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(54) **A finishing apparatus and document reproduction system incorporating same.**

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Courier Press, Leamington Spa, England.

Description

This invention relates to a finishing apparatus for receiving and binding into sets precollated copy sheets from a document reproducing apparatus, comprising a compiling station for registering and assembling copy sheets into sets and at least one stapling device for binding a set compiled at the compiling station and having means for clamping an edge of the set during stapling. It also relates to a document reproduction system incorporating such a finishing apparatus. Such apparatus is disclosed in US—A—4029309.

With the advent of higher speed and more sophisticated copy producing machines, printing presses, and the like, consideration as to how the mass of copies generated can best and most effectively be handled has assumed increasing importance. One way has been to provide a reproduction system with an input device in the form of a recirculating document handling apparatus. In this system, a document sheet is removed from a collated set of document sheets, placed on an exposure platen for exposure at the rate of one exposure for each document sheet, and returned to the top of the set in the document handling apparatus until the set of document sheets has been completely circulated through the apparatus, and a copy set has been produced. The set of document sheets is then recycled for the reproduction of a second copy set, and so on. After each copy set is produced and collected at a collection station, a finishing device such as a stitcher or stapler is activated to bind the set. These systems are of the precollation type wherein the document sheets are precollated in the document handling apparatus prior to commencement of a reproduction run. The output for the reproduction machine will likewise be precollated in sets corresponding to the sequenced numbered document set in the document handling apparatus. The copy sheets are collected in collated sets as they are sequentially produced so that binding may be effected without the interaction of additional devices. Such systems are described in US—A—4,134,672.

One of the disadvantages in these systems having continuous document recirculation to produce each bound copy set is that for compilation of each copy set and eventual stapling or stitching, many moving parts have been required and have added to the risks of unscheduled maintenance. In addition, generally, in providing for the stapling or stitching step, one or more machine pitches are lost thereby reducing throughput for the system.

In order to achieve still higher rates of production of finished copy sets, the present invention contemplates the concept of utilizing a compilation station which includes the stapler or stitcher heads in order to avoid the use of copy set transport devices and permit continuous compilation of successive copy sets.

Present day machines on the market, such as the Xerox duplication machine labeled the 9400® Duplicator marketed by Xerox Corporation of Stamford, Connecticut, utilize a document handler as an input device which exposes as many copies of a single document sheet at a time as is appropriate before starting on the next document sheet. The present invention, however, contemplates utilizing a recirculating type of document handling apparatus such as of the general type disclosed in the above referred to US—A—4,134,672. Any other suitable recirculating type of document handler may also be used in conjunction with the processor for the 9400® Duplicator.

In US—A—4,134,672, a system is disclosed wherein copy sheets are collected in an inclined tray and requires a set transport device for removal to a set collecting point after a stitching operation. Many moving parts are employed for the finishing step and related timing is critical for all of these parts. In US—A—3,719,266, copy sheets are collected in a vertically arranged tray for copy set separation. Another arrangement which collects copy sheets in a vertically inclined collecting tray is disclosed in the aforesaid US—A—4,029,309. After collection in the tray, a set of copy sheets is clamped and moved to a stapling position.

A finishing apparatus according to the present invention is characterised in that the stapling device and means for clamping are positioned to operate on the set while it is in the clamping station and said compiling station includes a support surface movable, while a said set is clamped by said stapling device, between a first position for supporting sheets received at the compiling station with their surfaces parallel to the support surface as they are being compiled into a set and a second position in which it no longer supports the sheets thus enabling a bound set on release by the clamping means to pass through said position to a collection point.

In a preferred embodiment, the compiling station is defined by a movable, horizontally arranged plate upon which sheets are collected, and the stapling heads of one or more stapling apparatus. When the last sheet of a set to be bound is collected, the plate is quickly retracted from the set in timed sequence with the clamping of the leading end of the set by the stapling heads whereupon the rear edge of the set lowers to carry the set downwardly upon a set collecting, vertically movable tray. A set kicker may be employed to facilitate quick removal of the stapled edge out of the stapling heads. As the stapled set is lowered, the collecting plate is repositioned into its compiling position to catch the first sheet of the succeeding copy set. The collecting plate reciprocates, that is, moves from a collecting position to a retracted position and back to its collection position at a cycle rate approximately equal to the rate of production of the reproduction machine with which the finisher is associated so that there is no loss of productivity. In other words, the time during

which the plate reciprocates is approximately equal to the pitch time for the machine i.e. the time for a copy sheet to move a distance from the leading edge of one copy sheet to the leading edge of a succeeding sheet regardless of where the sheets are in the system.

