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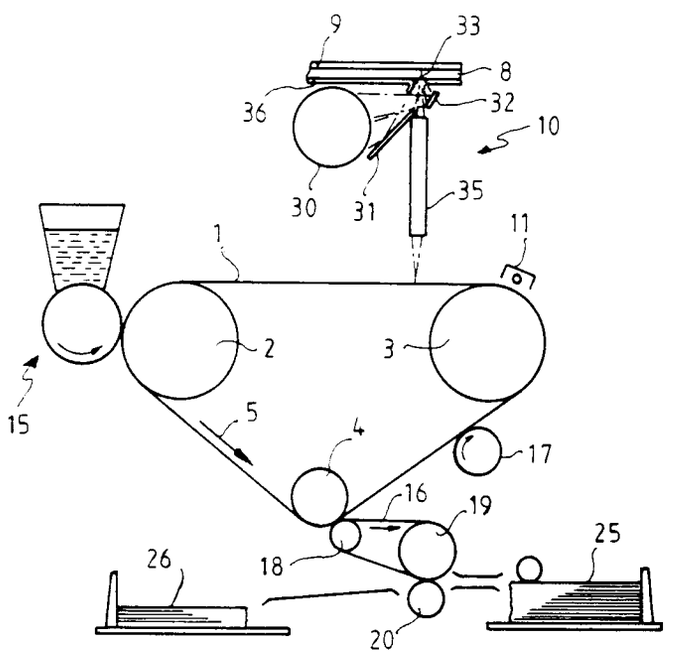
(54) A device for exposing an image information support.

(57) A device for exposing an image information support (9) in a slit-shaped exposure zone (33), the device comprising at least one tubular fluorescent lamp (30) extending parallel to the long centre-line of the exposure zone (33). A first reflection surface (36) is so disposed with respect to the fluorescent lamp (30) that part of the light emitted by the lamp (30) is reflected by the reflection surface (36) to the lamp (30) and is reflected again by the lamp (30) to the exposure zone (33). As a result, a greater proportion of the light emitted by the lamp (30) reaches the exposure zone (33) and contributes effectively to exposure.



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The invention relates to a device for exposing an image information support in a slit-shaped exposure zone, the device comprising at least one tubular fluorescent lamp extending parallel to the long centre-line of the exposure zone.

An exposure device of this kind is known from US-A 4 698 669, in which a slit-shaped exposure zone is illuminated by a pair of tubular fluorescent lamps.

The disadvantage of an exposure device of this kind is that only a restricted part of the quantity of light emitted by each lamp is effectively used for illumination of the exposure zone.

The object of the invention is to provide an exposure device of the type referred to in the preamble whereby a considerably greater proportion of the quantity of light emitted by the lamp reaches the exposure zone.

To this end, a first reflection surface is so disposed with respect to the fluorescent lamp that part of the light emitted by the lamp is reflected by the reflection surface to the lamp and is reflected again by the lamp to the exposure zone.

Consequently, part of the light emitted by the lamp and otherwise not reaching the exposure zone is reflected back to the lamp by the first reflection surface. This light is then re-emitted by the lamp via reflection on the outer surface of the lamp or via reflection on the white base of the lamp fluorescent layer situated at the periphery. This increase in the lamp efficiency can be utilised to achieve accelerated speed of the image-forming device in which the exposure device according to the invention is used, or enables lamps of lower power to be used, thus reducing the heat evolution in the exposure device.

In another embodiment of the exposure device according to the invention, a second reflection surface is so disposed with respect to the fluorescent lamp and the first reflection surface that part of the light emitted by the lamp is reflected by the first reflection surface to the second reflection surface, is reflected from there to the lamp, and is reflected by the lamp to the exposure zone.

Consequently, an even further-reaching improvement is achieved in respect of light intensity in the exposure zone, since part of the light which otherwise does not contribute effectively to exposure reaches the exposure zone again via the first and second reflection surface and the lamp.

In a further embodiment of the exposure device according to the invention, both the fluorescent lamp, the first reflection surface and the second reflection surface are disposed on the same side of the perpendicular plane through the long centre-line of the exposure zone and a third reflection surface is disposed on the other side of said plane.

