Handling Paper

Overview

For most machines, paper handling can be broken into six main procedures: feed, registration, transport, duplexing, misfeed detection and finishing. Originals are handled in a similar, though separate, fashion.

Paper handling begins at the paper source—this could be a paper tray, cassette, roll, or a single, hand-fed sheet in the by-pass tray. The paper feed process ensures that the paper is positioned and ready for use. It also feeds the paper into the main unit, and separates sheets of paper so that only one sheet is fed at a time.

Registration ensures that each sheet is positioned properly for printing. Registration typically addresses two issues: timing and skew. For timing, it synchronizes the image on the photoconductor with the paper. It ensures that the leading edge of the paper matches the leading edge of the developed image. Meanwhile, skew control ensures that the paper is lined up straight. It compensates for slight rotations to the paper during paper feed.

Paper transport is merely moving the paper. Paper is usually transported from paper feed to registration, from paper separation to fusing, and from fusing to the finisher or output tray.

Not all machines are capable of double-sided printing; however, those that are must have some type of duplex unit. The duplex process redirects the paper, allowing information to be printed on both sides of a single sheet. For duplexing, paper can be handled either inside the main unit or using external duplex units.

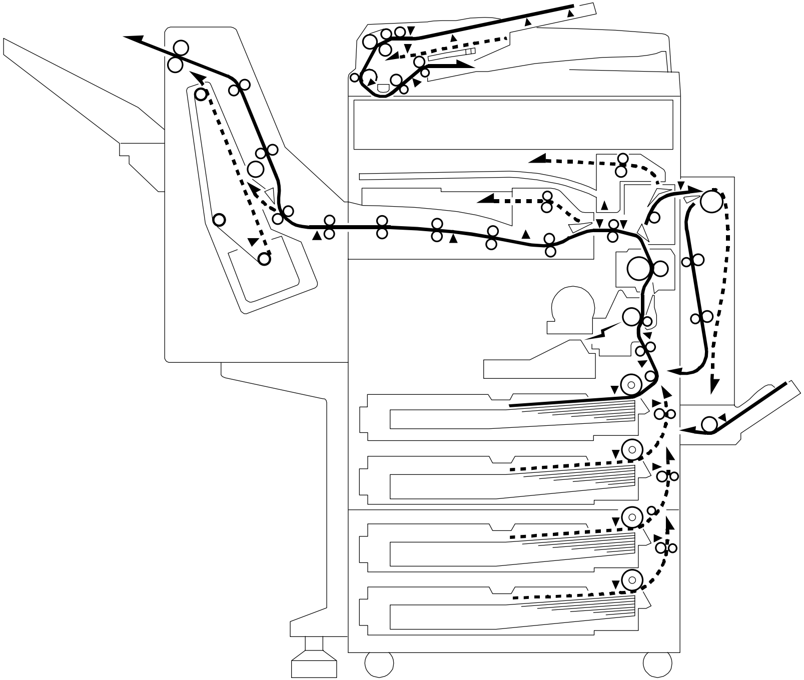
Misfeed detection uses a combination of sensors along the paper path to track the progress of each sheet of paper. These sensors help detect paper jams, determining when and where a jam takes place

Finally, after they are printed, the sheets can be stacked, sorted, directed to various output trays or bins, stapled, punched, or otherwise processed. Finishing processes can take place inside the main unit itself or can be handled by a finishing unit.

Paper Path

The paper path is, basically, the path that the paper travels from the paper source to the output tray. Most machines have a branching paper path—the paper can come from more than one source, and can be directed to more than one finishing process or output tray. Most paper paths can run through all six processes. There are two basic designs for the paper path. Most machines use a variation of these.

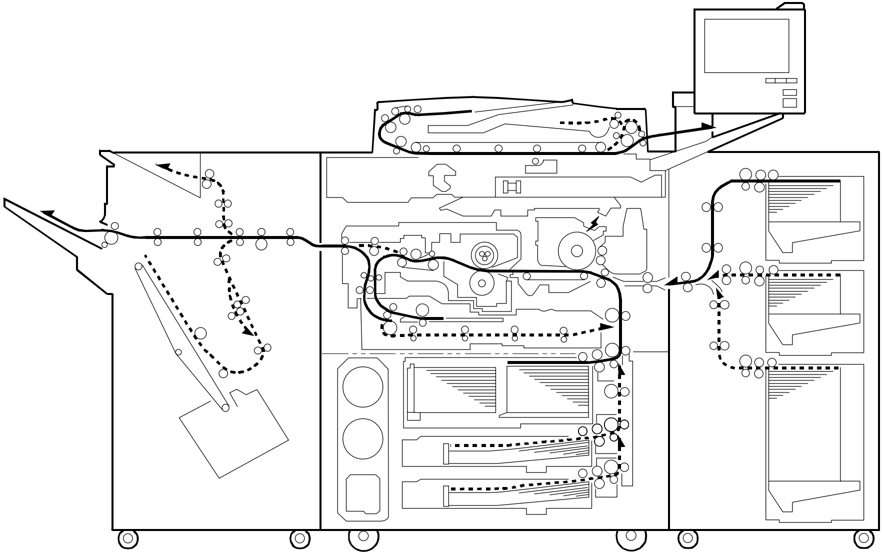
Vertical Path



Here, the paper is stored in the lower portion of the machine. Each sheet is fed from the paper source, transported vertically up the machine, then fed to the registration rollers and development section. Sometimes a shorter, straight path runs from the by-pass tray, this can be used to handle paper stocks that cannot run through the main paper path. Duplexing is handled through either an internal, horizontal duplexing unit or an external, vertical duplexing unit.

