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Steinle et al.

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[54] **COLOR IMAGE SENSING ASSEMBLY WITH MULTIPLE LINEAR SENSORS AND ALIGNED FILTERS**

[75] Inventors: **Michael J. Steinle**, Fort Collins; **Steven L. Webb**, Loveland, both of Colo.; **Hans D. Neumann**, Los Altos, Calif.

[73] Assignee: **Hewlett-Packard Company**, Palo Alto, Calif.

[21] Appl. No.: **63,838**

[22] Filed: **May 19, 1993**

Related U.S. Application Data

[63] Continuation of Ser. No. 869,273, Apr. 15, 1992, abandoned.

[51] **Int. Cl.**[5] **H01J 40/14**

[52] **U.S. Cl.** **250/208.1**; 250/226; 358/512

[58] **Field of Search** 250/208.1, 226; 358/75, 358/44, 41, 212, 213.11, 213.13, 213.27, 213.28; 359/629, 637, 638

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,709,144	11/1987	Vincent .	
4,783,696	11/1988	Neumann et al. .	
4,812,900	3/1989	Kadowaki et al. .	
4,896,217	1/1990	Miyazawa et al. .	
4,985,760	1/1991	Maeshima et al.	358/75
4,994,907	2/1991	Allen	358/75
5,019,703	5/1991	Boyd et al. .	
5,040,872	8/1991	Steinle	359/637
5,044,727	9/1991	Steinle .	
5,161,008	11/1992	Funk .	

FOREIGN PATENT DOCUMENTS

3618646A1	12/1987	Fed. Rep. of Germany .
3936930C1	5/1990	Fed. Rep. of Germany .

OTHER PUBLICATIONS

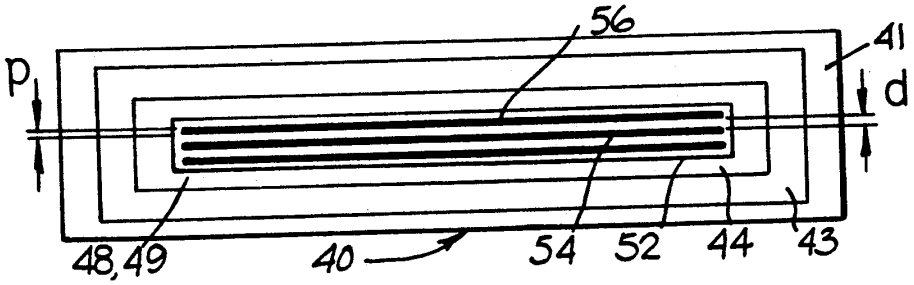
Patent Abstracts of Japan–vol. 2, No. 125 (E–065) Oct. 20, 1978 & JP–A–53 092 621 (Matsushita Denki Sangyo K.K.) 14 Aug. 1978.

Primary Examiner—David C. Nelms
Assistant Examiner—Que T. Le

[57] **ABSTRACT**

An optical scanning device for generating a data signal representative of an object which is scanned comprising a light source for illuminating the object; an imaging assembly for projecting imaging light from the object onto an image plane; a plurality of linear photosensor arrays positioned at the image plane for generating light sensing signals indicative of the intensity of light in different spectral regions impinged thereon; a transparent plate positioned in adjacent overlying relationship with the photosensor arrays; a plurality of filter coatings disposed on different regions of the transparent plate in alignment the plurality of photosensor arrays for filteringly transmitting imaging light in the predetermined different spectral regions to the different photosensor arrays.

