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(71) Applicant
The Mead Corporation
(USA—Ohio),
Courthouse Plaza
Northeast, Dayton, Ohio
45463, United States of
America
(72) Inventors
James William Davis,
Barry Curtis Kockler,
Dale Rodney Duvall

(74) Agent and/or Address for
Service
Baron & Warren,
18 South End,
Kensington, London
W8 5BU

(54) Document scanning system

(57) A document scanning system having a platen 55 for scanning bulky documents and two separate exposing stations 31, 32 for front and reverse side scanning of automatically fed sheet-type original documents 16. The platen 55 and the two exposing stations 31, 32 are arranged in a common plane for scanning by scanning elements 37, 38, 45, 43

carried on a linearly driven carriage 14. Image sensing is performed by CCD arrays mounted on the scanner carriage 14. Scanning at the two exposing stations 31, 32 is conducted with the scanner carriage 14 stationary, while platen scanning proceeds with the scanner carriage 14 moving linearly at a uniform speed. The coplanar positioning of the platen 55 and two exposing stations 31, 32 enables quick scanning and repositioning of the scanner carriage as required for generating scanning signals for loading into a memory for subsequent control of a printer. It also facilitates the utilization of fixed optics.

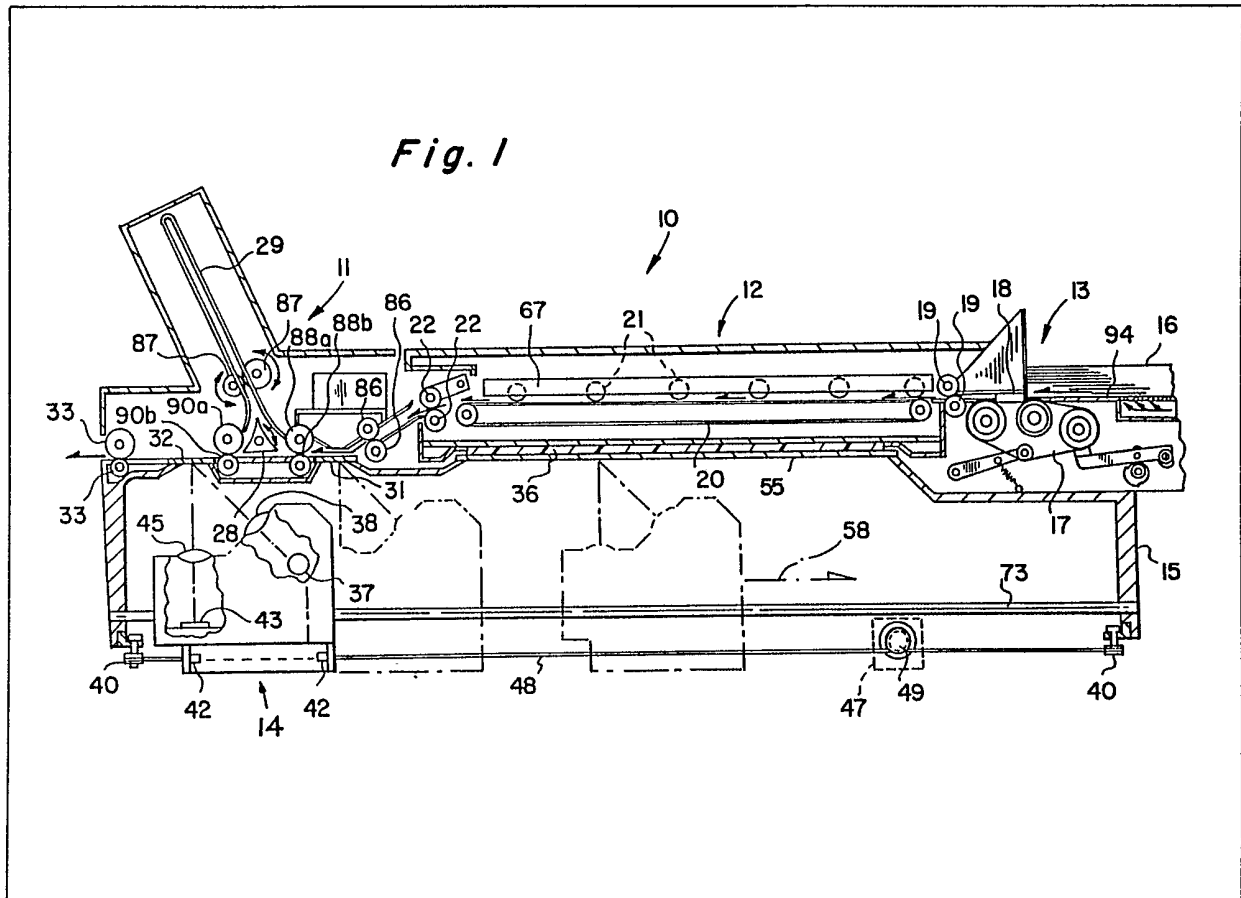


Fig. 1

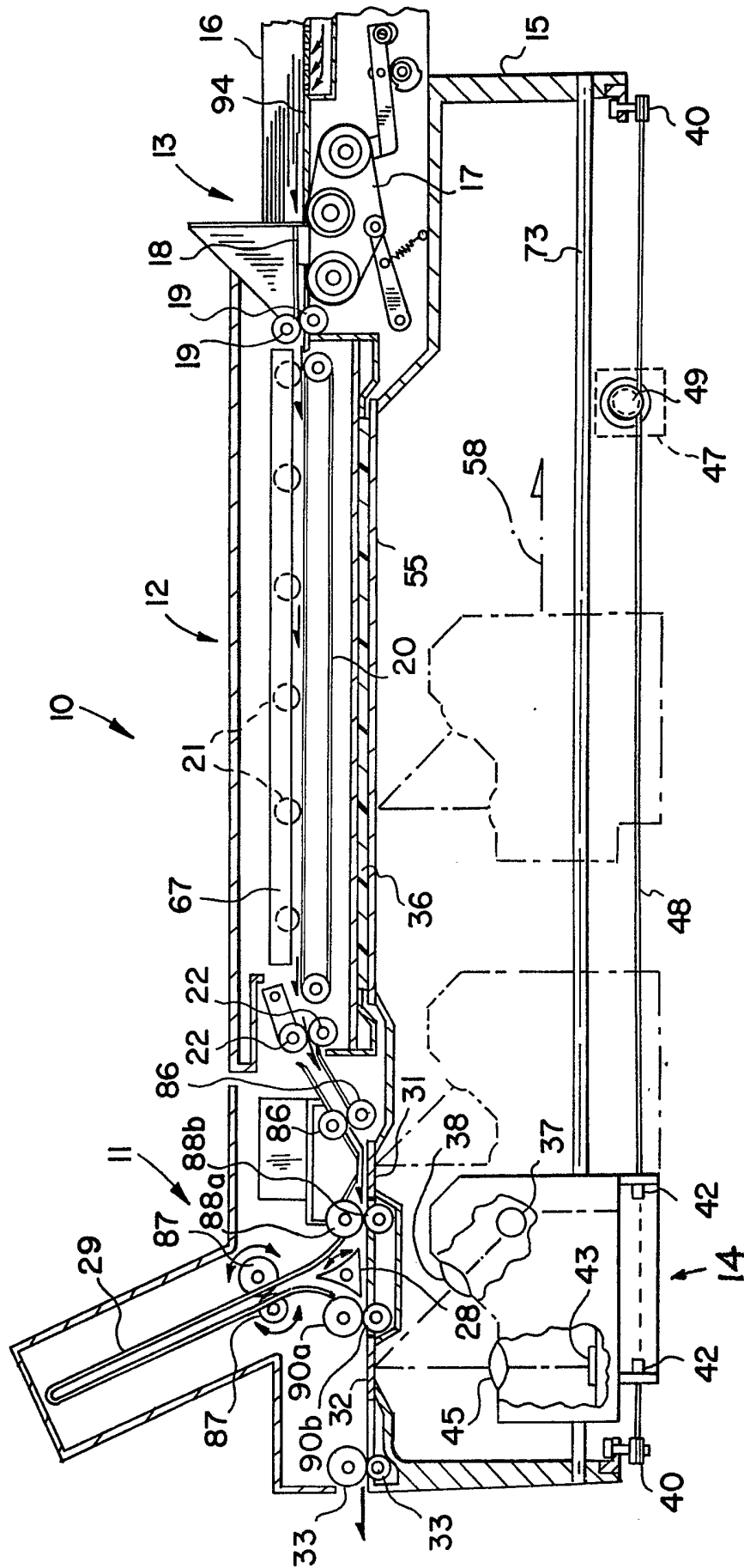
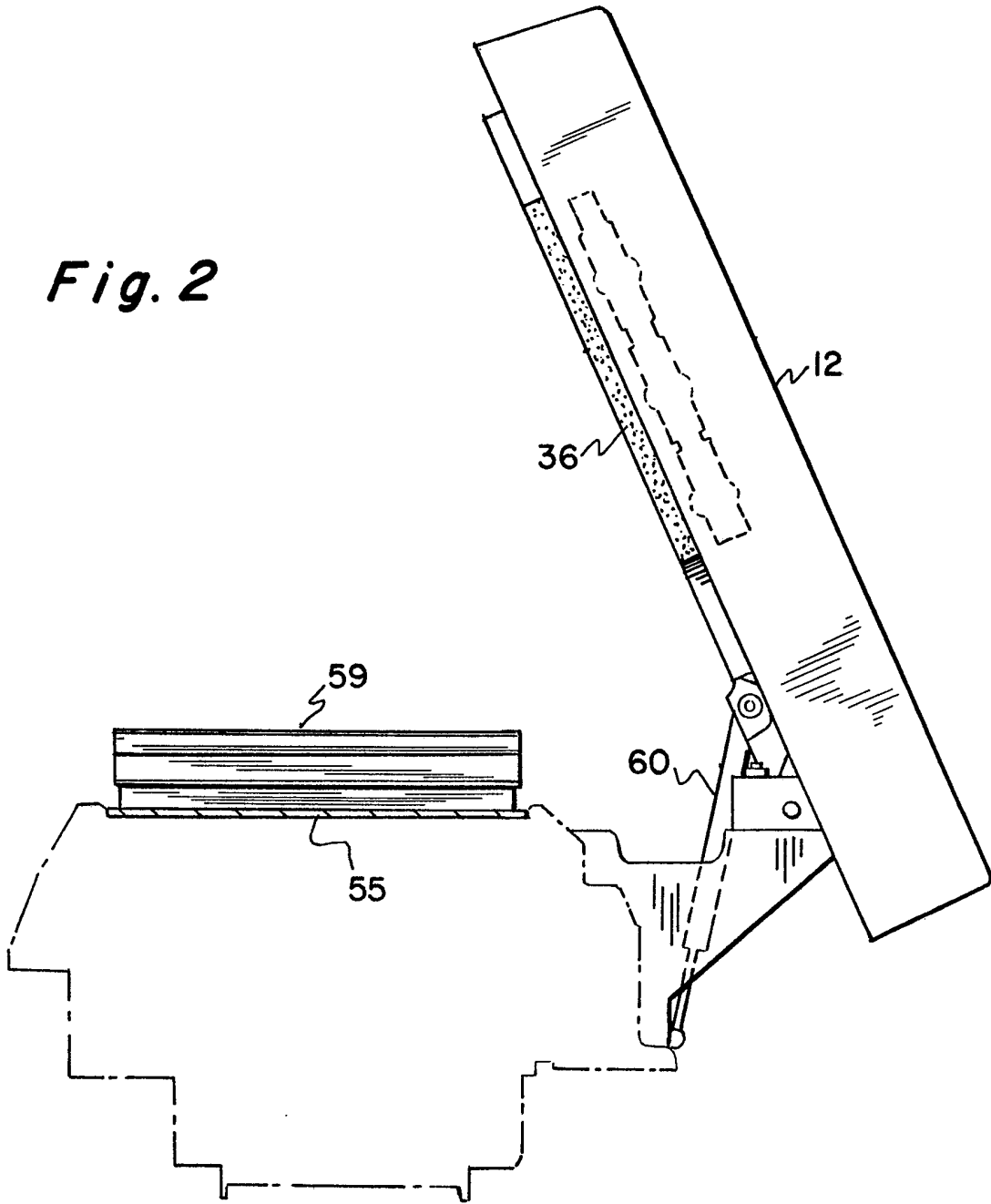


