Harzschicht oder Harzfolie, welche die farbbildhaltige hydrophile Bindemittelschicht bedeckt, geschützt wird, dadurch gekennzeichnet, daß die farbbildhaltige hydrophile Bindemittelschicht mit einer wäßrigen Flüssigkeit behandelt wird, welche Iodid-Ionen enthält, die während des Laminierungsvorgangs in der hydrophilen Bindemittelschicht zurückbleiben und im Laminarartikel einen Teil der Bindemittelschicht bilden.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß freie Iodid-Ionen durch Kaliumiodid geliefert werden.

3. Verfahren nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Behandlung mit Iodid-Ionen mit einer wäßrigen Flüssigkeit erfolgt, die gelöste Kaliumiodid in einer Konzentration von 1–150 g pro Liter enthält.

4. Verfahren nach irgendeinem der Ansprüche 1–3, dadurch gekennzeichnet, daß das Farbstoffbild im Laminarartikel in einer Silberhalogenidemulsionsschicht oder in einer Bildempfangsschicht erzeugt wird.

5. Verfahren nach irgendeinem der Ansprüche 1–4, dadurch gekennzeichnet, daß das Farbstoffbild durch Diffusionsübertragung von Farbstoff in die hydrophile Bindemittelschicht gebildet wird, die als Bildempfangsschicht wirkt und ein Beizmittel für den (die) Farbstoff(e) enthält, wobei die Übertragung durch Silberhalogenid-Entwicklung gesteuert wird.

6. Verfahren nach irgendeinem der Ansprüche 1–4, dadurch gekennzeichnet, daß das Farbstoffbild in der hydrophilen Bindemittelschicht durch Farbentwicklung von Silberhalogenid gebildet wird, wobei eine Entwicklersubstanz des p-Phenylentyps und ein Kuppler dafür verwendet werden.

7. Verfahren nach irgendeinem der Ansprüche 1–6, dadurch gekennzeichnet, daß die farbbildhaltige hydrophile Kolloidschicht vor oder während der Behandlung mit Iodid-Ionen mit einer wäßrigen, ein gelöstes Tensid enthaltenden Flüssigkeit behandelt wird.

8. Verfahren nach Anspruch 6, dadurch gekennzeichnet, daß das Tensid ein anionischer oder ein nicht-ionischer oberflächenaktiver Stoff ist, der eine Polyethylenoxid-Kette in seiner Struktur enthält.

9. Verfahren nach irgendeinem der Ansprüche 1–8, dadurch gekennzeichnet, daß die Unterlage der farbbildhaltigen hydrophilen Kolloidschicht eine Unterlage aus thermoplastischem Vinylchlorid-Polymerem ist.

10. Verfahren nach irgendeinem der Ansprüche 1–9, dadurch gekennzeichnet, daß das Laminarartikel eine Deckschicht für die farbbildhaltige hydrophile Kolloidschicht enthält und diese Deckschicht transparent ist und aus Celluloseacetatbutyrat, einem Cellulosetriacetat, einem Polyvinylchlorid, einem polymerisierten Polyethylenglykolester oder einem Polyolefin oder aus einem polyolefinbeschichteten Polyester besteht.

11. Verfahren nach irgendeinem der Ansprüche 1–10, dadurch gekennzeichnet, daß die Laminierung durch Einführung der zusammensetzenden Elemente zwischen flache Stahlplatten unter einem Druck von 4,9–9,21 bar (5–10 kg/cm^2) bei einer Temperatur im 100–150°C-Bereich erfolgt.

Revendications

1. Procédé de préparation d'un article lamifié contenant une image de colorant composée d'au moins un colorant organique formé ou appliqué dans la photographie à l'halogénure d'argent, dans une couche de support constituée d'un agent liant hydrophile, procédé dans lequel on chauffe au moins une partie de la couche d'agent liant hydrophile au cours d'un procédé de lamification, tandis qu'on la protège avec une feuille ou une couche protectrice constituée de résine thermoplastique, celle-ci recouvrant la couche d'agent liant hydrophile contenant l'image de colorant, caractérisé en ce qu'on traite cette couche d'agent liant hydrophile contenant l'image de colorant, avec un liquide aqueux contenant des ions iodure qui restent dans la couche d'agent liant hydrophile, lors du processus de lamification, tandis qu'ils font partie de cette couche d'agent liant dans l'article lamifié.

2. Procédé selon la revendication 1, caractérisé en ce que des ions iodure sont fournis par l'iodure de potassium.

3. Procédé selon la revendication 1 ou 2, caractérisé en ce que le traitement avec les ions iodure a lieu avec un liquide aqueux contenant de l'iodure de potassium dissous en une concentration de 1 à 150 g par litre.

4. Procédé selon l'une quelconque des revendications 1 à 3, caractérisé en ce que l'image de colorant se trouvant dans l'article lamifié est formée dans une couche d'émulsion à l'halogénure d'argent ou dans une couche réceptrice d'image.

5. Procédé selon l'une quelconque des revendications 1 à 4, caractérisé en ce que l'image de colorant est formée moyennant transfert par diffusion de colorant dans la couche d'agent liant hydrophile, celle-ci faisant office de couche réceptrice d'image contenant un mordant pour le ou les colorant(s), ce transfert étant réglé par le développement d'halogénure d'argent.

6. Procédé selon l'une quelconque des revendications 1 à 4, caractérisé en ce que l'image de colorant est formée dans la couche d'agent liant hydrophile par développement chromogène de l'halogénure d'argent, en faisant appel à un agent développateur du type de la p-phéylène-diamine et à un copulant destiné à cet effet.

7. Procédé selon l'une quelconque des revendications 1 à 6, caractérisé en ce qu'avant ou au cours du traitement avec des ions iodure, on traite la couche hydrophile colloïdale contenant l'image de colorant, avec un liquide aqueux contenant un agent tensio-actif dissous.

8. Procédé selon la revendication 6, caractérisé en ce que l'agent tensio-actif est un agent tensio-actif anionique ou non-ionique contenant dans sa structure une chaîne d'oxyde de polyéthylène.

9. Procédé selon l'une quelconque des revendications 1 à 8, caractérisé en ce que le support de la couche hydrophile colloïdale contenant l'image de colorant est un support thermoplastique d'un polymère de chlorure de vinyle.