22 Claims, 3 Drawing Sheets



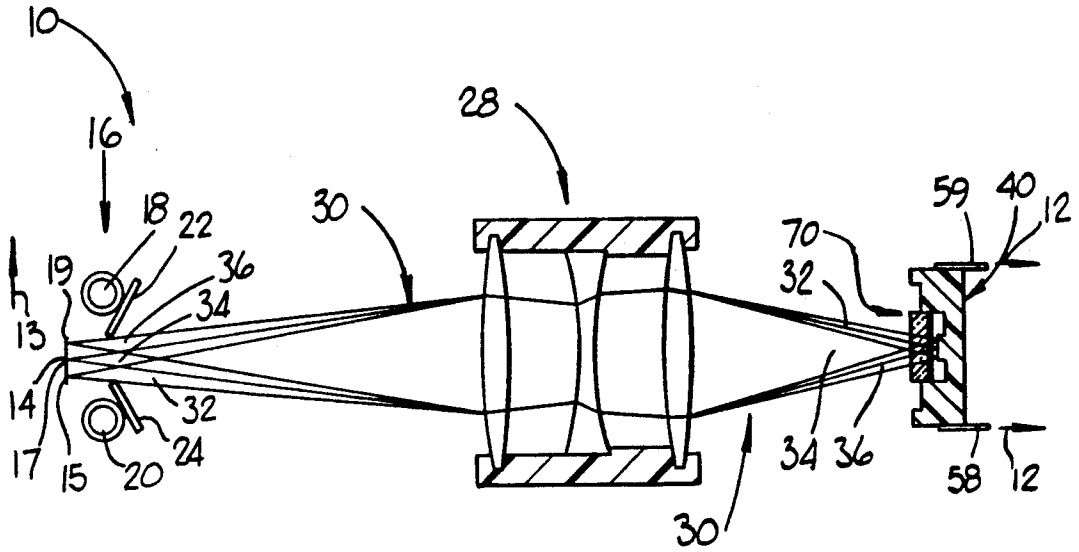


FIG. 1

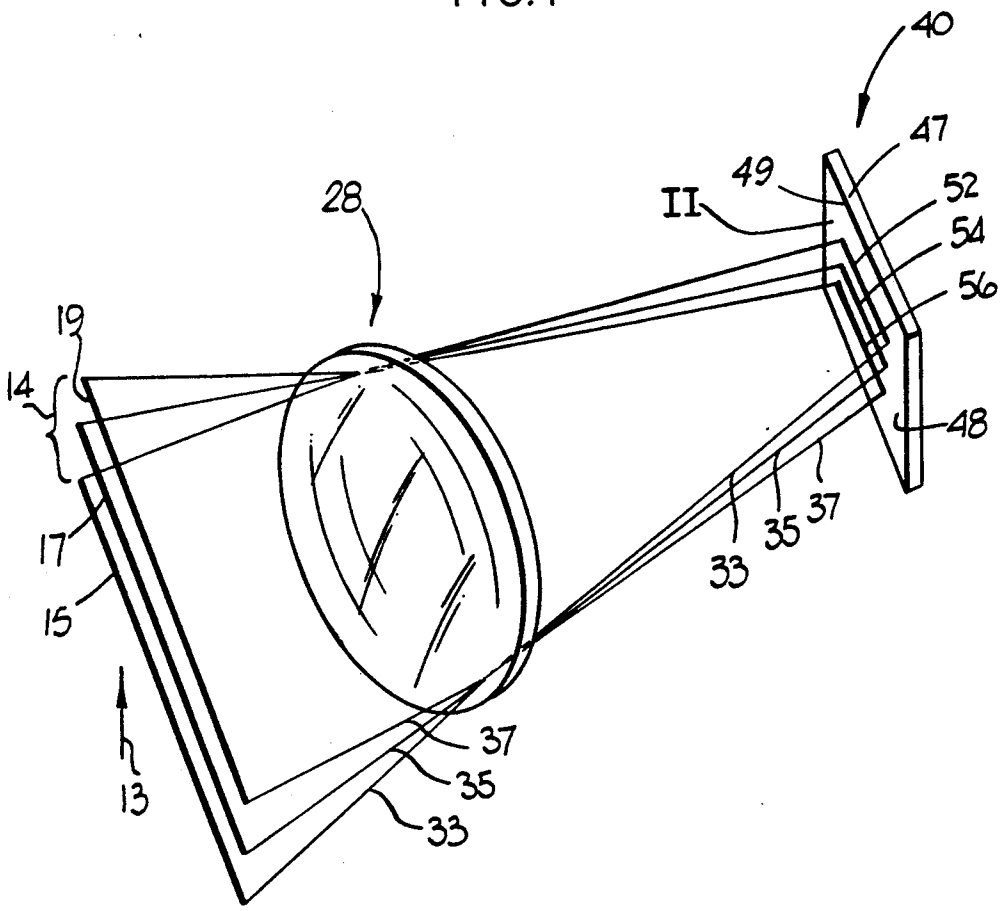


FIG. 2

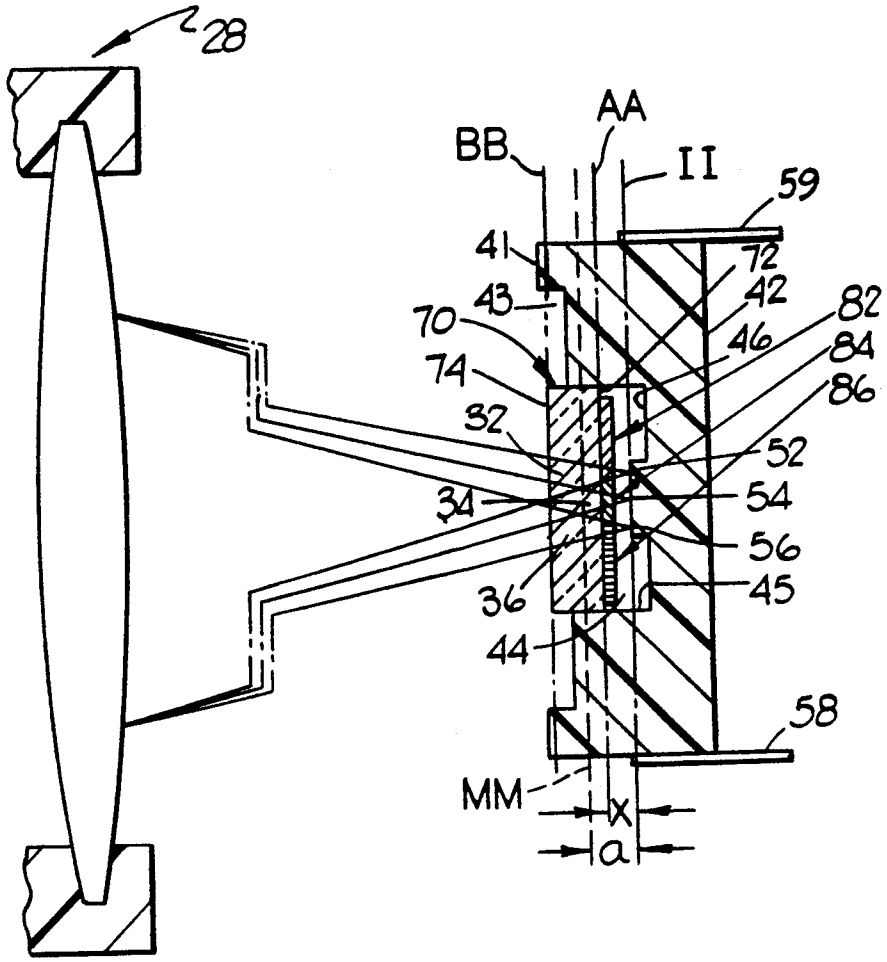


FIG.3

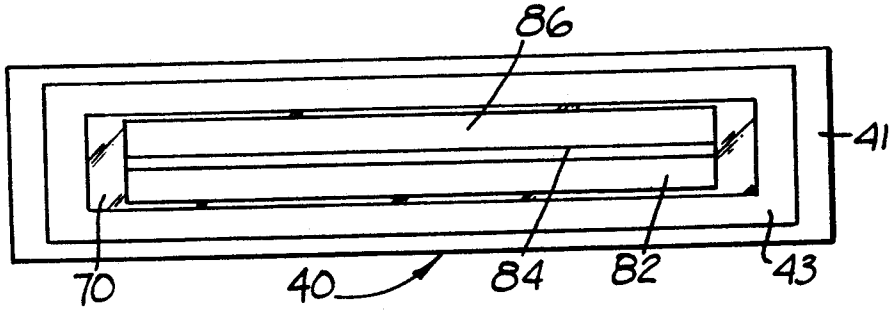


FIG.4

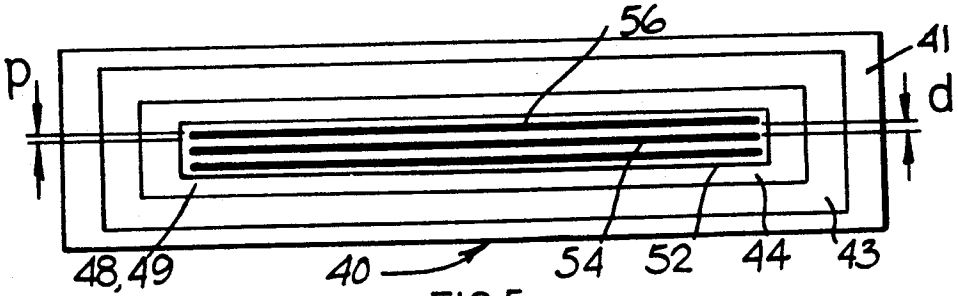


FIG.5

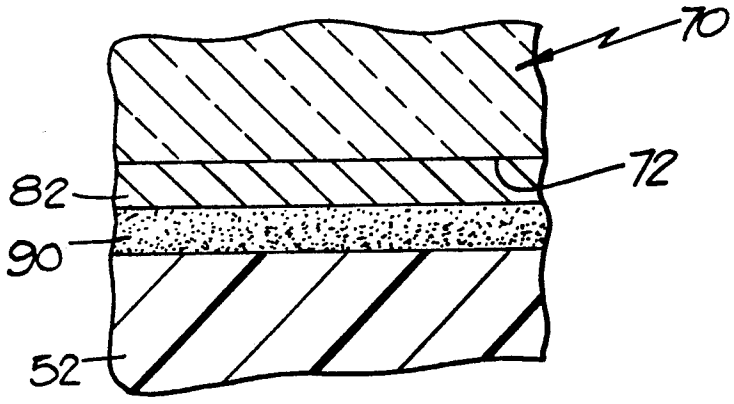


FIG. 6

COLOR IMAGE SENSING ASSEMBLY WITH MULTIPLE LINEAR SENSORS AND ALIGNED FILTERS

CROSS REFERENCE TO RELATED APPLICATION

This is a continuation of copending application Ser. No. 07/869,273 filed on Apr. 15, 1992, now abandoned.

BACKGROUND OF THE INVENTION

The present invention relates generally to optical scanners and, more particularly to color optical scanners and photosensors used therein.