In order that the invention may be more readily understood, reference will now be made to the accompanying drawings, in which:—

Figure 1 is a schematic illustration of a configuration of an electrostatographic printing/finishing system employing the present invention;

Figure 2 is an isometric view of the finishing station utilized in the system of Figure 1;

For a general understanding of a reproduction machine in which the present invention may be incorporated, reference is made to Figure 1 wherein components of a typical electrostatic printing system are illustrated. The printing system is preferably of the xerographic type e.g. including a xerographic processor 11, and a recirculating type document handling apparatus 12. Preferably, the processor 11 is the same as the processor in the commercial embodiment of the Xerox duplicator 9400®, which utilizes flash, full frame exposure for very high speed production. Document sheet exposure, image processing and copy sheet transport/handling are under control of a machine programmer and are effected in timed sequence, and in accordance with the program an operator has preset in the machine. Further details in this regard are not necessary since the Xerox 9400® Duplicator operates in this manner and is well known. Details of the timing relationships and related structure and events are described in US—A—3,790,270; US—A—3,796,486; and US—A—3,917,396. It will be understood that almost any other type of xerographic processor and document handling apparatus may be utilized. Operating in conjunction with the processor 11 and apparatus 12 is a finishing station 13 thereby forming the reproduction system shown in Figure 1.

The system comprising the processor 11 and the document handling apparatus 12 is under control of a programmer P which permits an operator various options: to turn the entire system ON or OFF; to program the reproduction system for a desired number of reproductions to be made of each original document sheet or set; to select whether simplex or duplex copies are to be made; to select a desired output arrangement, that is, sets mode or stacks mode, stapled or unstapled; to select one of a plurality of paper trays; to condition the machine for the type of document, that is, whether one sided or two sided, to select a copy size reduction mode, and other desirable functions. The programmer P also includes a controller which provides all operational timing and synchronization between the processor 11 and all of its xerographic processing functions, and system control functions, the automatic events to be described hereinafter. The controller may include any suitable microprocessor having a CPU and the appropriate machine clock, but preferably the microprocessor is one similar to the Intel 8080 Microprocessor manufactured by the Intel Corporation, Santa Clara, California, and having sufficient ROM's and RAM's for all of the necessary functions in the reproduction system.

The document handling apparatus 12 serves to feed one document sheet at a time from a supply of document sheets of a document D into copying position on the platen 14 where a single exposure of each document sheet is made per document set and during sequential operation. Following exposure, each document sheet is automatically returned to the document supply and the next document sheet, if any, is brought into the exposure position on platen 14. Document sheets returned to the supply stack may be recycled by the apparatus 12 in the event additional copy sets are to be produced, or simply removed by the user when the copying program is completed.

While the apparatus 12 has been described as being of the recirculating type, it will be understood that dual mode apparatus may also be utilized, that is, those which circulate documents to effect collated and noncollated copy sets, such as of the type disclosed in US—A—4,078,787. Further details of the document handling apparatus are not necessary to understand the principles of the present invention.

For either the simplex or duplex modes of operation, copy sheets exiting through the exit slot 50 positioned at one end of the housing for the xerographic processor 11 are directed to the finishing station 13 which comprises a compiling station, a stapler apparatus, and an output elevator system. After leaving the processor 11, as shown in Figure 2, each sheet is positioned upon a transport 92 to be further conveyed generally along the same horizontal plane as its previous path to a fixed receiving point or station 93. The transport includes a movable endless transport belt 94 upon which each sheet is placed and a plurality of loosely retained rotatable balls 95 which rest on and along the belt 94 by gravity and which coact with the belt to convey sheets therebetween. The belt 94 is driven by a motor and suitable gearing and pulleys (not shown) at a velocity slightly greater than the processing speed of the processor 11 in order to add more working space between the sheets and to ensure that the final handling of copy sheets does not impede the throughput of the entire system as determined by the process speed of the processor 11. The rate at which the sheets arrive at the station 93 nevertheless is the same as the process speed or reproduction rate of the processor.

