United States Patent

Greenfield et al.

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[45] **Oct. 10, 1972**

[54] DOCUMENT HANDLING APPARATUS

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[52] **U.S. Cl.** **271/4,** 271/57

[51] **Int. Cl.** **B65h 3/06**

[58] **Field of Search** 271/3, 4, 57; 250/227

[56] **References Cited**

UNITED STATES PATENTS

3,556,511	1/1971	Howard	271/4
2,256,595	9/1941	Metcalf	250/227
3,002,283	10/1961	Quinn et al.	250/227 X

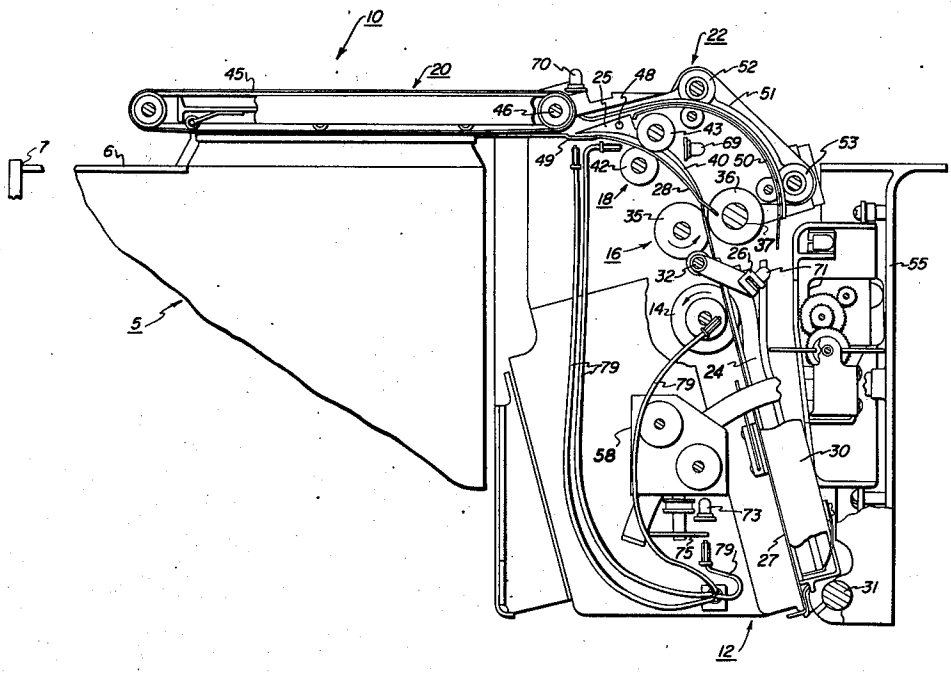
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[57] **ABSTRACT**

A document handling apparatus of the type in which documents are fed one by one from a document supply station to a work station and returned to the supply station for either recycling or removal. The apparatus incorporates a tray for holding the documents, feed means for feeding documents one by one from the bottom of the tray to the work station and back to the tray, a bail bar interposable above the tray to maintain documents returning to the tray segregated from documents awaiting feeding, and a cover for the tray. An operating control system for the document handling apparatus is provided, with light responsive detectors disposed at strategic points within the apparatus confines to trace movement of the documents. To provide light for the various detectors while facilitating repair and replacement of the light without the need to resort to substantial disassembly of the apparatus, a central light source is provided, there being individual fiber optic type light conductors to lead the light into an operative position opposite each detector.

