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Pei et al.

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3,893,764

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[54] PLURAL REFLECTOR, SINGLE SPEED
UNI-DIRECTIONAL SCANNING DEVICE[75] Inventors: Jack Chia Kai Pei, Machida; Hitoshi
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355/47

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355/66, 8; 176/7.6, 7.4, 5.4 ES, DIG. 27;
352/84, 106, 108, 109, 111, 112

[56]

References Cited

UNITED STATES PATENTS

1,994,708	3/1935	Hogan.....	178/7.6
3,049,049	8/1962	Katona.....	350/7 X
3,142,224	7/1964	Andrews et al.....	350/7 X

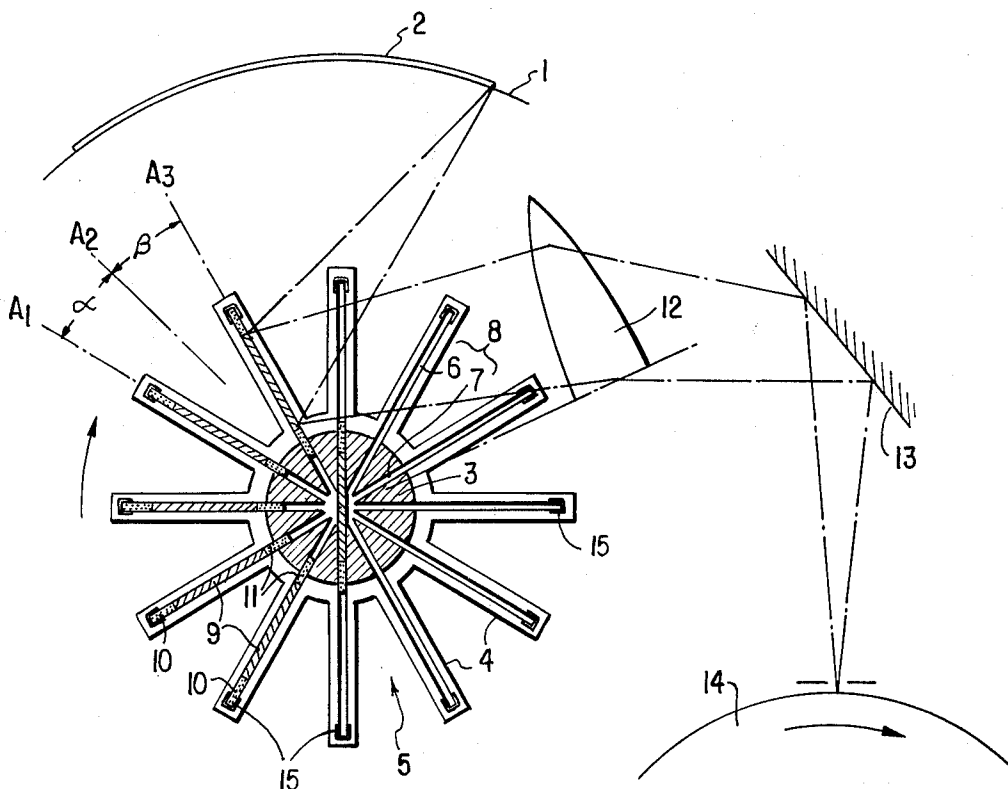
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[57]

ABSTRACT

In a scanning device for a copying machine and the like including a light source for illuminating document, a photosensitive material, and reflecting means for directing light from the document towards the photosensitive material, the improvement comprising the reflecting means including a plurality of reflectors radially disposed about a predetermined axis for scanning the original document by progressively directing the light from the document towards the photosensitive material; a plurality of rotatable reflector support members radially disposed about the predetermined axis, each pair of reflector support members being oppositely disposed about the axis and being provided with internal slots for receiving the reflectors so that a continuous movement path is provided between each pair of opposed reflector support members for its associated reflector; and means for rotating the reflector support members about the predetermined axis in the same direction at a constant speed so that each reflector, after scanning the document, retracts from a scanning position along its movement path to a sheltered position where it does not interfere with scanning by the following reflector.