Consequently, on the one hand, use is made of the efficiency increase given by the first reflection surface in cooperation with the fluorescent lamp and the second reflection surface, and, on the other hand, an illumination of the exposure zone from both sides of the perpendicular plane through the long centre-line of the exposure zone is achieved by the selected disposition of the optical elements. This illumination from both sides of the perpendicular plane prevents shadow formation, which would occur, for example, at the edges of an image support or at folds in the image support in the case of unilateral illumination.

The invention will be explained in detail with reference to the accompanying drawing which is a diagrammatic cross-section of an image-forming device using an exposure device according to the invention.

The image-forming device illustrated is provided with an endless photoconductive belt 1, which is advanced in the direction of arrow 5 at a uniform speed by means of drive and guide rollers 2, 3 and 4 respectively.

The image of an original 9 on a platen 8 is projected strip- wise on to the belt 1 by means of an exposure device 10 after belt 1 has been electrostatically charged by a corona device 11.

The strip-wise exposure can be effected either by fixing the exposure device 10 and conveying the original 9 at a constant speed over the platen 8, or by moving the exposure device 10 at a constant speed beneath the platen 8 with a stationary original 9 thereon.

The latent charge image forming on the belt 1 upon exposure is developed with toner powder by means of a magnetic brush device 15 to give a toner image which is then brought into contact under pressure with an endless intermediate belt 16 in a first transfer zone, said belt being made from or covered with a resilient and heat-resistant material, e.g. silicone rubber.

In these conditions the toner image is transferred by adhesion forces from the belt 1 to the belt 16. After this image transfer, any toner powder residues remaining are removed from belt 1 by means of a cleaning device 17, whereafter the photoconductive belt 1 is ready for re-use.

The intermediate belt 16 is trained about drive and guide rollers 18, 19, the intermediate belt 16 being heated to a temperature above the softening temperature of the toner powder, e.g. by means of an infrared radiator inside roller 19.

While belt 16 is advanced with the toner image thereon, the toner image becomes tacky due to the heating.

In a second transfer zone between the belt 16 and a pressure roller 20 the tacky toner image by pressure is transferred onto and simultaneously fixed on a sheet of receiving material supplied from reservoir 25.

The resulting copy is finally deposited in a tray 26.

The exposure device 10 of the image-forming device comprises a tubular fluorescent lamp 30 (e.g. a low-pressure mercury vapour lamp) which in co-operation with two reflection surfaces 31 and 32 can illuminate an elongate exposure zone 33 from both sides of the perpendicular plane through the long centre-line of that exposure zone 33.

The light reflected by the original 9 in the exposure zone 33 is then projected by an array 35 of imaging glass fibres (a "Selfoc lens array") on to the photoconductive belt 1 to form a charge image thereon.

Only a part of the total quantity of light emitted by the lamp 30 is used via the reflection surfaces 31 and 32 to illuminate the exposure zone 33. The rest of the light is lost and shielding of the exposure device 10 with respect to the photoconductive belt 1 is necessary to prevent such light from reaching the belt 1 and distorting the charge image.

A considerable proportion of this light can, according to the invention, be re-used for image-wise exposure by the use of an extra reflection surface 36. This reflection surface 36 is disposed adjacent the exposure zone 33 against the platen 8 on the same side of the perpendicular plane through the long centre-line of the exposure zone 33 as that on which the lamp 30 and the reflection surface 31 are situated.

It has been found that in this way a quantity of light which does not reach the exposure zone 33 directly from lamp 30 via the reflection surfaces 31 and 32 reaches the lamp 30 again via the reflection surface 36 direct or via the reflection surface 31.

This light which is reflected back is then re-emitted by the lamp 30 by reflection from the outer surface of the lamp 30, by reflection on the white base of the fluorescent layer of lamp 30 situated at the periphery, or by re-striking of the fluorescent layer.

It has been found that a much greater quantity of light (up to about 50% more) can be achieved in the exposure zone 33 by the addition of the reflection surface 36 to the exposure device 10.