Optical scanners operate by imaging an object and then separating the imaging light into its spectral components, typically red, green, and blue. Separate color component images are sensed by different optical sensor arrays which each generate a signal representative of the associated color component image which is sensed. These data signals from the different sensors are then processed and stored on a suitable medium, e.g. a hard disk of a computer or video tape of a camcorder for subsequent display and/or manipulation.

A number of color scanning devices are described in U.S. Pat. No. 4,709,144 for COLOR IMAGER UTILIZING NOVEL TRICHROMATIC BEAMSPLITTER AND PHOTOSENSOR of Vincent issued Nov. 24, 1987; U.S. Pat. No. 4,783,696 for COLOR IMAGE INPUT APPARATUS WITH VARIOUS ELEMENTS HAVING MATCHED APERTURES of Neumann et al. issued Nov. 8, 1988; U.S. Pat. No. 5,019,703 for OPTICAL SCANNER WITH MIRROR MOUNTED OCCLUDING APERTURE OR FILTER of Boyd et al. issued May 28, 1991; and U.S. Pat. No. 5,044,727 for BEAM SPLITTER/COMBINER APPARATUS of Steinle issued Aug. 13, 1991 which are each hereby specifically incorporated by reference for all that is disclosed therein. Scanners typically employ linear sensor arrays which sense imaging light from a scan line portion of an object. A linear sensor array comprises a single row of picture elements or "pixels" which each generate a signal representative of the intensity of the light impinged thereon. A typical pixel dimension in a linear sensor array of a color optical scanner is 0.008 mm×0.008 mm.