6 Claims, 3 Drawing Figures



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OR IN 355/66

FIG. 1

(PRIOR ART)

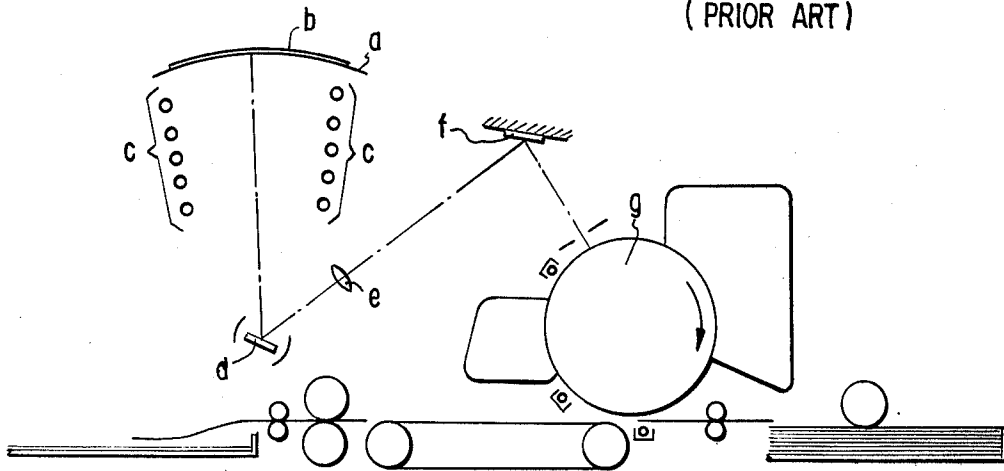
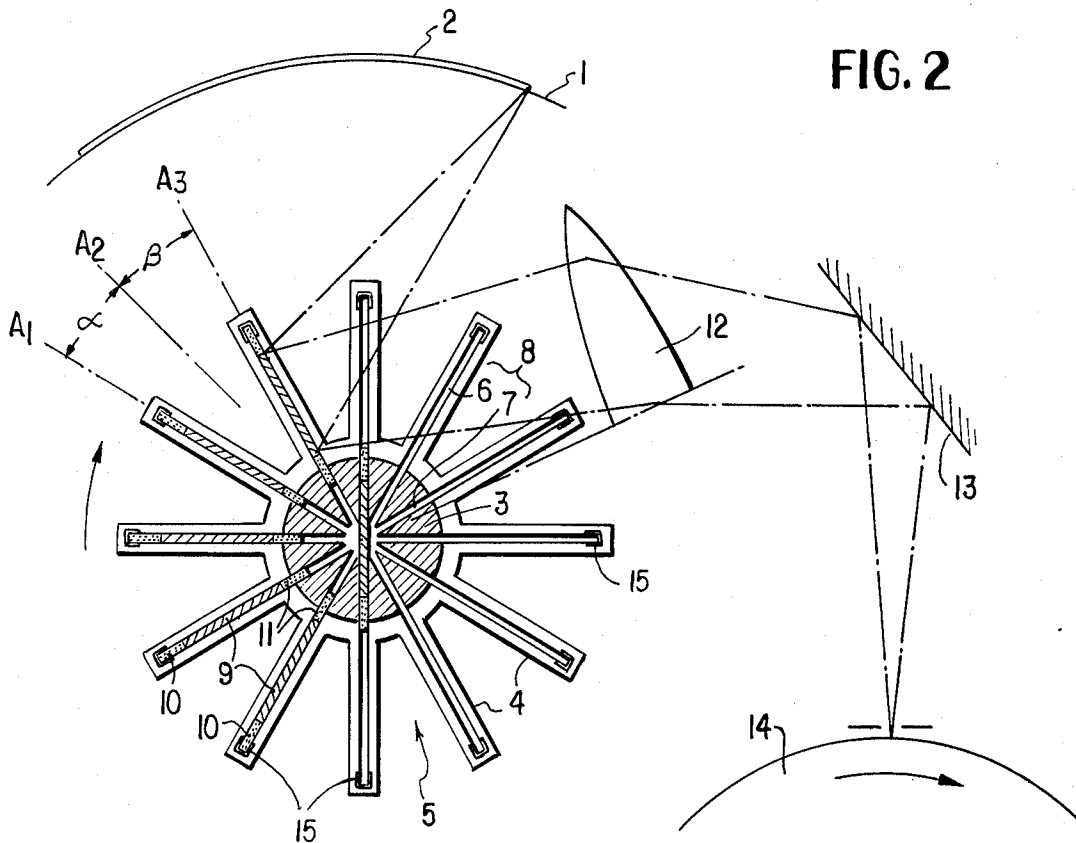