It will be noted that the axis of the belt 94 is at a slight angle to the direction of the movement of the copy sheets. This arrangement drives each sheet of copy slightly laterally against a side registration edge 97 which is parallel to and offset from the centerline of the incoming path of sheet movement. As viewed in Figure 2, the sheet S as can be seen through a sheet clearance opening

formed in the top plate of the transport 92. In this orientation, the sheets are positioned so that their toner image side is down, for the simplex mode, or an odd numbered page is down for the duplex copying mode, and the top of each sheet is along the edge 97.

At the exit slot 50, a sheet contacting switch S-1 is positioned to be actuated as each sheet enters the transport 92 of the finishing station 13. The circuit for this switch is connected to the logic in the programmer P and serves to reset the machine clock for the finishing function so that zero time for the sheet commences when the sheet is at the station 93 which serves as the system reference point.

At the receiving station 93, there is positioned a pair of contacting transport rollers or a set of corrugating rollers 100 which receive each copy sheet within the nip for directing a sheet onto a compiling receiving plate 102 located at a compiling station which includes this plate. The plate 102 is suitably mounted for horizontal reciprocable movement between the position showing in Figure 2 whereat copy sheets are compiled to form a set C just prior to a stapling operation to its retracted position shown in Figure 3. A pneumatic cylinder 104 having an electromagnetically actuable valve 105 is suitably connected to the plate to provide very fast reciprocating movement upon logic control in the programmer P. The valve 105 is energized by means of a time signal from the programmer logic to drive the plate to the collecting or compiling position of Figure 1 or to retract the plate to the position shown in Figure 3.

The time during which the plate 102 makes a complete reciprocating cycle is approximately equal to the rate of production of the processor, or its pitch time. For example, if the production rate for the processor is 120 copies per minute, its pitch is one sheet plus one space between sheets per one-half second and the cycle time for reciprocation of the plate will be approximately one-half second.

Also positioned along the far edge of the compiler station is an individually-operable, dual stapler apparatus 110 which provides a stapling function either with a single staple or with two staples, both being adapted to be applied at variable positions along the long edge of a set C of copy sheets. Stapling is achieved by way of two identical mechanisms, each of which provides the functions of copy set clamping, staple driving and staple clinching. Preferably, the apparatus utilizes two commercial type stapler heads 112, such as the Bostitch staple head indicated as the 64-E manufactured by the Bostitch Division of the Textron Corporation of Providence, Rhode Island. The stapling apparatus 110 may be identical to that disclosed in detail in EP—A—46675 which claims priority from application Serial No. 180,184, filed August 21, 1980.

In that apparatus, logic timed control signals are imparted to two electromagnetic clutches and to a clinching solenoid in order to acquire copy set clamping along the edge of the copy set to be stapled; to separate a staple from a supply and drive it through the set; and to effect clinching wherein the staple legs are bent to secure the copy sheets.

During a compiling operation, the receiving plate 102 is in the position shown in Figure 1 wherein its far edge is adjacent the clamping position for the stapling apparatus. As sheets are conveyed past the reference point 93 by the rollers 100, they are directed onto the plate 102 and into clamping positions relative to the stapler heads 112. As the sheets are being directed into their prestapling position, they engage and become registered against corner registration members 114, 115. The member 114 is so positioned between the heads 112 that when all sheets of a set are against the member, the now aligned edge of the set is in proper position to be clamped and stapled by the stapling heads.

After a stapling operation, a stapled copy set is dropped onto an elevator device 118 which is utilized to collect into a pile stapled or unstapled sets or stacks of copy sheets for delivery to an operator. The elevator comprises a tray 119 mounted in cantilever fashion on a pair of vertically arranged, drive screws 120 threadedly received in threaded members 121 secured one to each corner of the tray 119, so that upon rotation of the drive screws 120, the tray 119 is moved vertically in the up or down direction. A reversible motor M-1 is operatively connected to the drive screws 120 for imparting rotation to the same in either direction. The height of piled sets or stacks in the elevator is controlled by an optical sensor SR-1 which "looks" across the pile and effects the energization of the motor M-1 and lowering of the tray 119 until the top of the pile is at or below the sensor.

A typical reproduction run will now be described in order to illustrate the sequence of events which occur during operation of the system of Figure 1. For this run, it will be assumed the operator programmed the system to produce twenty copy sets of a five sheet document set, in the simplex mode. This program is manually preset in the programmer P and the five document sheets placed in the document handler 12 in precollated arrangement. Upon activation of the system, each page or sheet of the document set is placed upon the plate 14 for exposure, removed therefrom and returned to the stack of document sheets, and so on until the set of five document sheets has been recycled in the document handling apparatus twenty times.