Some optical scanners employ a three-line, CCD (charge coupled device) photosensor unit which is used to simultaneously sense red, green and blue imaging light from the scanned object. One method of filtering the component light beams which are sensed by a three-line CCD unit is to pass the imaging light beam through multiple reflective color filter coatings applied to glass plates located between an imaging lens assembly and the three-line CCD unit. Such filtering methods are used with beamsplitter devices such as described in detail in the above referenced patents of Vincent, Boyd et al. and Steinle.

U.S. Pat. No. 4,783,696 of Neumann et al. discloses a color image input apparatus which includes a support assembly, and beam forming assembly, a projection assembly, and a sensor assembly. The support assembly includes an opaque platen provided with an elongate aperture. The beam forming assembly includes a pair of front reflecting mirrors and a filter assembly. The filter assembly includes three filter windows, each of which includes a transmissive color separation filter. Light shining through a first filter window produces a blue beam, light shining through a second filter window produces a green beam, and light shining through a third filter window produces a red beam. The projection assembly typically includes a number of lenses and an aperture forming iris. The sensor assembly includes three photoelectric sensor arrays. The projection assembly focuses the red beam on the first sensor array, the green beam on the second sensor array, and the blue beam on the third sensor array. The outputs of the sensor assembly form a red/green/blue signal which represents the portion of the color image on a transparency which is aligned with the support assembly aperture. The blue, green and red beams are transposed and focused by the projection assembly. The photoelectric sensor arrays, which are typically formed from a matrix of photosensitive semiconductor devices, convert the intensities of various portions of the red, green, and blue beams to form the red/green/blue signal.

Another known method of filtering imaging light which is to be impinged upon a three-line CCD unit is to apply a filter coating directly to each linear CCD array. Three-line CCD units which have different color filters deposited directly on the linear CCD arrays are known in the art and are commercially available. However there are several disadvantages which are associated with such CCD units:

1) The deposited filter material must be compatible with the silicon substrate material from which the CCD is constructed. There are only a limited number of filter materials which are suitable for deposit on a CCD substrate. The spectral response bandwidths available from such deposited filters is limited and may not be suitable for some imaging device applications where high color fidelity is required.

2) The efficiency or transmissibility of filters deposited directly onto the CCD sensor arrays is relatively low and thus when such coated sensors are used it may be necessary to use expensive, highly efficient optics.

3) The production process for depositing filter coatings directly onto CCD arrays is rather expensive. Additionally, if a process error occurs during the filter deposit process the entire silicon substrate must be scrapped at considerable expense.

It is an object of the present invention to provide a filter and sensor assembly which overcomes these problems in the art.

SUMMARY OF THE INVENTION

The present invention is directed to a light sensor assembly of the type which is used in a color imaging device such as an optical scanner. The light sensor assembly includes a plurality of spatially separated photosensor arrays which each generate light sensing signals indicative of the intensity of the light which is impinged on the photosensor array. In one embodiment, the photosensor arrays are linear photosensor arrays which are positioned in parallel relationship on a common plane. The light sensor assembly also includes a transparent plate which is positioned in overlying relationship with the plurality of separate photosensor arrays. One surface of the transparent plate has filter coatings applied to adjacent regions thereof which are aligned with the underlying photosensor arrays. A filter coating of a different spectral range is aligned with each of the different photosensor arrays.

The light sensor assembly is particularly adapted to be positioned at the image plane of an associated color

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