3 Claims, 4 Drawing Figures



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SHEET 1 OF 4

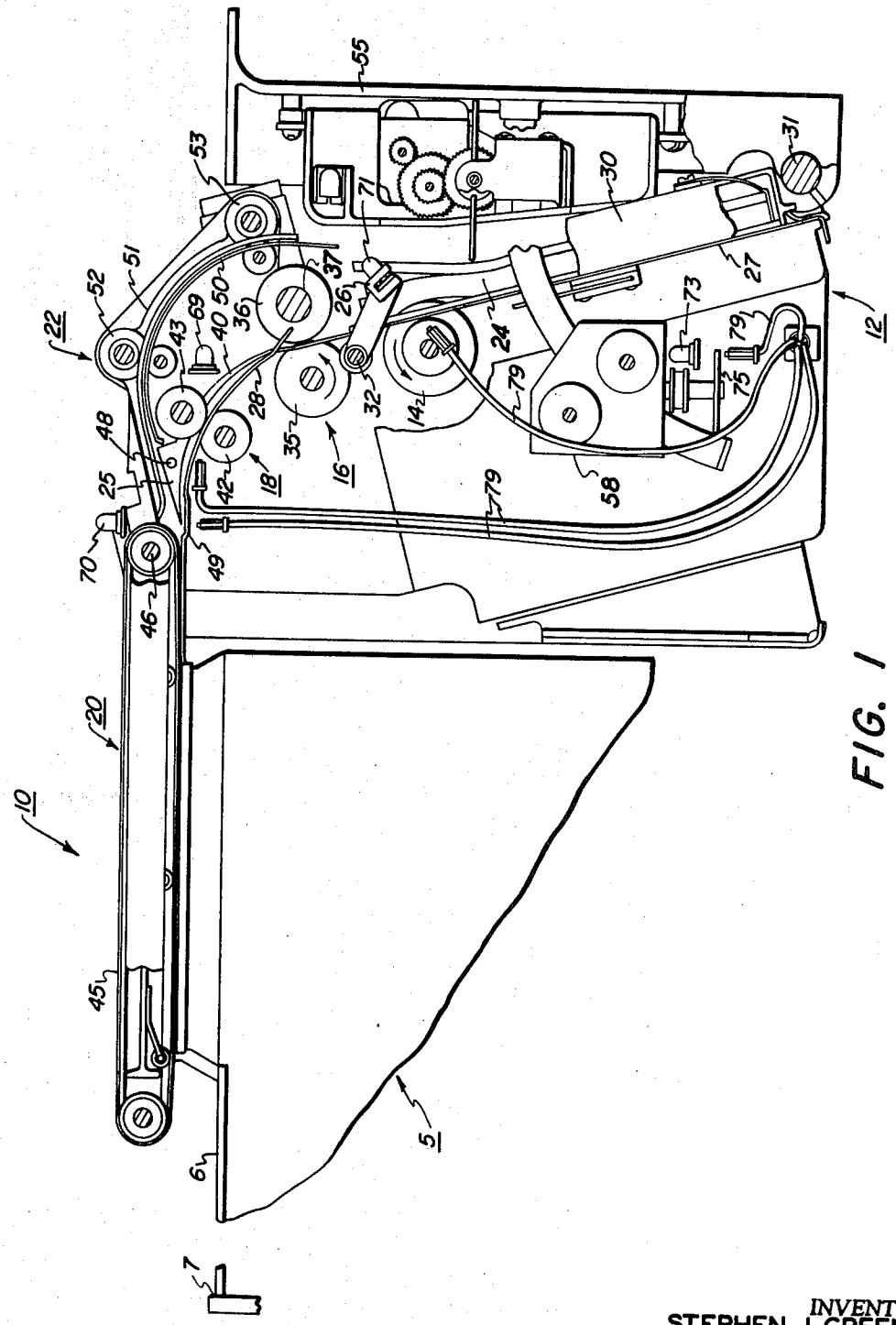