FIG. 2



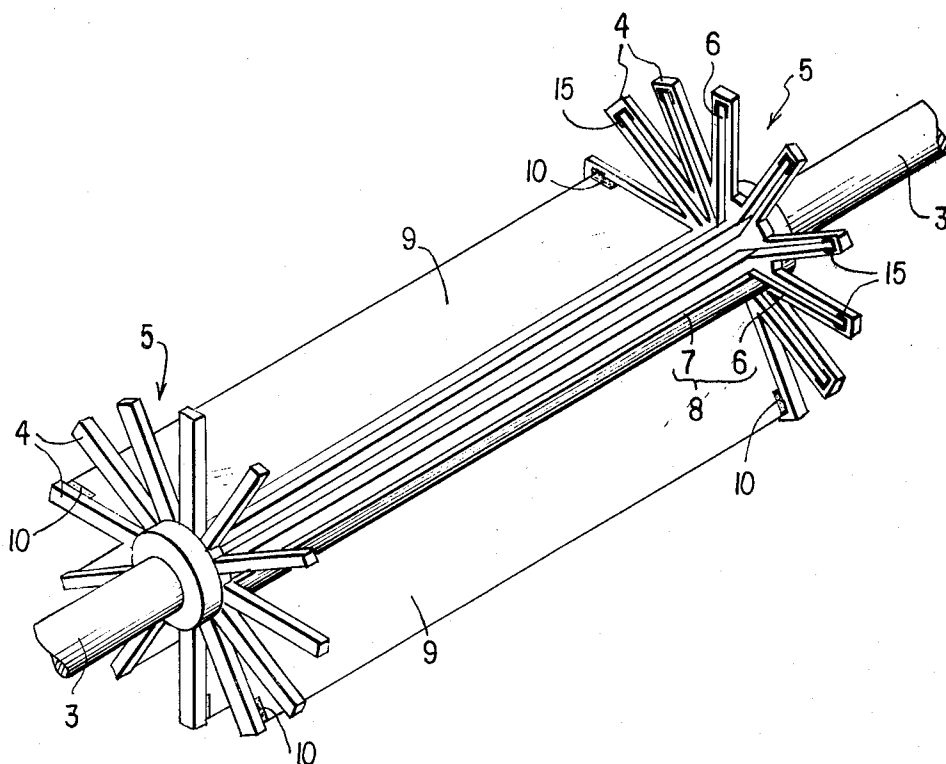


FIG. 3

PLURAL REFLECTOR, SINGLE SPEED UNI-DIRECTIONAL SCANNING DEVICE

CROSS REFERENCE TO RELATED APPLICATION

This application is related to co-pending United States patent application filed by Jack Pei Nov. 19, 1973, assigned Ser. No. 417,195, entitled "Uni-directional Scanning Device for Use in Copying Machines and the Like," which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of The Invention

This invention relates to a document scanning device for use in copying machines and the like and more specifically to a document scanning device of the type in which a stationary document is scanned by rotating reflectors.