This provides an increase in speed of the image-forming device without any increase in the power of the lamp 30.

In addition, the use of the reflection surface 36 prevents reflection of light to the lamp 30 via those parts of the original 9 which are situated on the platen 8 outside the exposure zone 33.

This reflection would in fact result in a variable quantity of light depending on the quantity of image information on the original 9. This would result in a variable quantity of light in the exposure zone 33, something which is unacceptable.

Although the exposure device 10 has been described above in connection with use in an electrophotographic image-forming device, the invention is not limited thereto.

The exposure device according to the invention can also be used in an image information scanner, the exposure device being used to scan an image information support and project the image-wise reflected light on to a sensor array.

In the art of image scanners it is very well known to use CCD's (charge coupled devices) as sensor arrays, onto which a line of a scanned original 9 is imaged.

In commercially available CCD's, the number of light-sensitive elements which are sensitive to individual pixels is limited to approximately 5000, so that the length of a line segment of an original 9 which can be scanned with a single CCD is limited - depending on the desired degree of image resolution.

If a large-size original is to be scanned, it is therefore necessary to use a plurality of CCD's disposed along a line in such a manner that their operative ranges are consecutive. Such a digital image scanning system inherently has the possibility to apply measurements of and corrections for non-uniformities due to a non-uniform illumination of the original 9 or differences between the imaging fibres of the lens array 35, the CCD's or the light-sensitive elements of the CCD's.

It is well known in the art of CCD image scanners to execute a calibration cycle in which a white reflective calibration surface, for instance a calibration roller, is positioned behind the platen 8 in the exposure zone 33. During such calibration cycle the light is reflected from the calibration surface so that every light-sensitive element of the CCD's is illuminated. The output signal (gain) of each light-sensitive CCD element is then measured, compared with a reference signal, whereafter the deviation measured for each element is used to adjust the amplification ratio of an amplifier that is coupled to that specific light-sensitive element.

In that way all occurring non-uniformities are corrected.

In order to assure that the illumination during the calibration cycle is representative for a normal imaging illumination of an original 9, the reflectivity of the calibration surface has to be almost ideal diffuse. This because when the calibration surface shows specular reflectivity to some extent the adjustment of one or more light-sensitive CCD elements or a whole CCD will be different from the rest, thereby introducing non-uniformity in the illumination system, since specular reflection has a specific direction and is thus uneven while diffuse reflection is even.

In practice the reflective surface of a calibration device can be realised by coating of a suitable, dull lacquer on a substrate like for instance a roller.
In view of the above mentioned reflectivity requirements a suitable lacquer can be characterised by the ratio between the specular reflection portion and the maximum diffuse reflection measured on a test surface.
In order to be characterised as a suitable lacquer for a calibration surface said ratio may not exceed the values as mentioned in he following diagram, depending on the angle of incidence of a light beam (the angle between the light beam and the vertical to the test surface).

angle of incidence	0	1	2	3	4	5	6	7
ratio	1.32	1.72	1.80	1.87	2.26	2.65	2.99	3.34

angle of incidence	8	9	10	11	12	13	14	15
ratio	4.97	6.78	8.60	10.41	12.36	14.31	16.26	18.21