FIG. 1

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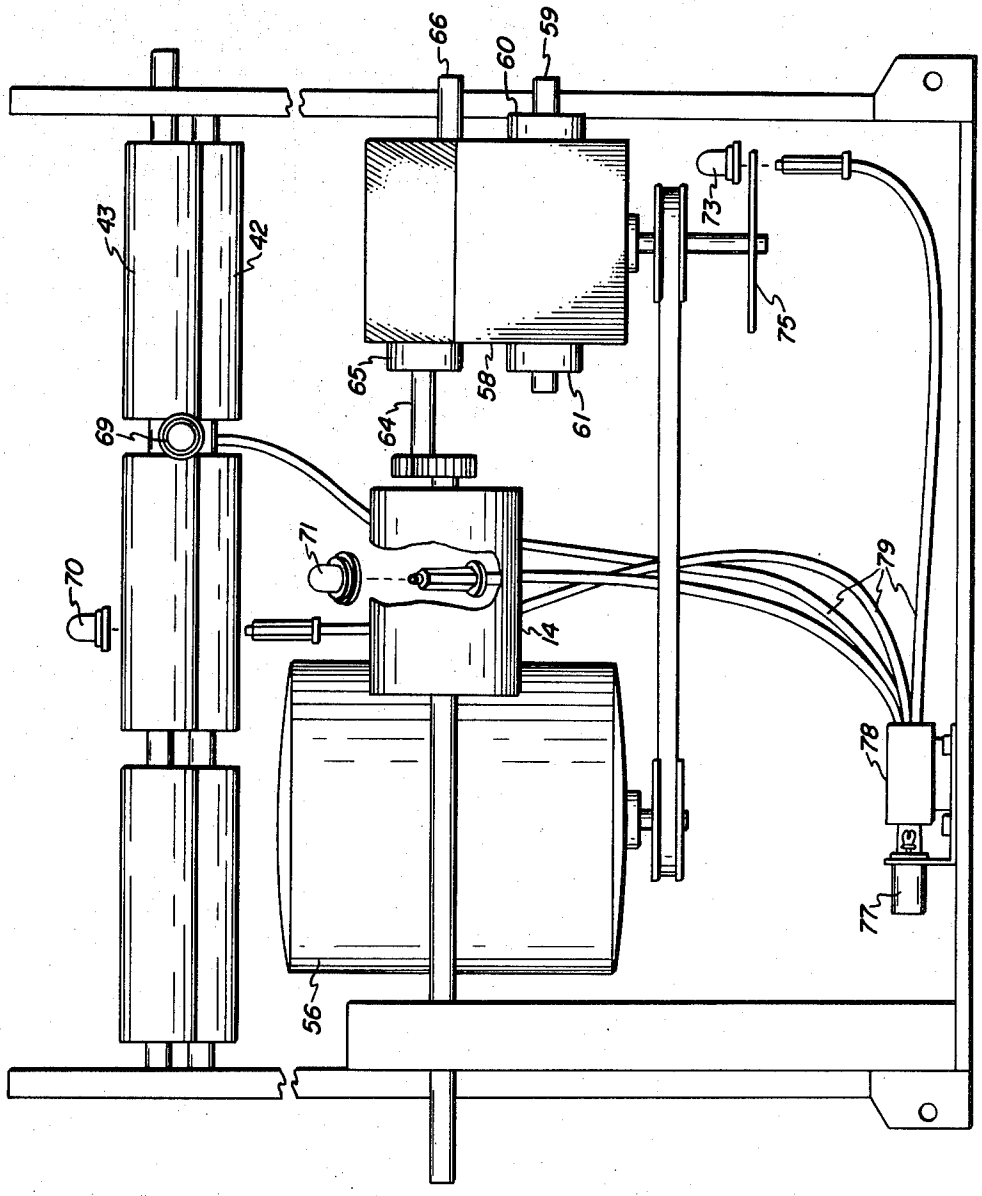