Corresponding copy sheets are produced in collated arrangement in the processor 11 and exited at the slot 50 in succeeding order in accordance with the production rate for the processor. Since the arrangement is such that there will be no skipped pitches in the production run, the copy sheets will be evenly spaced throughout processing, for all twenty times five, or one hundred sheets set to be produced. The first five copy sheets, corresponding to the first

complete cycling of the document apparatus 12 are transported by way of the transport 92, through the reference point 93 and into the compiling station to be collected for a stapling operation. Each of these sheets is conveyed to and along the top surface of the plate 102 and into the clamping position for the stapling heads 112, the edges of the sheets being registered by the members 114, 115. At the instant the fifth sheet is so positioned, so as to complete the collection of the first copy set, the clamping clutches for the stapling heads are activated to clamp the adjacent edge of the collected set. Simultaneous with this action, the compiling plate 102 is retracted to permit the lowering of the opposite or trailing edge of the set, as shown in Figure 3. This plate is returned immediately to its compiling position as shown in Figure 1 so as to be in position to receive the first sheet of the second set of five copy sheets being transported. Immediately after the leading edge of the first set was clamped, the clutch for providing the force to drive staples through this edge and the clinching solenoid are activated in timed sequence to produce a stapled set. The forward registration member 114 may be suitably connected to a kicker driving mechanism and timed in its actuation to kick the stapled edge out of the stapling positions over the heads 112 at the instant before the plate 102 is returned. With the far portions of the stapled set already in position below the level of the plate 102 and dropping, the final kick of the set causes immediate lowering of the set and out of the return path of the plate.

The timing sequences for the activations enumerated above: i.e. clamping by the stapling heads, retraction of the plate 102, staple driving and clinching, final kicking of a completed copy set, and return of the plate 102 are provided in the logic for the programmer P. Final kicking of a completed copy set is such that the compiling plate 102 is returning to the compiling position as the first copy sheet of a succeeding copy set is being delivered. The logic will determine when these actions are to occur by way of operator manipulation of the programmer P during presetting of the desired reproduction run. As the stapled sets are produced, one by one, they fall upon the elevator tray 119 which lowers in accordance with the sensed height of the topmost set thereon.

From the foregoing it will be apparent that an electrostatographic system with finishing station has been described which will produce stapled collated sets at a high production rate without loss of throughput, in fact, at a rate in accordance with the full processing speed of the copy processing machine. Furthermore, it will be apparent that the present invention accomplishes high speed stapling or stitching with a minimum of parts especially a minimum of moving parts thus minimizing maintenance calls and down time.

Claims

1. A finishing apparatus for receiving and binding into sets (C) precollated copy sheets (S) from a document reproducing apparatus, comprising a compiling station (102) for registering and assembling copy sheets into sets and at least one stapling device (110) for binding a set compiled at the compiling station (102) and having means (112) for clamping an edge of the set (C) during stapling, characterised in that the stapling device and means for clamping are positioned to operate on the sheet while it is in the compiling station and said compiling station (102) includes a support surface movable, while a said set (C) is clamped by said stapling device (110), between a first position for supporting sheets received at the compiling station (102) with their surfaces parallel to the support surface as they are being compiled into a set (C) and a second position in which it no longer supports the sheets thus enabling a bound set (C) on release by the clamping means to pass through said first position to a collection point.

2. A finishing apparatus according to claim 1, wherein said support surface (102) is formed by a support plate reciprocably movable in a generally horizontal plane.

3. A finishing apparatus according to claim 1 or 2, wherein in the second position of the support surface (102) a bound set (C) may be collected beneath said first position.

4. A finishing apparatus according to claim 3 including an elevator means (118) arranged beneath said first position of the support surface.

5. A finishing apparatus according to claim 1, 2, 3 or 4, including a kicker mechanism for driving a stapled set out of the clamping position after stapling.

6. A document reproduction system for producing precollated copy sheets (S), having a document handling apparatus (12) adapted to transport individual document sheets (D) from a supply stack to an exposure station (14) and effecting an exposure of each document sheet before returning same to the supply stack, a processor (11) for reproducing copy sheets (S) of the exposed document sheets (D), and a finishing apparatus (13) according to any preceding claim for receiving and binding into sets (C) precollated copy sheets (S) from the processor (11).