10. Procédé selon l'une quelconque des revendications 1 à 9, caractérisé en ce que l'article lamifié contient une feuille de recouvrement pour la couche hydrophile colloïdale contenant l'image de colorant, tandis que cette feuille de recouvrement est transparente et qu'elle est constituée d'acéto-butyrate de cellulose, d'un triacétate de cellulose, d'un chlorure de polyvinyle, d'une polyoléfine ou d'un ester polymérisé de polyéthylène-glycol ou d'un polyester revêtu de polyoléfine.

11. Procédé selon l'une quelconque des revendications 1 à 10, caractérisé en ce qu'on réalise la lamification en introduisant les éléments à assembler, entre des plaques plates en acier, sous une pression de 4,9 à 9,21 bars (5 à 10 kg/cm^2), dans un intervalle de température allant de 100 à 150°C.

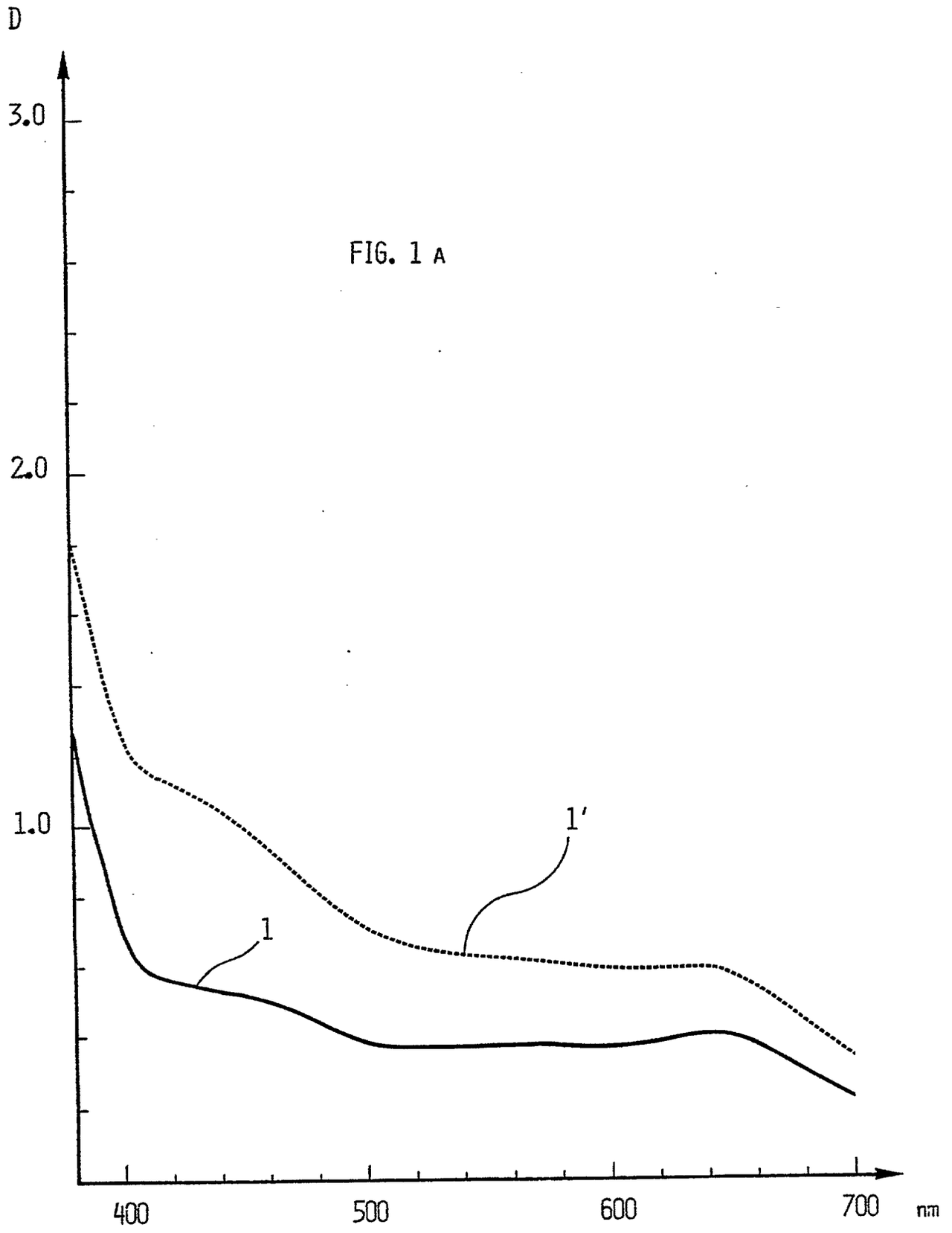


FIG. 1 A

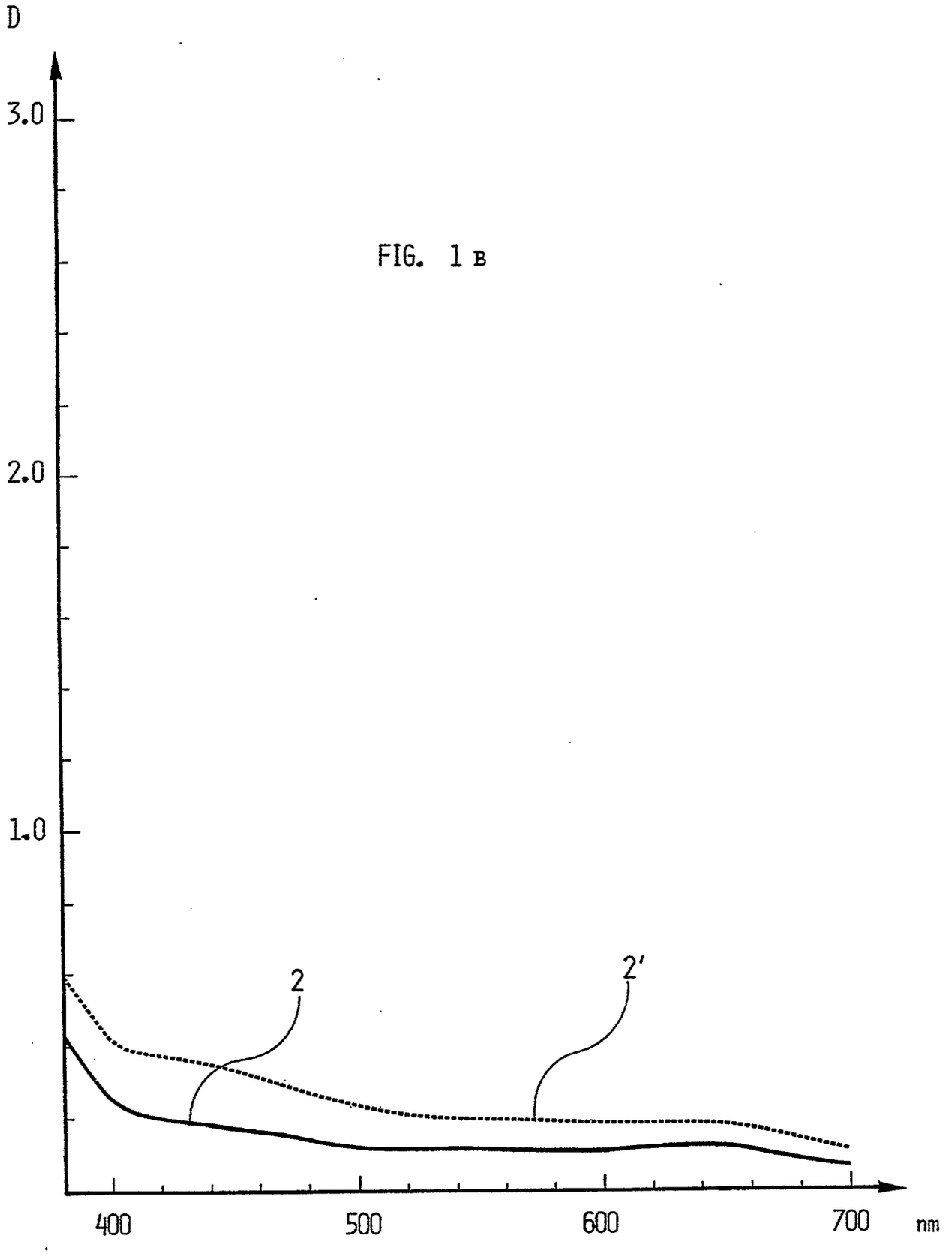


FIG. 1 B

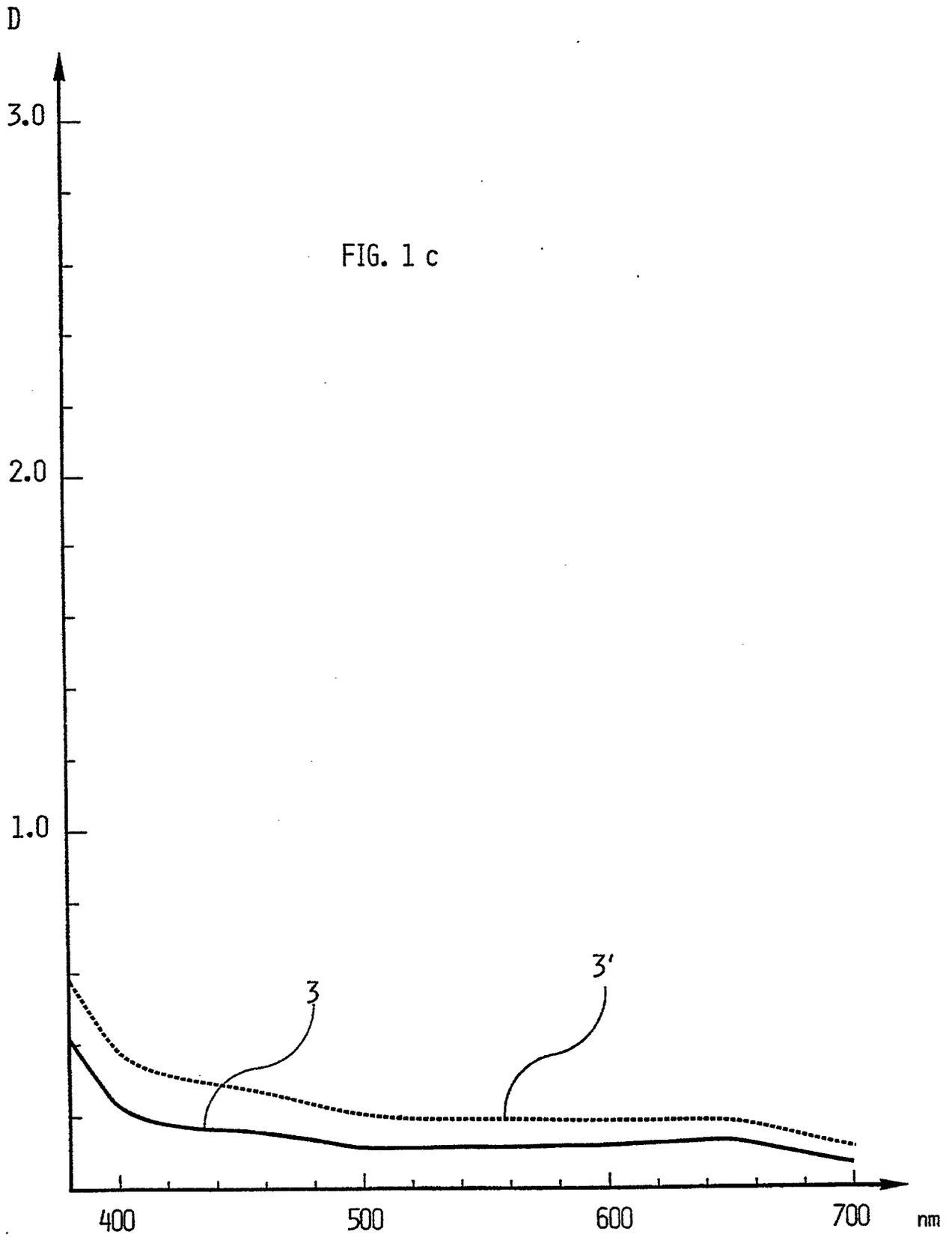


FIG. 1 c

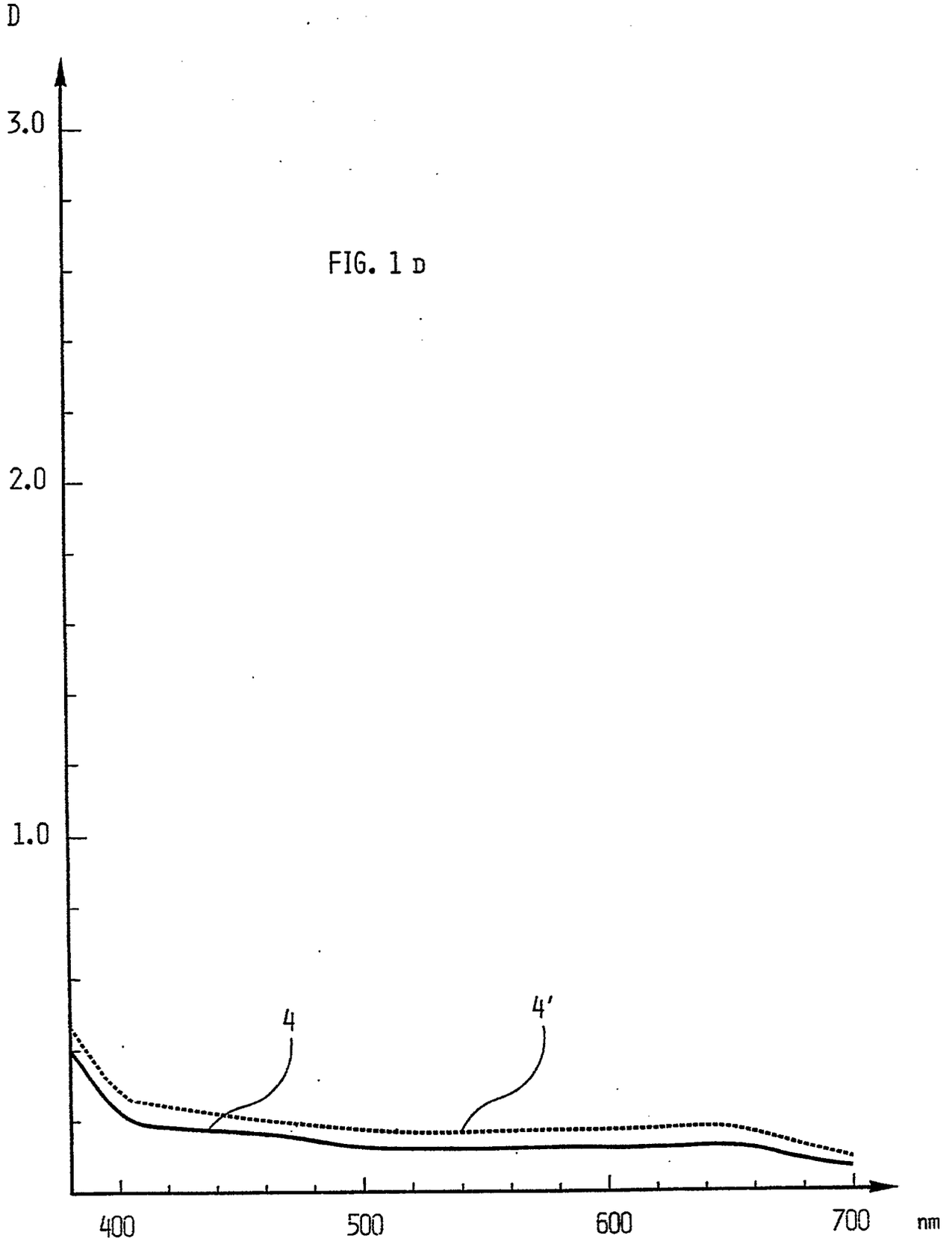