FIG. 2

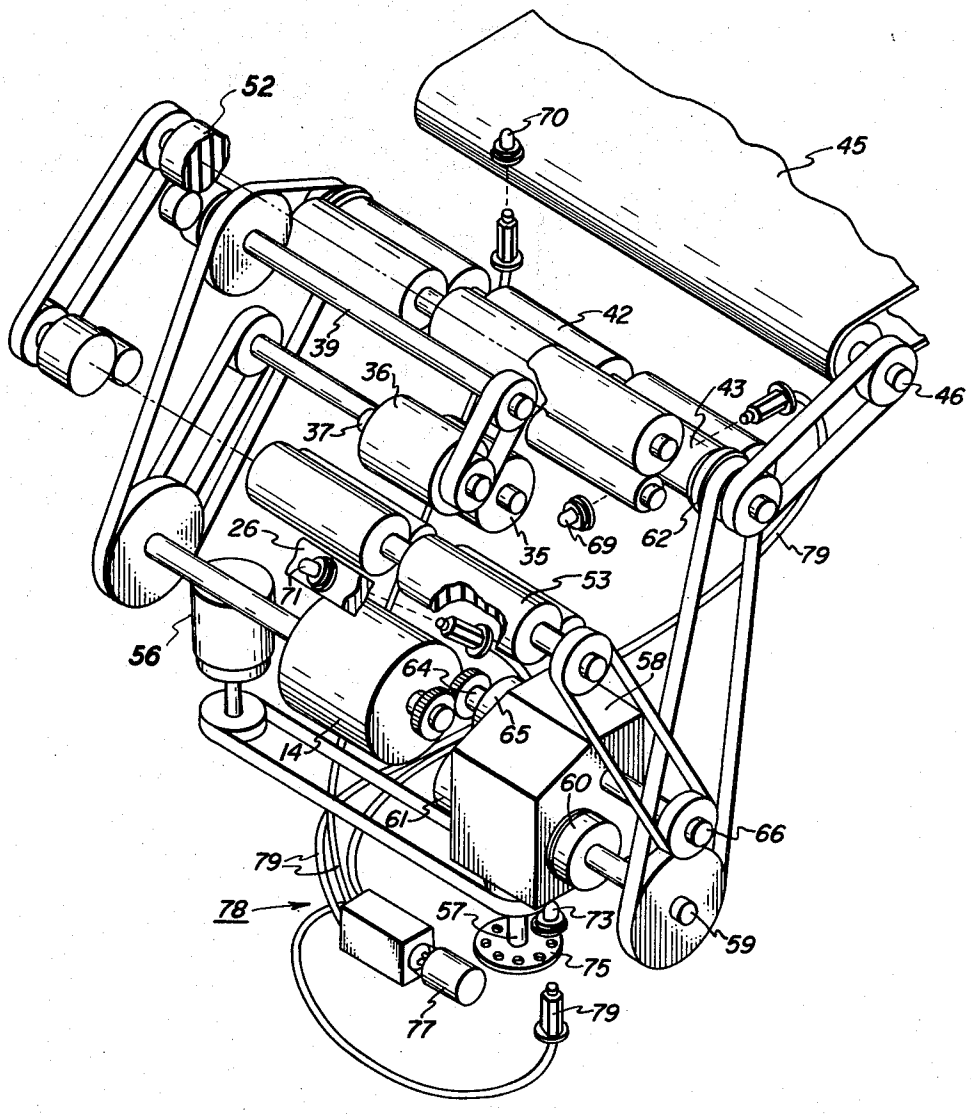

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FIG. 3

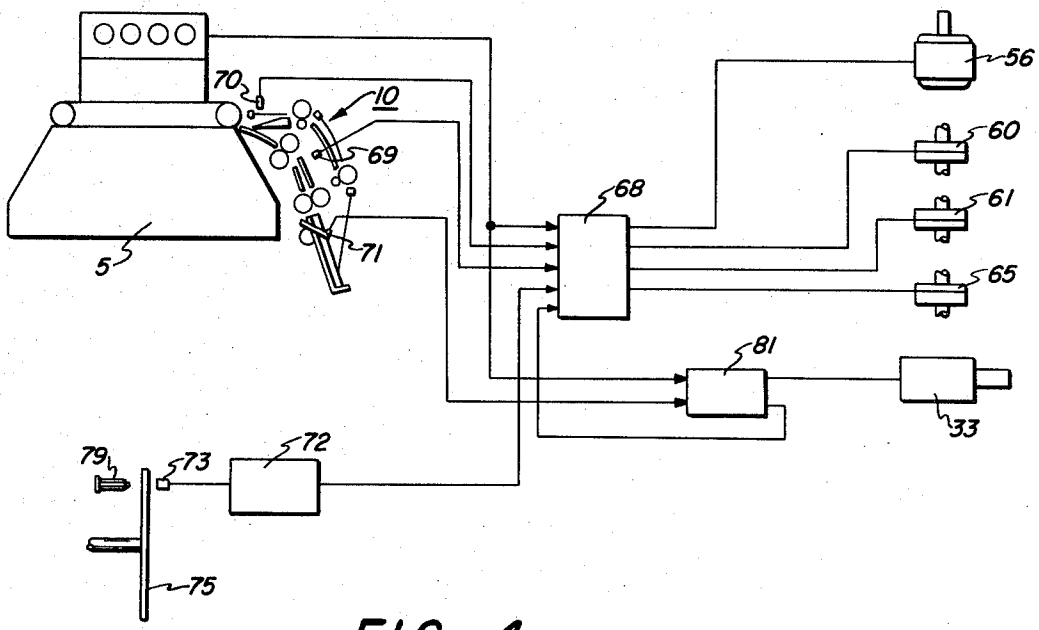


FIG. 4

DOCUMENT HANDLING APPARATUS

This invention relates to a document handling apparatus, and more particularly, to a document handling apparatus having improved accessibility for repair and servicing.