7. A reproduction apparatus according to claim 6 including means (100) for conveying copy sheets onto said support surface (102) at a rate equal to the process rate for reproducing copy sheets, and means for moving said surface from said first position to said second position and back to said first position in a time period approximately equal to the pitch of the processor.

Patentansprüche

1. Fertigstellungsvorrichtung zum Aufnehmen und Zusammenheften von von einer Schriftstück-Vervielfältigungsvorrichtung stammenden, in korrekter Reihenfolge angesammelten Kopien (S) zu Sätzen (C) mit einer Zusammenstellungsstation (102) zum Ausrichten und

Zusammenstellen von Kopien zu Sätzen und mit wenigstens einer Mittel (112) zum Festklemmen eines Randes des Satzes (C) während des Heftens aufweisenden Hafteinrichtung (110) zum Zusammenheften eines in der Zusammenstellungsstation (102) zusammengestellten Satzes, dadurch gekennzeichnet, daß die Hefteinrichtung und die Mittel zum Festklemmen positioniert sind, um auf den Satz einzuwirken, während sich dieser in der Zusammenstellungsstation befindet, daß die genannte Zusammenstellungsstation (102) eine Abstützfläche aufweist, die während des Festklemmens eines genannten Satzes (C) mittels der genannten Hefteinrichtung (110) bewegbar ist zwischen einer ersten Stellung zum Abstützen von von der Zusammenstellungsstation (102) aufgenommenen, mit ihren Flächen parallel zur Abstützfläche angeordneten Kopien während ihres Zusammenstellens zu einem Satz (C) und einer zweiten Stellung, in welcher die Abstützfläche die Kopien nicht mehr abstützt, wodurch es möglich ist, daß ein zusammengehefteter Satz (C) bei Freigabe durch die Festklemm-Mittel durch die genannte erste Stellung hindurch zu einer Sammelstelle bewegt wird.

2. Fertigstellungsvorrichtung nach Anspruch 1, in welcher die genannte Abstützfläche (102) durch eine in einer allgemein horizontalen Ebene hin- und herbewegbare Abstützplatte gebildet ist.

3. Fertigstellungsvorrichtung nach Anspruch 1 oder 2, in welcher in der zweiten Stellung der Abstützfläche (102) ein zusammengehefteter Satz (C) unterhalb der genannten ersten Stellung aufgenommen werden kann.

4. Fertigstellungsvorrichtung nach Anspruch 3, mit einer Hebeeinrichtung (118), die unterhalb der genannten ersten Stellung der Abstützfläche angeordnet ist.

5. Fertigstellungsvorrichtung nach Anspruch 1, 2, 3 oder 4 mit einem Stößelmechanismus zum Bewegen eines zusammengehefteten Satzes nach dem Zusammenheften aus der Festklemmstellung heraus.

6. Schriftstück-Vervielfältigungssystem zum Herstellen von in korrekter Reihenfolge angesammelten Kopien (S) mit einer Schriftstück-Handhabungsvorrichtung (12), die zum Transport von einzelnen Schriftstückblättern (D) von einem Vorratsstapel bis zu einer Belichtungsstation (14) und zum Durchführen einer Belichtung jedes Schriftstückblattes vor dem Zurückführen desselben zum Vorratsstapel angepaßt ist, mit einem Prozessor (11) zum Herstellen von Kopien (S) der belichteten Schriftstückblätter (D), und mit einer Fertigstellungsvorrichtung (13) gemäß irgendeinem vorhergehenden Anspruch zum Aufnehmen und Zusammenheften von von dem Prozessor (11) stammenden, in korrekter Reihenfolge angesammelten Kopien (S) zu Sätzen (C).

7. Vervielfältigungsvorrichtung gemäß Anspruch 6 mit Mitteln (100) zum Fördern von Kopien zur genannten Abstützfläche (102) mit einer Geschwindigkeit, die gleich der Arbeitsabluafgeschwindigkeit bei der Herstellung von Kopien ist, und mit Mitteln zum Bewegen der genannten Fläche von der genannten ersten Stellung zur genannten zweiten Stellung und zurück zur genannten ersten Stellung während eines Zeitraums, der ungefähr gleich der Zeit ist, die der Prozessor zum Vorschubeiner Kopie um die Strecke zwischen den Vorderkanten zweier einander nachfolgender Kopien benötigt.