2. Description of The Prior Art

Document scanning devices of this type typically comprise, as shown in FIG. 1, a manuscript support plate, *b*, for holding a document in a stationary position, a light source, *c*, for uniformly illuminating the document, *a*, and a moving reflector, *d*, which is reciprocally rotated to scan document *a* during the forward scan motion of the reflector so that light reflected from the document, *a*, is progressively directed through a lens, *e*, and a fixed reflector, *f*, to a photosensitive body, *g*. The moving reflector, *d*, has to return to the initial scanning position after it has completed the forward motion. Hence, in copying machines employing a scanning device of this type, the size of the mechanism tends to become large and requires high precision. Further, vibration develops in every part of the mechanism due to the continuous oscillating or reciprocal motion of the reflector, imposing limits to the scanning speed.

SUMMARY OF THE INVENTION

This invention was devised in view of the above-described drawbacks and has a primary object of providing an improved document scanning device which is capable of greatly increasing the copying speed with respect to prior art devices, while at the same time being simpler and smaller in construction.

In a preferred embodiment, the document scanning device of this invention includes a plurality of reflectors contained in a reflector support body which rotates at a constant speed to progressively direct the light reflected from a document to a photosensitive body. Each reflector, after having scanned the manuscript, is quickly retracted along a radial path in the reflector support member so that scanning of the succeeding reflector will not be interrupted.

Other objects and advantages of this invention will become apparent upon reading the appended claims in conjunction with the following detailed description and the attached drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic diagram of a prior art copying machine employing a scanning device of the reciprocal rotary type.

FIG. 2 is a partial cross-sectional diagram of an illustrative embodiment of this invention.

FIG. 3 is a perspective view of major parts of an illustrative embodiment of this invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. 2 and 3, there is illustrated a plate, 1, for holding a document, 2. A rotating shaft, 3, is driven at a constant speed in a predetermined direction by appropriate means. On the rotating shaft are mounted a plurality of transparent reflector support members, 5, radially about shaft 3 at predetermined, equal angular intervals. The angular intervals are such that each support member, 5, is always opposed by another support member mounted 180° from the first support member on shaft 3. An internal guide groove or slot, 6, is provided within each of the support members, 5.

Within rotating shaft 3 are provided further internal grooves or slots, 7, which connect with the guide grooves, 6, of support arms 5 as shown in FIG. 2. The grooves 6 and 7 are in line with each other so that a continuous path is provided between each support member 5 and the support member 180° opposed therefrom. Each movement path comprises a radial line which crosses the center line of rotating shaft 3. In each of the movement paths is a slidable reflector which is restricted to its associated path. Cushion members 10 and 11 are on both sides of each of the sliding reflectors, 9, and function as dampeners to restrict vibration.

In operation, the document scanning device of this invention executes scanning in the following manner. The scanning of the document in FIG. 3 is started from position A2 and is completed at position A3. Each reflector, 9, during the scan remains at the scanning position on its movement path due to a pair of clips 15 or restraints within the guides of the support members, 5. But after passing position A3, the reflector, 9, slides down after being shuttled across by a pair of actuators, situated at both edges of the reflector and outside of the optical path, along the guide and into a locked position at the opposite end. The reflector is out of the way of the reflector succeeding it and thus the succeeding reflector can commence scanning without interference from the reflector retracted to the locked position. Retention is provided for by a pair of clips 15 within the guides of the support members, 5.

If the minimum angle required for a reflector to pre-scan for the previous reflector to have enough time to be retracted to a sheltered position and properly dampened of vibrations is ($A1$ to $A2$), the scanning angle is $<\beta$, and the number of reflectors is N , then the following relation results:

$$<\alpha + <\beta = 360/2N$$

The angular interval between successive support members, 5, should be no less than $<\alpha + <\beta$. The light reflected from the document, 1, is progressively directed by each of the reflectors, 9, through lens 12 and fixed mirror 13 to a photosensitive body 14 such as a selenium photosensitive drum used in electrophotography.

It should be understood that this invention is not limited to the above-mentioned embodiment, and the means for moving the reflector on the radial lines or movement paths may be modified appropriately.

Since each reflector, immediately after scanning, is quickly retracted from the scanning position along its radial movement path provided in the reflector support members, copying speed is greatly enhanced with a rel-

atively simple and small device which can be readily manufactured.