Automatic document handlers, particularly those designed to cycle the documents from the document supply station to the work station and back to the supply station for either reuse or removal, are relatively complex mechanisms. As will be understood by those skilled in the art, this type of document handler normally has several document transports for moving the documents about, with power drive trains for operating the transports at desired speed and in the correct direction and various guides and supports for routing the documents back and forth through the unit. And while document handlers are normally designed to handle conventionally sized documents and hence are fairly large, nevertheless the trend is to compact the various operating components and controls of the document handler into the smallest possible package.

As a result, many of these operating components are buried deep within the internals of the document handler in relatively inaccessible areas requiring substantial or complete disassembly of the document handler for repair. And while some components, not limited to specific locations may, through careful design be located where accessibility is good, the location of other components such as the document detectors may be frozen and relocation impossible. In many applications therefore, the document detectors are found buried deep within the document handler so that servicing and repair thereof requires substantial disassembly of the document handler if repairs, which in many cases involves no more than replacing a burned out light, are to be made.

It is a principal object of the present invention to provide a new and improved document handling apparatus.

It is an object of the present invention to provide an automatic document handling apparatus in which the light source for the various document control detectors comprises a single lamp.

It is a further object of the present invention to provide a common light source for the various document control detectors of a document feeder, with fiber optic transmitter bands for conducting the light to the individual detectors.

It is an object of the present invention to provide, in an automatic document handler having plural relatively inaccessible light responsive control detectors for detecting movement of the documents within the apparatus confines, a central light source arranged for relatively easy accessibility with individual light pipes for transmitting light from the light source to each of the several detectors.

It is an object of the present invention to provide a document handler with improved service accessibility.

This invention relates to a document handling apparatus, comprising in combination; tray means for holding documents, document transport means for feeding the documents one by one from the tray means to a work station; control means for operating the apparatus to feed the documents, the control means including internal light responsive detector means for sensing the position of the documents within the confines of the apparatus whereby to enable the control means to operate the apparatus; a remote light source for the detector means, the light source being positioned for convenient access thereto whereby to facilitate servicing thereof; and a light ray conductor for bringing light from the light source into operative relationship with the internal detector means.

FIG. 1 is a schematic view partly in section of the document handling apparatus of the present invention;

FIG. 2 is a schematic view showing the document detector arrangement for the document handling apparatus shown in FIG. 1;

FIG. 3 is an isometric view showing the drive train and fiber optic light transmitters for the document handling apparatus of FIG. 1; and

FIG. 4 is a control schematic for the document handling apparatus of FIG. 1.

Referring to the drawings, there is shown the recirculating document handling apparatus, designated generally by the numeral 10 of the present invention. Document handling apparatus 10 is adapted to handle any bendable sheet-like material such as paper, film, and the like. For purposes of explanation, the apparatus 10 is combined with an electrostatic type document copying or reproduction machine 5 having a transparent platen 6 on which documents to be copied rest. However, it is understood that the document handling apparatus 10 may be used with other types of reproduction machines, or other apparatus requiring repeated input of documents, papers, etc. thereto.

Document handling apparatus 10 includes the document supply tray 12, primary feed roll 14, document separator 16, intermediate transport 18, platen transport 20, and return transport 22. As will become apparent herein, apparatus 10 transports one document at a time from a document supply 24 in tray 12 to a registered position at a work station, exemplified here by platen 6. Following completion of the work cycle, the document is returned to tray 12. While one document is on platen 6, a second document is brought forward to a waiting station adjacent the platen 6. Where a collated copy output is required, the apparatus 10 functions to repeatedly transport each document to platen 6 in the order in which the document had been placed in tray 12 as required to provide the requisite number of collated copies.

In operation, the lowermost document in tray 12 is advanced by primary feed roll 14 into the nip of rolls 35, 36 of document separator 16 which serve to limit feed to one document at a time. From separator 16, the document is carried by intermediate transport 18 and platen transport 20 onto the platen 6 where the document is registered against platen edge 7. Following use, transport 20 is reversed to carry the document over return guides 25 to return transport 22 and tray 12.

Bail bar 26 on tray 12 prevents refeeding of the documents returned to tray 12 following feed of the last document from below bar 26. Where a second copy cycle is required, as where collated copies are being made, bar 26 is reset.

Document tray 12 has a substantially flat, relatively steeply inclined base 27 suitably supported from one side of copying machine 5. A curved base segment 28 effects a juncture between the tray base 27 and platen 6

there being suitable openings in the bases 27 and 28 to accommodate the document feed rolls 14, 35, 42.