Fig. 2



SPECIFICATION

Document scanning system

This invention relates to a document scanning system for use with a reprographic system. More particularly, the invention relates to a document scanning system for scanning original documents which may be in the form of either individual sheets or bound volumes and generating corresponding scanning signals suitable for loading into a memory. Once loaded into memory, the scanned information may be used for controlling the operation of a programmable printing device. A suitable programmable printing device may be a xerographic copier utilizing a modulated laser beam which scans and selectively discharges a photoconductive surface. Alternatively, an ink jet or some form of dot matrix printer may be utilized.

This invention provides a document scanning system which includes a platen for scanning bulky documents, and two exposing stations for scanning two sides of sheet-type documents; the platen and the two exposing stations being positioned in a common plane. An illumination device and an array of photosensors are mounted on a carriage for movement past the platen at a uniform scanning speed and for positioning at fixed positions adjacent the two exposing stations. Sheet feeding means are provided for feeding sheet-type documents at uniform speed past the two exposing stations and inverting the documents prior to presentation to one of the exposing stations. The coplanar positioning of the platen and the two exposing stations enables quick scanning and repositioning of the illuminator and the photosensor array, as required to generate and store switching control signals for the printer.

In the accompanying drawings:—

Fig. 1 is a partially sectioned side elevation view of a document scanning system according to the present invention; and

Fig. 2 is an end elevation view illustrating a raised platen cover.

A document scanning system 10 in accordance with the present invention may be constructed as generally illustrated in Fig. 1. As illustrated in Fig. 1 document scanning system 10 may comprise a scan station assembly 11, a platen cover 12, a document feeder assembly 13, and a scanner carriage assembly 14, all supported by a frame 15. Front side exposure of a document occurs either at a platen 55 or at a first exposure station defined by scan glass 31. In either case, scanning is performed by optical elements mounted upon scanner carriage 14.

Scan glass 31 is utilized for front side scanning of automatically fed sheet-type original documents, while platen 55 is used for exposure of hand-held documents, which may be either sheet-type or bulky in nature. Platen cover 12 is hinged, as hereinafter described, to accommodate exposure of bulky documents.

Document scanning system 10 also comprises a second exposure station defined by scan glass

32. The second exposure station is provided in order to accommodate reverse side scanning of automatically fed sheet-type documents, thereby providing scanning information for duplex copying. Automatic reversal of sheet-type documents is carried out as hereinafter described.

It is a feature of this invention that scan glass 31, scan glass 32 and platen 55 are all positioned in a common plane for scanning by scanning elements carried by scanner 14. The scanner elements are adjusted for optical focusing at the common plane, and scanner carriage 14 is supported for linear motion along a path parallel to the plane so defined.

Document scanning system 10 is equipped with operator controls (not illustrated) which enable selection of either a manually initiated scanning mode (platen scanning) or an automatic document handling mode. Other controls are provided for selecting either one or two side scanning, and entering various control commands as appropriate for operating the scanning system and controlling an associated printer. A data processing system (not illustrated) receives, processes and stores scanning information produced by the scanner. Thereafter the data processing system generates printing control commands for the printer. Once the scanned information has been stored, it may be used for printing as many copies as may be desired.