FIG. 1 D

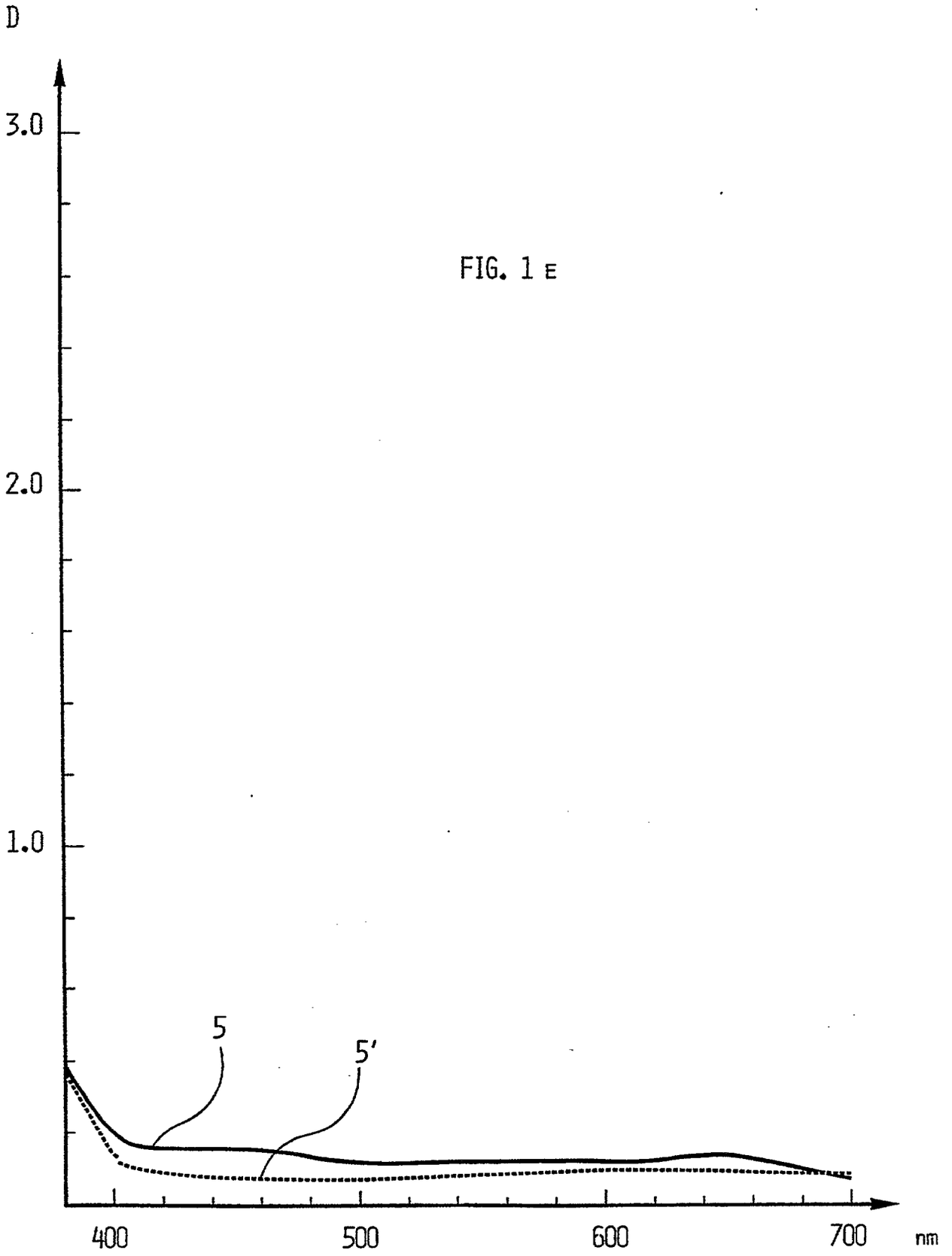


FIG. 1 E

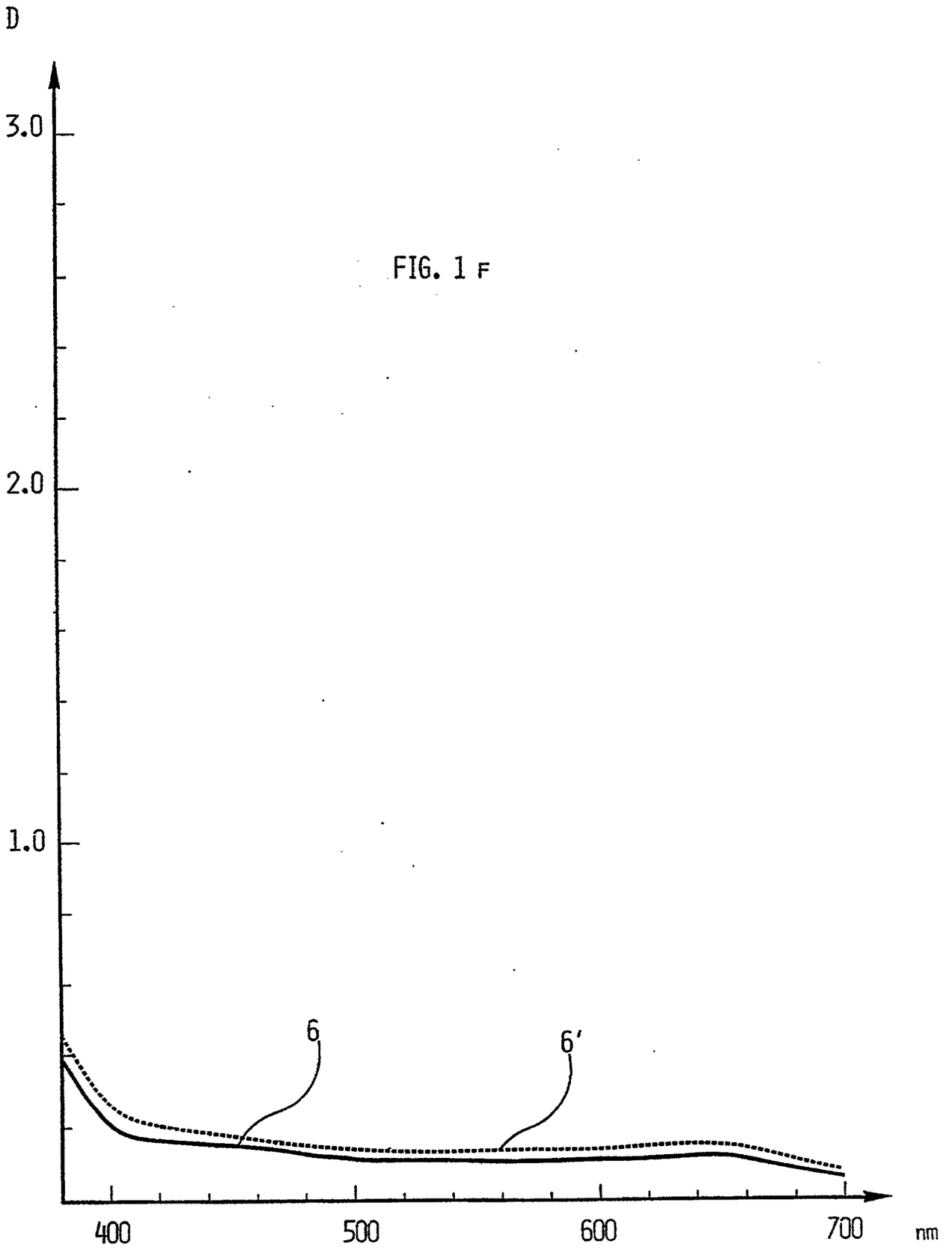


FIG. 1 F

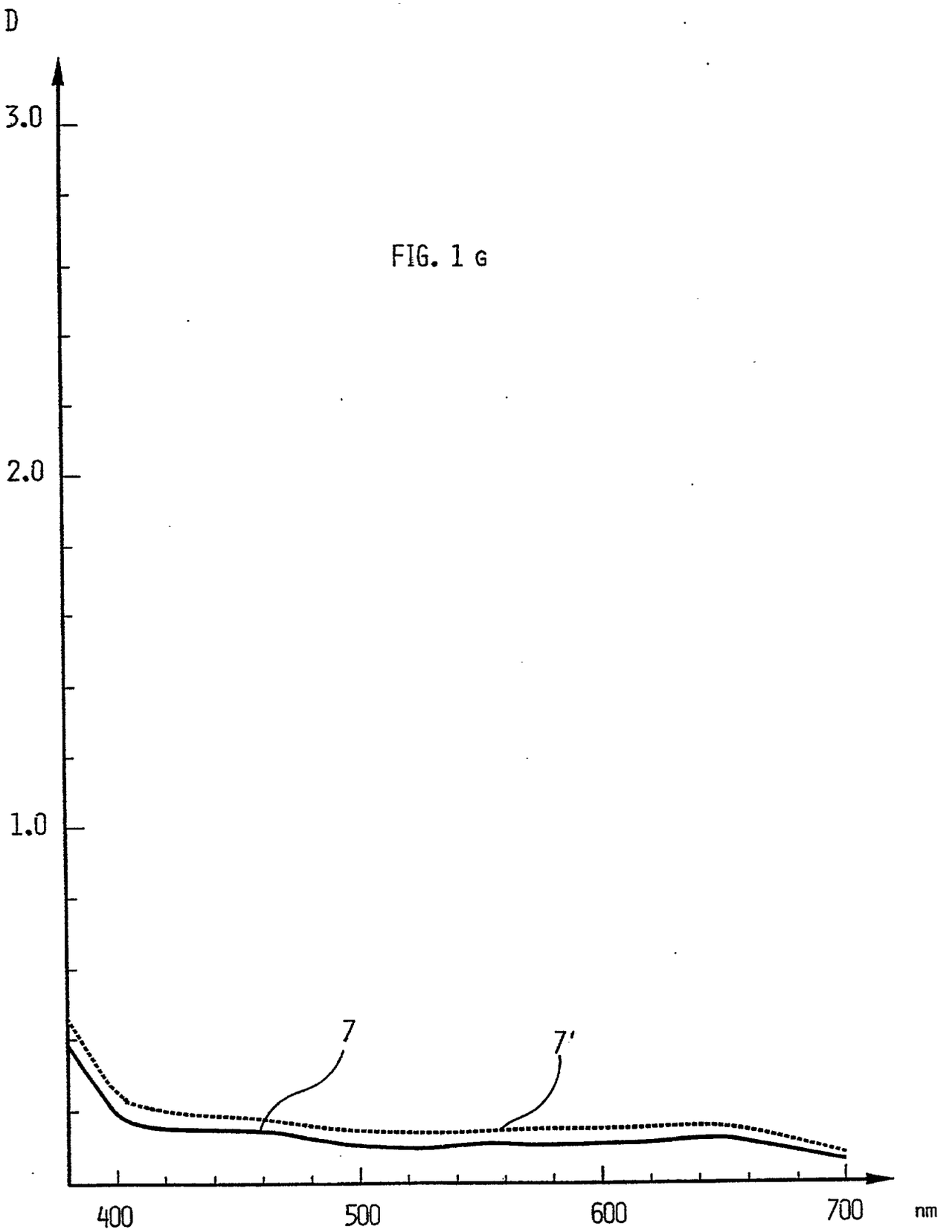


FIG. 1 G