Document tray 12 has matching right and left hand document holding receptacles 30 disposed in facing relationship to one another and journaled at their lower ends on shaft 31 above tray base 27. The receptacles 30 are generally U-shaped in cross section, with the upper interior edges cut away to accommodate the primary feed roll 14. The receptacles 30 are adjustable toward and away from one another along shaft 31 to accommodate various size documents with suitable detent means provided to maintain receptacles 30 in adjusted position.

Bail bar 26 is supported on rotatable cross-shaft 32, the base 27 of document tray 12 being slotted as required to accommodate the depending ends of bar 26. Suitable means such as solenoid 33 are provided for turning cross-shaft 32 and selectively raising bar 26 out from below documents in supply tray 12 to permit documents thereabove to engage feed roll 14. When released, bar 26 falls back onto the topmost one of the documents thereunder.

Other arrangements for turning cross-shaft 32 to displace bar 26, as for example, a clutch, may be contemplated. It may be further appreciated that suitable spring means may be provided to bias bail bar 26 downwardly to maintain documents thereunder in operative contact with feed roll 14.

Primary feed roll 14 is suitably journaled below tray base 27 such that the periphery of roll 14 projects slightly thereabove. As will appear more fully, primary feed roll 14 is driven intermittently (in the counterclockwise direction shown by the solid line arrow in FIG. 1) to feed the bottommost document in tray 12 forward. It is understood that a suitable belt type feeding mechanism may be employed in place of roll 14.

Document separating rolls 35, 36 are arranged downstream of and preferably in alignment with primary feed roll 14. The periphery of roll 35, which is supported below tray base 26 and driven in a document feeding direction (counterclockwise as shown by the solid line arrow in FIG. 1 of the drawings), projects slightly above base 26 of tray 12.

The upper separator roll 36 is supported on a stub shaft 37 journaled between suitable arms (not shown), which are in turn journaled on driven shaft 39 by suitable means (not shown). Suitable spring means (not shown) may be provided to hold roll 36 in contact with roll 35 and the document passing therebetween. Upper separator roll 36 tends to rotate in the direction opposite to that of lower separator roll 35.

A curved guide 40 is spaced above the curved base segment 28 and cooperates therewith to turn documents discharged from document separator rolls 35, 36 toward platen 6. Intermediate transport 18 has lower and upper pinch rolls 42, 43 respectively, the rolls 42, 43 projecting through suitable openings (not shown) in the curved base 28 and upper guide 40 respectively. Suitable means (not shown) are provided to maintain pinch rolls 42, 43 in releasable contact with one another. Pinch rolls 42, 43 serve to carry the documents from document separator 16 to platen transport 20.

Platen 6 comprises a generally rectangular transparent section having a raised border edge 7 to provide a locating stop or register for the document forward edge. By this arrangement, documents are located on platen 6 in a preset operating position.

Platen transport 20 consists of feed belt 45 supported above platen 6 with the lower surface in operative contact therewith. Transport 20 is journaled through shaft 46 for upward swinging movement thereabout to permit transport 20 to be raised for access to platen 6. As may be understood, this construction facilitates clearing of document jams and enables copying of single documents without operating the document handling apparatus 10. In the arrangement illustrated, the weight of transport 20 establishes the necessary frictional relationship between the working surface of feed belt 45 and the document on platen 6.

Platen transport belt 45 which serves as a light reflector in addition to a document feeder, preferably has an outer working layer or coating comprised of a suitable light reflective material to enhance the copying or reproduction process.

A plurality of spaced generally triangular shaped, finger-like return guides 25 are mounted on rockable shaft 48 upstream of return transport 22. Fingers 25 project in the direction of platen 6, the terminal ends thereof being adapted to rest lightly within transverse depression 49 in the surface of base 28. Suitable bias means (not shown) may be provided to assure light contact of finger guides 25 with the surface of base 28. Return guides 25 serve to route documents leaving platen 6 into the return passage formed by spaced guide plates 50, 51. Return transport 22 comprises pinch roll pairs 52, 53 cooperable with return guide plates 50, 51 to transport returning documents leaving platen 6 to tray 12.