It will therefore be seen that a document scanning system in accordance with this invention has the following four different operating modes:

Mode I — Manually initiated scanning of bulky documents (platen cover 12 raised).

Mode II — Manually initiated scanning of sheet type original documents (platen cover 12 closed).

Mode III — Automatic feeding and single side scanning of sheet-type original documents.

Mode IV — Automatic feeding and two-side scanning of sheet-type original documents.

As illustrated in Fig. 1, document scanning system 10 is operating in above-mentioned Mode IV. Moreover, the system is illustrated during that portion of a scanning cycle when the reverse side of a sheet is being scanned. At that particular time, scanner carriage 14 is positioned such that the scanning optics are directly below scan glass 32. During Mode IV scanner carriage 14 is driven back and forth between the illustrated position and a second position (as indicated in phantom lines) under scan glass 31. For operation in the Mode III, scanner carriage 14 remains fixed at the position under scan glass 31.

During operation of Modes I and II scanner carriage 14 performs a scanning motion beneath platen 55, as also illustrated by phantom lines in Fig. 1. The operating controls for these latter two modes are identical, the only difference being that for Mode I, the platen cover 12 is raised as illustrated in Fig. 2 so as to facilitate copying of a bulky document 59. In Mode II platen cover 12 is lowered, to the position illustrated in Fig. 1.

Document scanning system 10 also has a calibration strip (not illustrated) which is mounted

against platen 55. Prior to commencement of scanning in any of Modes I through IV, scanner carriage 14 is in its "home" position. As the first step in any scanning sequence, a dark calibration reference is established by scanning with the illumination off. As the second step, illumination is commenced, and scanner carriage 14 is driven to a calibration position where the scanner may view the above mentioned calibration strip. At that time, the scanner is calibrated to produce output signals accurately representing the known reflectivity of the calibration strip.

After calibration has been completed, scanner carriage 14 moves under platen 55 (Modes I or II) or toward a position under scan glass 31 (Modes III or IV). In the case of scanning in either of Modes I or II the document to be scanned is held stationary on platen 55 while the scanner carriage moves at a uniform speed in the direction of arrow 58.

For operation of document scanning system in either of Modes III or IV, a set of sheet-type original documents are placed face down in a stack 16 upon a receiving tray 94 of feeder 13. A high friction feed belt 17 feeds individual documents past a retard member 18. Retard member 18 has a surface which produces a frictional drag force against sheets being pulled therepast by feed belt 17. This frictional drag force is lower than the driving force produced by feed belt 17 but higher than inter-sheet coupling forces. This effectively prevents multiple feeds, so that individual documents are fed through the nip between rollers 19. Feeding may be assisted by an air flotation arrangement, as illustrated.

After passage between rollers 19, the sheet-type documents are received by a series of belts 20 which are mounted inside platen cover 11. Also mounted within platen cover 12 is a ball cage 67 which supports a series of hold-down balls 21. Hold-down balls 21 urge the sheet-type documents downwardly against transport belts 20 during passage through platen cover 12.

Sheet-like documents which are transported through platen cover 12 are ejected therefrom by a pair of rollers 22, 22. Thereafter the documents are fed across scan glass 31 by pairs of rollers 86, 86 and 88a, 88b. As the documents travel across scan glass 31 the front sides thereof are scanned line by line. Such scanning is performed by a suitable scanner mounted in scanner carriage 14. As mentioned above, scanner carriage 14 is positioned below scan glass 31 for such front side scanning.

After front side scanning has been completed, the sheet-type documents are directed by a gate 28 into an inverting tray 29. Movement into inverting tray 29 is controlled by a pair of reversible rollers 87, 87.