Revendications

1. Appareil de finition pour la réception et le lien en jeux (C) de feuilles de copie pré-assemblées (S) provenant d'un appareil de reproduction de document, comprenant un poste de compilage (102) pour cadrer et assembler des feuilles de copie en jeux et au moins un dispositif d'agrafage (110) pour lier un jeu compilé au poste de compilage (102) et comportant un moyen (112) pour fixer un bord du jeu (C) pendant l'agrafage, caractérisé en ce que le dispositif d'agrafage et le moyen de fixation sont placés de manière à agir sur la feuille alors qu'elle se trouve dans le poste de compilage, et le poste de compilage (102) comprend une surface de support mobile, alors qu'un jeu (C) est fixé par le dispositif d'agrafage (110), entre une première position pour le support des feuilles reçues au poste d'agrafage (102) avec leurs surfaces parallèles à la surface de support alors qu'elles sont compilées pour donner un jeu (C) et une seconde position dans laquelle elle ne supporte plus les feuilles, permettant ainsi à un jeu lié (C) d'être libéré par le moyen de fixation pour traverser la première position jusqu'à un point de recueil.

2. Appareil de finition selon la revendication 1, où la surface de support (102) est constituée d'une plaque de support mobile dans un mouvement de va-et-vient suivant un plan généralement horizontal.

3. Appareil de finition selon la revendication 1 ou 2, où dans le seconde position de la surface de support (102) un jeu lié (C) peut être recueilli au-dessous de la première position.

4. Appareil de finition selon la revendication 3, comprenant un moyen élévateur (118) disposé au-dessous de la première position de la surface de support.

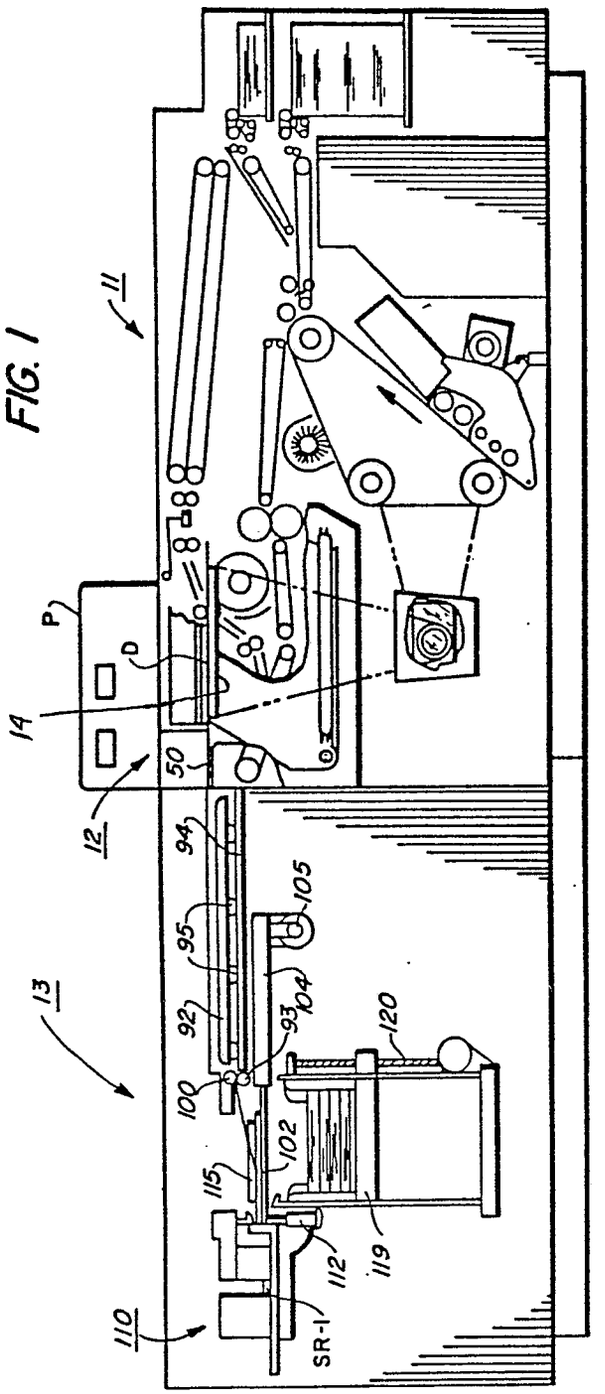
5. Appareil de finition selon la revendication 1, 2, 3 ou 4, comprenant un mécanisme provoquant un choc pour sortir un jeu agrafé de la position de fixation après l'opération d'agrafage.