A cover 55 is provided for tray 12 to guide the returning documents into the receptacles 30 and prevent documents from falling out of tray 12, particularly when bail bar 26 is raised. Cover 55 is secured to shaft 31 to enable cover 55 to be opened for access to document tray 12 as when loading or unloading documents.

A drive motor 56 is conveniently supported below the tray base 27. Motor 56 is operatively connected with the input shaft 57 of reversible transmission 58. A first output shaft 59 of transmission 58 is selectively driven in either a forward or reverse direction by means of electromagnetic clutches 60, 61. Shaft 59 in turn drives intermediate transport roll 43 through one-way clutch 62 and platen transport shaft 46. One-way clutch 62 serves, on engagement of clutch 61 and reverse rotation of shaft 59, to uncouple intermediate transport roll 43.

A second output shaft 64, selectively coupled to motor 56 through transmission 58 by means of electromagnetic clutch 65, drives primary feed roll 14, rolls 35, 36 of document separator 16 and lower feed roll 42 of intermediate transport 18 at reduced speed. Upper feed roll 43 of transport 18 is driven through one-way clutch 62 so that roll 43 free wheels when driven from the lower feed roll 42. Transmission output shaft 66 drives return transport pinch roll pairs 52, 53.

Referring particularly to FIG. 4 of the drawings, a suitable controller 68 is provided to operate motor 56, clutches 60, 61, 65 and solenoid 33 both to operate document handling apparatus 10 in accordance with

the demands from reproduction machine 5 and to stop the apparatus 10 in the event of a malfunction.

As seen in FIGS. 1 and 2, photocell type detector 69 is provided above base 28 and between intermediate transport 18 and return guide fingers 25. Detector 69 responds to the leading edge of a document as the document moves toward platen 6 to stop primary feed roll 14, document separator 16, and intermediate transport 18 when the document reaches a ready position adjacent platen 6. A second photocell type detector 70 is positioned between platen 6 and return guide fingers 25. Detector 70 serves to indicate that platen 6 is clear so that the next document may be brought forward. A third photocell type detector 71 is positioned on bail bar 26. Detector 71 serves to signal when the last document has been removed from under bar 26.

A suitable counter 72 is provided for timing operation of the document handling apparatus 10. Counter 72 is driven from a signal generating mechanism consisting of photocell type detector 73, light pipe 79 spaced opposite thereto, and apertured masking disc 75 therebetween. Disc 75 is secured to the input shaft of transmission 58. As is understood, the rotating disc 75 permits light to sequentially strike detector 73 to generate a pulse-like signal output which drives counter 72 in accordance with operation of the document handling apparatus 10.

A more detailed description of the construction and operation of the aforedescribed document handling apparatus may be found in copending application Ser. No. 824,803, filed May 15, 1969 in the name of Anthony Howard.

A single light source 77 is provided for detectors 69, 70, 71 and 73, light 77 being suitably disposed at a convenient and relatively accessible place. In the arrangement shown, light 77 is supported below tray base 27 adjacent the lower end thereof. A four pipe fiber optic bundle 78 is disposed opposite light 77, the various pipes 79 thereof being routed in and through the document handling apparatus interior to an operative position opposite detectors 69, 70, 71 and 73.

In operation of the document handling apparatus 10, one or more documents 24 are placed on tray 12 in receptacles 30 and underneath bail bar 26. Bar 20 is ordinarily raised with opening of cover 55 to permit loading or unloading of the documents. Following loading, the tray cover 55 is closed.

On a signal from reproduction machine 5, controller 68 starts motor 56 while engaging clutch 65 to drive primary feed roll 14, rolls 35, 36 of document separator 16, and intermediate transport rolls 42, 43 in the direction shown by the solid line arrow in FIG. 1 to advance the lowermost document in tray 12 forward. As the first document emerges from intermediate transport 18, detector 69 responds to the leading edge thereof and the signal from detector 69 to controller 68 disengages clutch 65 while engaging forward clutch 60. With clutch 65 disengaged, primary feed roll 14 and document separator 16 stop. Clutch 60 starts belt 45 of platen transport 20 and sustains operation of intermediate transport 18 through drive to roll 43 thereof. The document is accordingly carried by transport rolls 42, 43 and platen transport 20 onto platen 6 and against register edge 7 thereof.

It is understood that masking disc 75 rotates in unison with motor 56. Following start-up of platen transport belt 45, a signal from counting means 72 in response to a preset number of signal pulses from detector 73 sufficient to enable belt 45 to carry the document across platen 6 and into abutment with the raised register edge 7 disengages clutch 60 stopping platen transport 20.