Once a sheet has been delivered into inverting tray 29, gate 28 is rotated as necessary to provide a path from inverting tray 29 into the nip of a pair of rollers 90a, 90b. Rollers 87, 87 are then activated to feed the sheet downwardly toward

rollers 90a, 90b for passage across scan glass 32. As the document passes across scan glass 32, its reverse side is exposed for scanning, if desired. Thereafter the document is fed by a pair of rollers 30, 30 into a suitable collection tray. In the event that reverse side scanning is not desired, then gate 28 may be positioned to enable passage of the document directly from rollers 88a, 88b to rollers 90a, 90b. In order to improve passage through the narrow region under gate 28 a vacuum belt may be carried around rollers 88b and 90b.

As noted above, scan glasses 31 and 32 and platen 55 are all positioned in a common plane. This facilitates utilization of fixed optics, such as, for instance, a line source illuminator 37, a cylinder lens 38, a focusing lens 45 and a photodiode array 43 as illustrated in Fig. 1. The cylinder lens 38 focuses a sharp line of illumination at the scanning plane. This line of illumination then exposes a line of image pixels extending along the face of an original document positioned at the scanning plane. The line of image pixels, which are so exposed, are imaged upon the face of photodiode array 43 by the action of focusing lens 45. The scanning optics are carried to each of the required positions by simple linear movement of scanner carriage 14. For this purpose scanner carriage 14 may be mounted on a guide rail 73 and driven by conventional driving means. The driving means may comprise a drive motor 47, a drive pulley 49, and a drive cable 48 guided around a set of idler wheels 40. Drive cable 48 may be attached to scanner carriage 14 by fastening bolts 42. Four of the idler wheels 40 may be provided, two of which can be seen in Fig. 1.

Fig. 2 illustrates the platen cover 12 in its raised position for Mode I operation. In this position the system is above to copy bulky documents such as the book 59 which is illustrated in a resting position directly on top of platen 55. In this position that page of book 59 which is in direct contact with platen 55 rests in the above-mentioned common scanning plane. Thus the graphic material on that page is positioned at the correct distance from scan carriage 14 for illumination and scanning.

The lower surface of platen cover 12 comprises a reflective white pressure pad 36. This pad provides a suitable clean background for sheet-type original documents during Mode II scanning. It will be observed that pad 36 also hides transport belts 20. This avoids imaging of dirty belts in the background surrounding small sized original documents; a problem common to prior art scanners which transport original documents directly across an exposure platen.

As further illustrated in Fig. 2, platen cover 12 may be hinged along a line which is offset from the working area of platen 55. This facilitates copying of documents having great thickness or a large surface area. Lifting of platen cover 12 is facilitated by a weight counterbalancing gas spring 60.

CLAIMS

1. Document scanning apparatus comprising a platen for exposing bulky original documents, auxiliary exposing means for exposing the front and reverse sides of sheet-type original documents, scanning means for illuminating and imaging documents located either at said platen or at said auxiliary exposing means, support means for said scanning means, document transport means for transporting sheet-type original documents to said auxiliary exposing means, drive means for causing scanning movement of said scanning means and document reversing means for reversing said sheet-type original documents to enable presentation of both sides thereof to said auxiliary exposing means; characterized in that said auxiliary exposing means comprise two scanning stations which support said sheet-type original documents in positions which are coplanar with the plane of said platen, and further characterized in that said drive means and said support means are arranged for cooperatively moving said scanning means along a linear path parallel to the common plane of said platen and said scanning stations.
2. Apparatus according to claim 1 characterized in that said document transport means transport said sheet-type original documents along a path above said platen and spaced apart therefrom.
3. Apparatus according to claim 2 characterized in that said document transport means comprise a transport belt mounted within a cover for said platen.
4. Apparatus according to claim 3 characterized in that said cover comprises means for obscuring said transport belt from the view of said scanning means.
5. Apparatus according to any preceding claim characterized in that said document reversing means are positioned between said two scanning stations.
6. Apparatus according to any of claims 1 through 5 characterized in that said scanning means maintains a first fixed position while scanning documents being transported through one of said two scanning stations, maintains a second fixed position while scanning documents being transported through the other of said two scanning stations, and moves continuously while scanning documents positioned on said platen.
7. Document scanning apparatus substantially as hereinbefore described with reference to the drawings.