Numerous modifications of the invention will become apparent to one of ordinary skill in the art upon reading the foregoing disclosure. During such a reading, it will be evident that this invention provides a unique plural reflector, single speed, uni-directional scanning device for accomplishing the objects and advantages hereinstanted.

What is claimed is:

1. In a scanning device for a copying machine and the like including a light source for illuminating a document, a photosensitive material, and reflecting means for directing light from said document towards the photosensitive material, the improvement comprising:

said reflecting means including a plurality of reflectors respectively disposed along radials extending from said predetermined axis for scanning the original document by progressively directing the light from the document towards the photosensitive material;

a plurality of pairs of rotatable reflector support members radially disposed about said predetermined axis, the two members of each pair of reflector support members being radially, co-planarly, respectively disposed on opposite sides of said axis and having internal slots for slideably receiving and supporting one of said reflectors and for providing a continuous path between the two reflector supporting members in each pair for said one reflector; and

means for continuously rotating said reflector support members about said predetermined axis only in one direction at a constant speed so that each reflector, after scanning a document, retracts along said continuous path from a scanning position on one side of said predetermined axis to a sheltered position on the side of said axis opposite said one side where it does not interfere with scanning by the following reflector and shuttles back and forth between said scanning and sheltered positions as said reflector support members are rotated.

2. The improvement as in claim 1 where each said reflector is retracted to said sheltered position by actuators aided by the force of gravity after it has scanned the document.

3. The improvement as in claim 1 where the number of said reflectors is no greater than N which is determined from the following relation:

$$<\alpha + <\beta = 360/2N$$

where $<\alpha$ is the minimum angle through which each reflector must prescan so the reflector preceeding it has enough time to be retracted to said sheltered position out of its way and to be properly dampened of vibrations caused by said retraction of the reflector to said sheltered position, and $<\beta$ is the angle through which each reflector rotates while it scans the document following the said pre-scan angle $<\alpha$ and prior to it being shuttled to said sheltered position and out of the way of the following reflector.

4. The improvement as in claim 1 where said reflector support members are spaced about said predetermined axis at equal angular intervals.

5. In a scanning device for a copying machine and the like including a light source for illuminating a document, a photosensitive material, and reflecting means for directing light from said document towards the photosensitive material, the improvement comprising;

said reflecting means including a plurality of reflectors radially disposed about a predetermined axis for scanning the original document by progressively directing the light from the document towards the photosensitive material;

a plurality of pairs of rotatable reflector support members radially disposed about said predetermined axis, the two members of each pair of reflector support members being co-planarly, respectively disposed on opposite sides of said axis and having internal slots for slideably receiving and supporting one of said reflectors and for providing a continuous path between the two reflector supporting members each pair for said one reflector; means for continuously rotating said reflector support members about said predetermined axis only in one direction at a constant speed so that each reflector, after scanning a document, retracts along said continuous path from a scanning position on one side of said predetermined axis to a sheltered position on the side of said axis opposite said one side where it does not interfere with scanning by the following reflector; and

a rotatable shaft coaxial with said predetermined axis having a plurality of radially disposed slots extending therethrough, said reflector support members being mounted on said shaft so that the internal slots therein are in alignment with the slots in said shaft thereby providing each said continuous path for the reflectors to shuttle back and forth between the two ends of the paths.

6. A manuscript scanning device for copying machines and the like comprising;

a light source for illuminating a stationary document; a plurality of reflectors for successive scanning of said document;

a plurality of pairs of rotatable reflector support members disposed radially about a predetermined axis, the two members of each pair of reflector support members being radially, co-planarly, respectively disposed on opposite sides of said axis and having internal slots for slideably receiving and supporting one of said reflectors and for providing a continuous path between the two reflector supporting members each pair for said one reflector; and

means for continuously rotating said reflector support members about said predetermined axis only in one direction at a constant speed so that each reflector, after scanning a document, retracts along said continuous path from a scanning position on one side of said predetermined axis to a sheltered position on the side of said axis opposite said one side where it does not interfere with scanning by the following reflector and shuttles back and forth between said scanning and sheltered positions as said reflector support members are rotated.

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