With advance of the first document past detector 69 and onto platen 6, a reset signal from detector 69 to controller 72 engages clutch 65 to restart primary transport roll 14, document separator 16, and intermediate transport 18 to bring the next document forward. As the next document leaves intermediate transport 18, the signal from detector 69 in response to the leading edge thereof disengages clutch 65 to stop roll 14, separator 16, and intermediate transport 18 with that document in the ready position adjacent the entrance to platen 6.

When the copy cycle is completed, a signal from reproduction machine 5 to controller 68 engages clutch 61 to reverse platen transport belt 45 and carry the first document backwards off of platen 6. Guide fingers 25 direct the returning document upwardly into the nip of return transport pinch roll pair 52, between guide plates 50, 51 and through second pinch roll pair 53 into receptacles 30 of tray 12. There the forward portion of the returned document rests on bail bar 26 which precludes contact of that document with primary roll 14 when the last of the documents therebelow has been fed forward.

As the trailing edge of the document leaving platen 6 passes detector 70, a signal from detector 70 to controller 68 disengages reverse clutch 61 to terminate reverse movement of platen transport belt 45. At the same time, controller 68 engages forward clutch 60 to drive intermediate transport 18 and platen transport belt 45 forward to bring the second document forward from the ready position onto platen 6.

The aforedescribed process is repeated for each of the succeeding documents in tray 12.

On feed of the last document from under bar 26, the signal from detector 71 momentarily actuates solenoid 33 to raise bar 26 out from below the returned documents then in tray 12. Bar 26 then drops back upon the topmost document. At the same time, the signal from detector 71 readies a timer 81 for operation.

When copying of the last document is completed, a signal from reproduction machine 5 triggers timer 81. Timer 81, after a delay sufficient to enable that document to be returned to tray 12 signals controller 68 to again trigger solenoid 33 and raise bar 26 out from below the just returned last document. This returns bail bar 26 and documents back in the same relative positions as they were in when tray 12 was originally loaded with documents.

It is understood that the document handling apparatus 10 is operated in the manner described for as many additional document copies as reproduction machine 5 is programmed for. When the last copy cycle is completed, a signal from reproduction machine 5 shuts down the document handling apparatus 10. Cover 55 may then be opened and the documents 24 removed.

The relative complexity of the document handling apparatus **10** together with the very specific and critical positioning of the document movement responsive detectors **69, 70, 71** renders servicing of these items together with their light sources difficult. Often the service required involves no more than replacement of a burned out light which, due to the difficulty in obtaining access, may require shutdown of the document handling apparatus **10** itself and often reproduction machine **5** for extended periods. The single accessible light source **77** of the present invention obviates to a large degree any delay attending replacement of a burned out or otherwise inoperative light source, repair simply requiring opening or removal of a suitable access cover adjacent light **77**.

While the invention has been described with reference to the structure disclosed herein, it is not confined to the details set forth; but is intended to cover such modifications, or changes as may come within the scope of the following claims.

What is claimed is:

1. Means for sensing and controlling movement of documents in a document handling apparatus having a housing and within said housing a document feed apparatus, a document supply section for holding a supply of documents to be handled, a plurality of transports for feeding said documents from said supply section along a pre-determined path to a work station and returning said documents along a pre-determined path, said paths being in layered configuration, said paths being between said supply station and said work station comprising a plurality of light responsive signal generators located at strategic points along said paths, said signal generators each comprising a photocell type pick up and a light means, said light means comprising a remote light source positioned adjacent said housing and positioned for convenient access whereby to facilitate servicing thereof and a plurality of light ray conductors for bringing light in a substantially continuous path from said source into operative relationship with said signal generator.

2. The apparatus according to claim **1** in which said document transport means includes first feed means for advancing documents forward from said tray means toward the work station, and second feed means for returning documents leaving the work station back to said tray means;

said detector means including a first photocell arranged to sense advance of documents by said first feed means toward said work station, and a second photocell upstream of said second feed means to sense documents leaving the work station;

there being individual light ray conductors leading from said light source to an operative position opposite each of said first and second photocells.

3. The apparatus of claim **1** further including a timing device operatively associated with said document feed apparatus actuated by at least one of said signal generators.

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