6. Système de reproduction de document pour produire des feuilles de copie pré-assemblées (S), ayant un appareil (12) manipulateur de document qui est destiné à acheminer des feuilles individuelles (D) de document à partir d'un empilage de fourniture jusqu'à un poste d'exposition (14) et effectuer une exposition de chaque feuille de document avant son retour à l'empilage de fourniture, un processeur (11) pour reproduire des feuilles de copie (S) des feuilles de document exposées (D), et un appareil de finition (13) selon l'une quelconque des revendications pré-

cédentes, pour recevoir et lier en jeux (C) des feuilles de copie pré-assemblées (S) en provenance du processeur (11).

7. Appareil de reproduction selon la revendication 6, comprenant un moyen (100) pour acheminer des feuilles de copie sur la surface de support (102) à une cadence égale à la vitesse de traitement pour la reproduction des feuilles de copie, et un moyen pour déplacer cette surface entre une première position et une seconde position, et la ramener à la première position dans une période temporelle approximativement égale au pas du processeur.

FIG. 1


11
P
D
14
50
12
94
105
95
13
92
104
93
120
100
102
115
112
119
110
SR-1

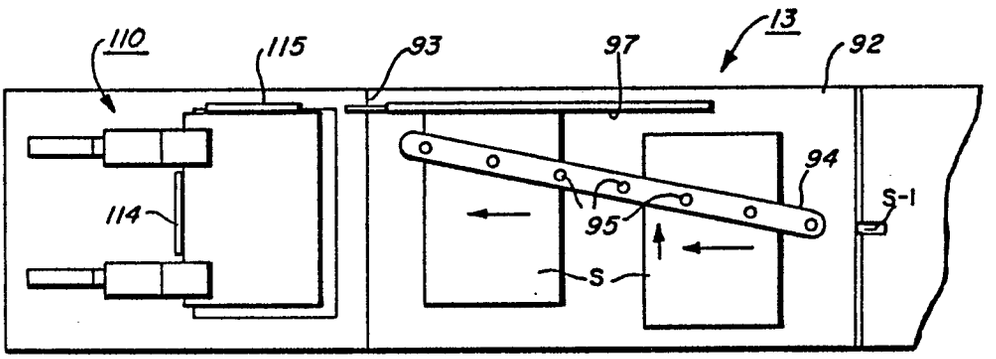
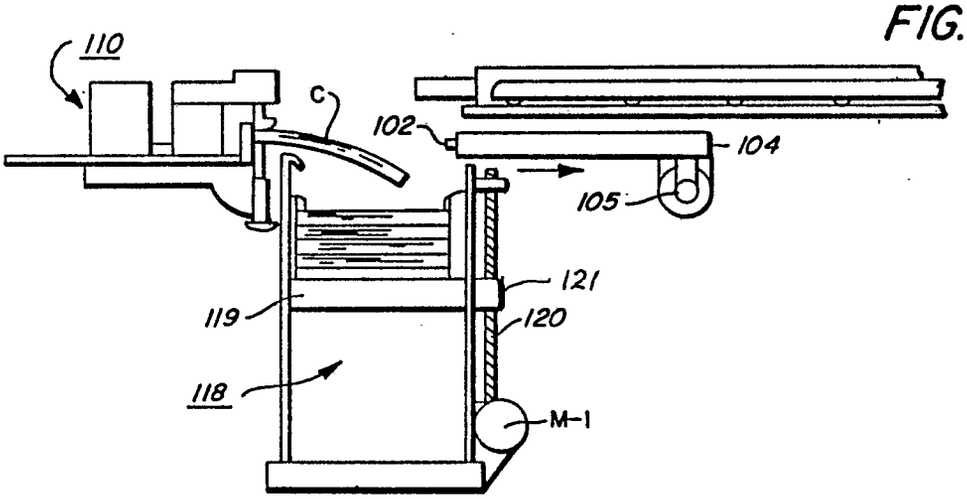

110
115
93
97
13
92
94
114
95
S-1
S

FIG. 2

FIG. 3


110
C
102
104
105
121
119
120
118
M-1