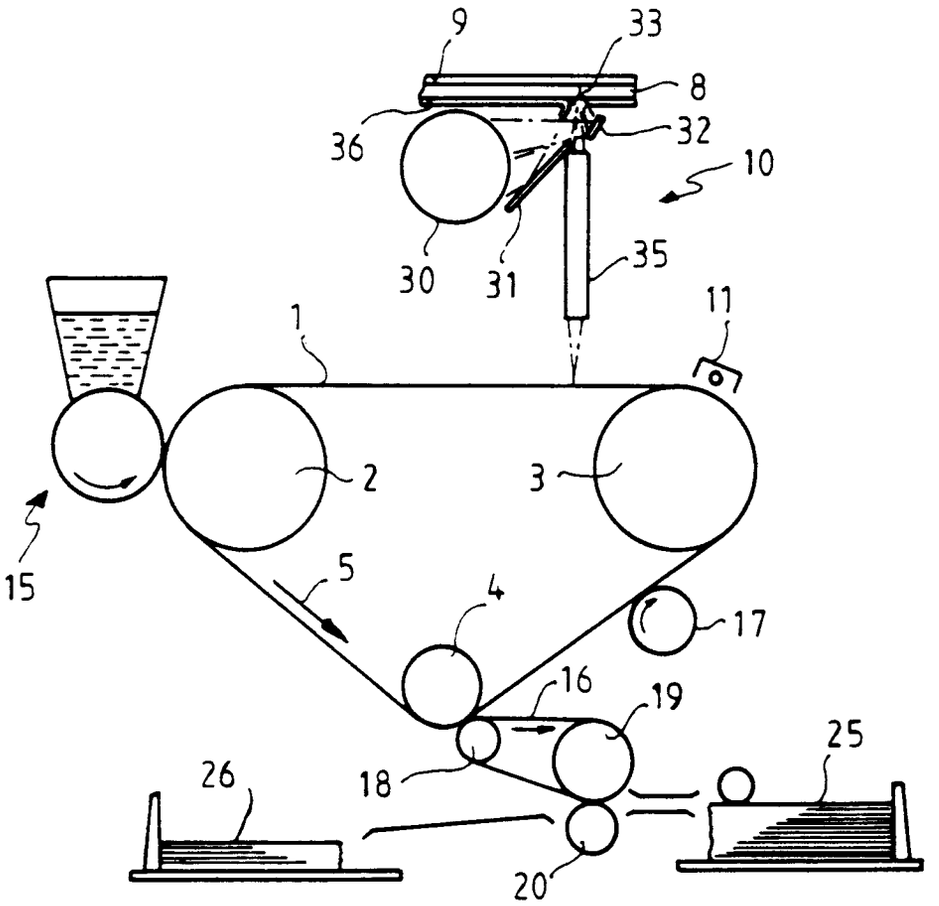
An example of a suitable lacquer is Sigma Dur ASC HB of the firm Sigma Coatings.

Claims

1. A device for exposing an image information support (9) in a slit-shaped exposure zone (33), the device comprising at least one tubular fluorescent lamp (30) extending parallel to the long centre-line of the exposure zone (33), characterised in that a first reflection surface (36) is so disposed with respect to the fluorescent lamp (30) that part of the light emitted by the lamp (30) is reflected by the reflection surface (36) to the lamp (30) and is reflected again by the lamp (30) to the exposure zone (33).

2. A device according to claim 1, characterised in that a second reflection surface (31) is so disposed with respect to the fluorescent lamp (30) and the first reflection surface (36) that part of the light emitted by the lamp (30) is reflected by the first reflection surface (36) to the second reflection surface (31), is reflected from there to the lamp (30), and is reflected by the lamp to the exposure zone (33).

3. A device according to claim 2, characterised in that both the fluorescent lamp (30), the first reflection surface (36) and the second reflection surface (31) are disposed on the same side of the perpendicular plane through the long centre-line of the exposure zone (33) and a third reflection surface (32) is disposed on the other side of said plane.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EUROPEAN SEARCH REPORT

Application Number
EP 93 20 3159

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X	PATENT ABSTRACTS OF JAPAN vol. 6, no. 51 (P-108)(929) 6 April 1982 & JP-A-56 164 362 (FUJI XEROX K.K.) 17 December 1981 * abstract *	1-3	G03G15/04
A	IBM TECHNICAL DISCLOSURE BULLETIN. vol. 19, no. 2 , July 1976 , NEW YORK US pages 384 - 385 D. J. ROBERTS 'COPIER MACHINE ILLUMINATION PACKAGE' * the whole document *	1,2	
A	XEROX DISCLOSURE JOURNAL. vol. 9, no. 1 January/February 1984, , STAMFORD, CONN US page 53 ROGER W. BUDNIK 'INFRARED FILTER FOR AN ELLIPTICAL REFLECTOR' * the whole document *	1-3	
			TECHNICAL FIELDS SEARCHED (Int.Cl.5) G03G G03B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	23 February 1994	Cigoj, P

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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