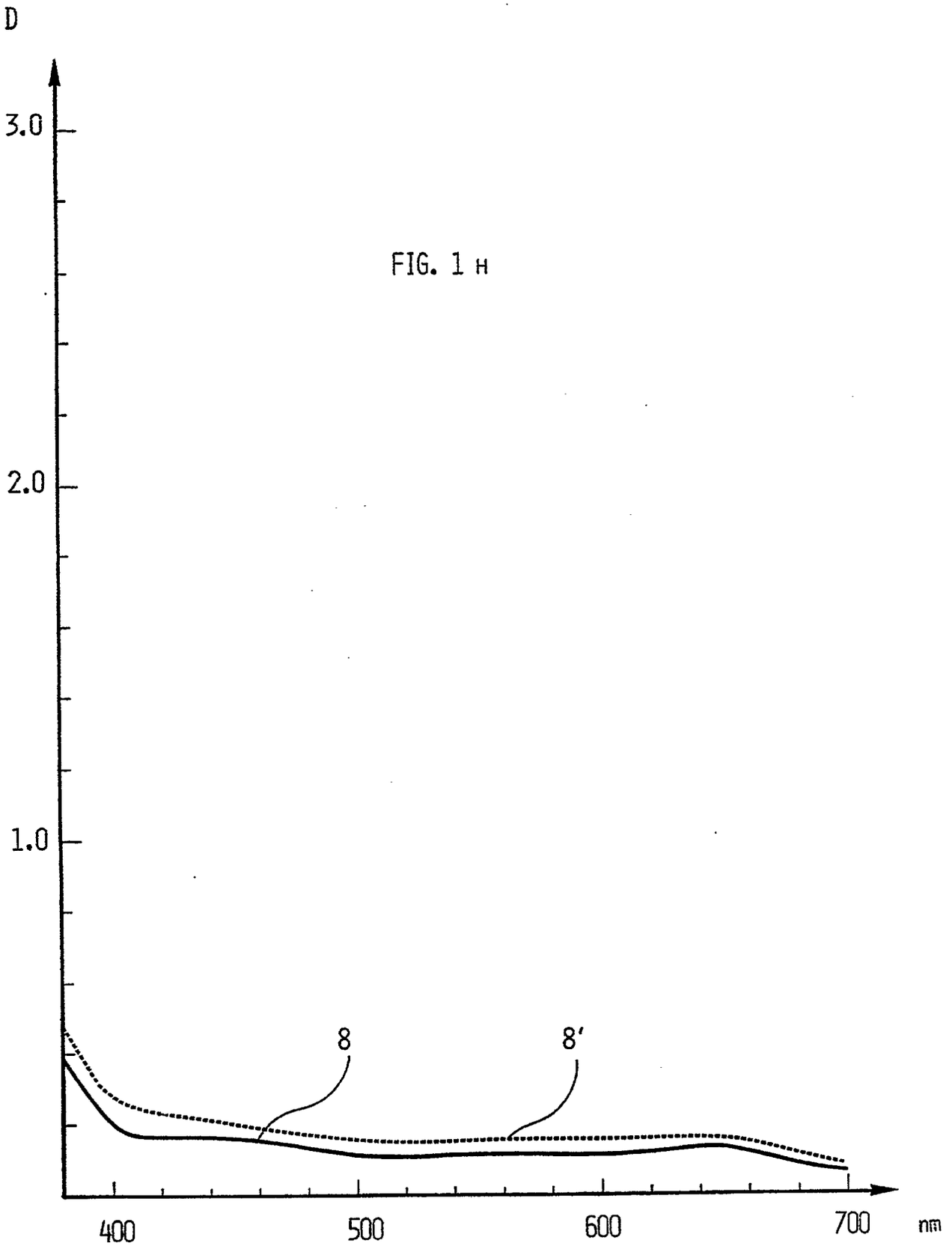


FIG. 1 H

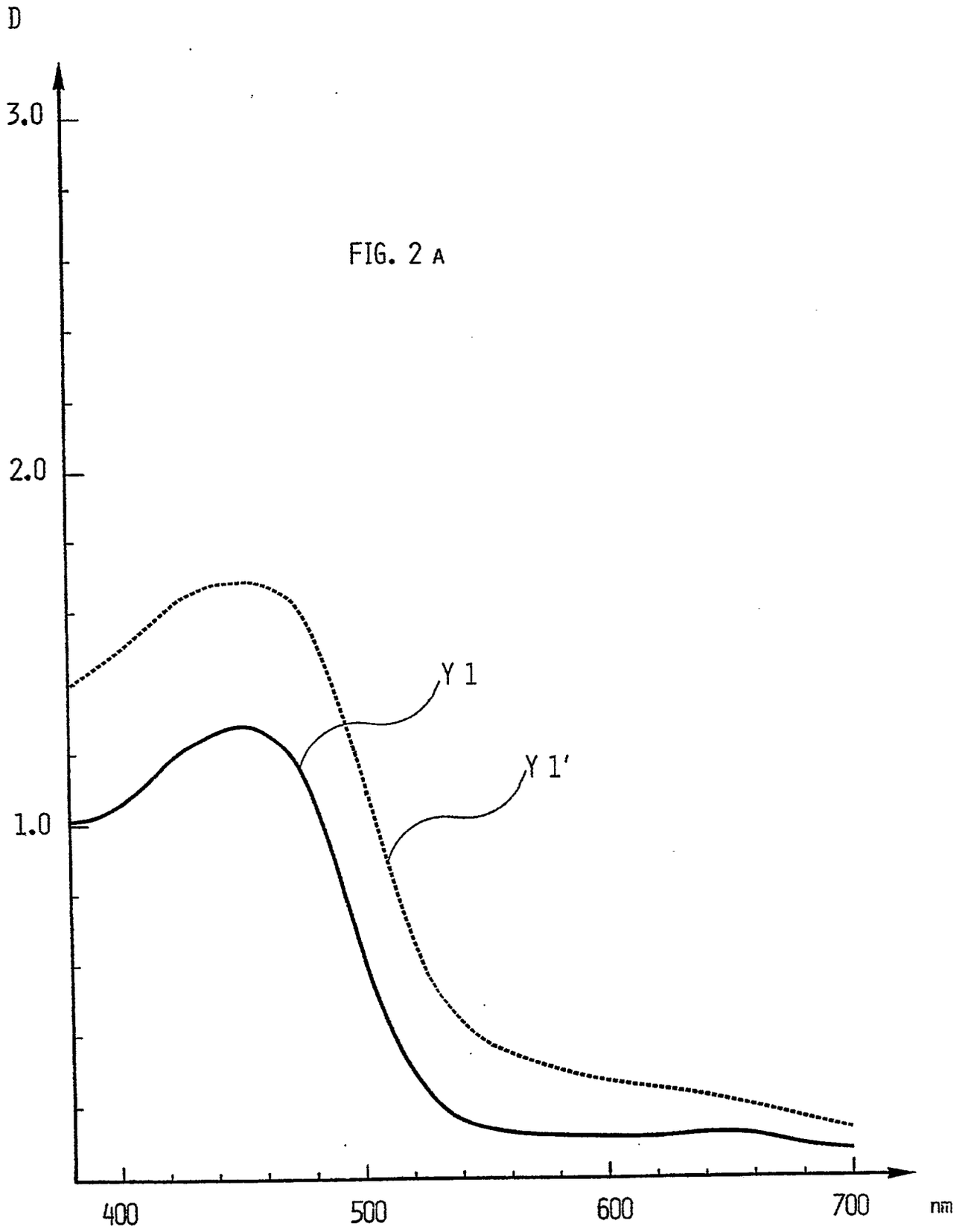


FIG. 2 A

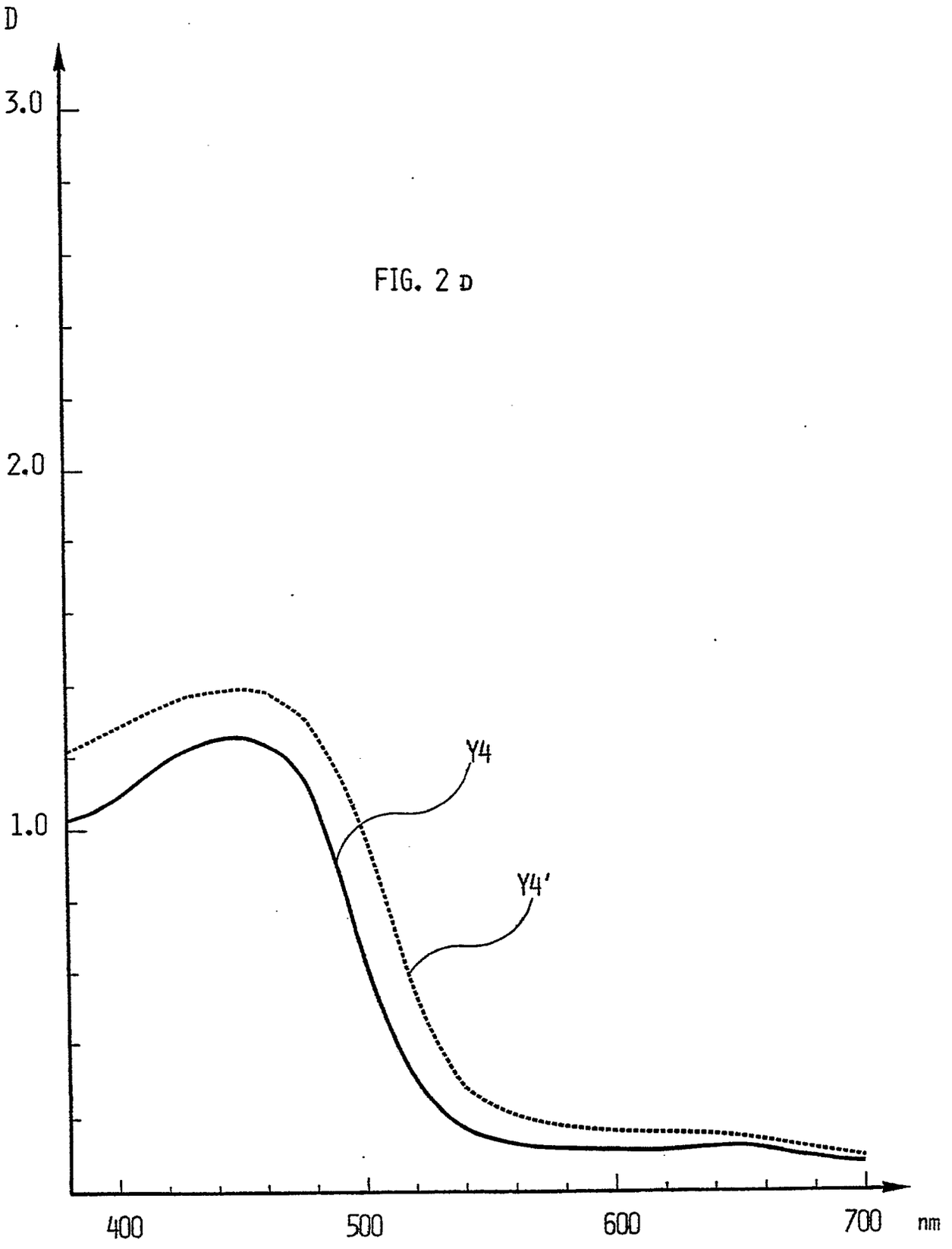


FIG. 2 D

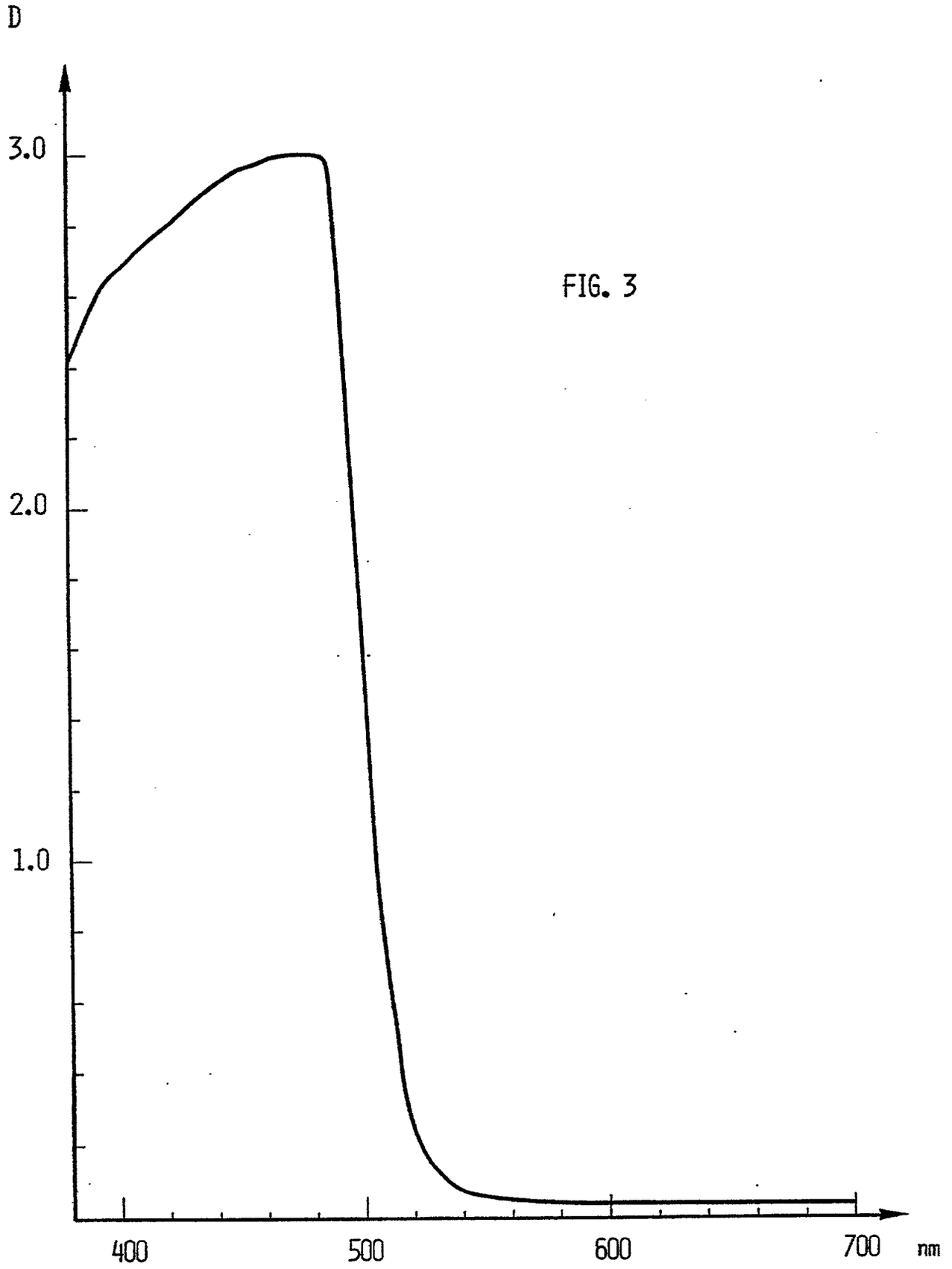


FIG. 3