The illustration shows the *A265*. Paper is stored in paper trays or fed in the by-pass tray. The copier uses an external duplexing unit. Finished sheets can be routed to a variety of output trays or to the finisher. Note: in this machine even the development unit and fusing unit are vertical. The horizontal path across the top of the machine is merely to transport sheets to the finisher. Also, this copier does not provide a straight paper path from the by-pass tray. This layout is used in many new copiers and multifunction products.

Horizontal Path



Here the paper travels a generally horizontal path from the paper source to the finisher or output tray. A straight, horizontal paper path reduces the likelihood of paper jams. It may also improve speed, or to allow a wider variety of paper stocks—particularly heavier paper stocks.

In some color machines, a development process called *tetradrive* uses a horizontal path. Four development units are placed in a line. This provides quick, high quality color printing.

Unfortunately, the horizontal paper path is not as compact as the vertical path. These machines tend to be larger.

The illustration above shows the *A294*. Paper from the LCT follows a traditional, horizontal paper path. However, paper from the main unit's trays follows a largely vertical transport path. (Pure horizontal systems have become quite rare.) Also, unlike the A265, the copy processes are aligned horizontally. This machine also includes a finisher and an internal, horizontal duplex unit.

Paper Feed

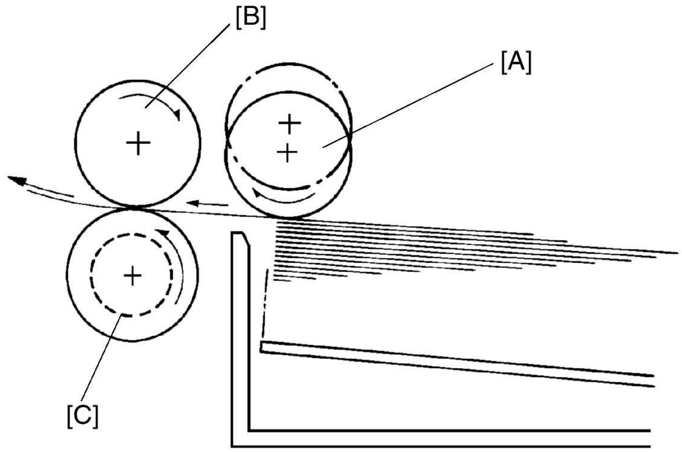
Paper feed is the separation of a single sheet of paper from a paper source—usually a stack of paper in a cassette or tray—and moving it into the machine.

Paper Feed Methods

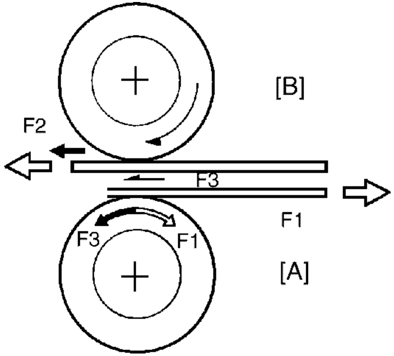
Feed and Reverse Roller (FRR)

The FRR feed mechanism consists of a pick-up roller, a feed roller, and a reverse roller.

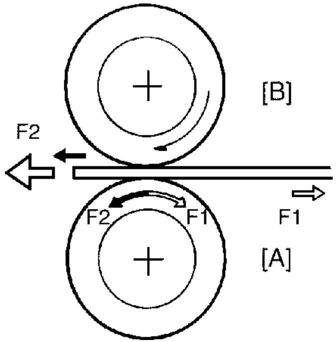
The pick-up roller [A] is not in contact with the paper stack before it starts feeding paper. Shortly after the start key is pressed, the pick-up roller drops down and feeds the top sheet between the feed roller [B] and the reverse roller [C]. At almost the same time that the paper's leading edge arrives at the feed roller, the pick-up roller lifts off the paper stack so that it does not interfere with the operation of the feed and reverse rollers. The feed and reverse rollers then take over the paper feed process.



There is a one-way bearing inside the feed roller so it can turn only in one direction. The reverse roller turns in the opposite direction as the feed roller. A slip clutch (*torque limiter clutch*) drives the reverse roller, however, allowing it to turn in either direction depending on the friction between the rollers. A spring keeps the reverse roller in contact with the feed roller.



The direction that the reverse roller [A] turns depends on the frictional forces acting on it. The slip clutch applies a constant clockwise force (F1). When there is a single sheet of paper being driven between the rollers, the force of friction between the feed roller [B] and the paper (F2) is greater than F1. So, the reverse roller turns counterclockwise.

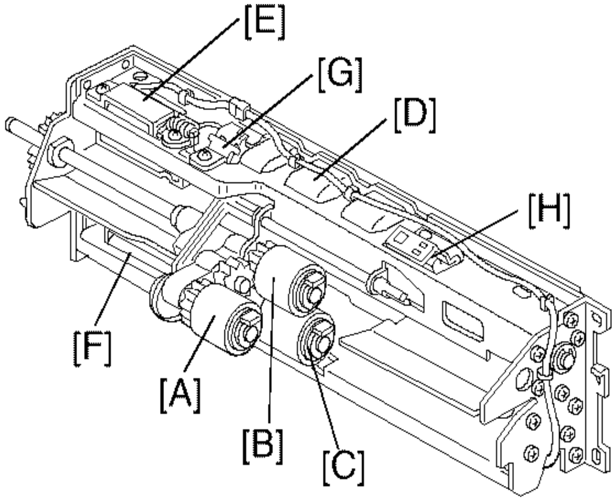


If two or more sheets are fed between the rollers, the forward force on the second sheet (F3), becomes less than F1 because the low coefficient of friction between the two sheets. So, the reverse roller starts turning clockwise and drives the second sheet back to the cassette.

Example: Model A113

Drive Mechanism

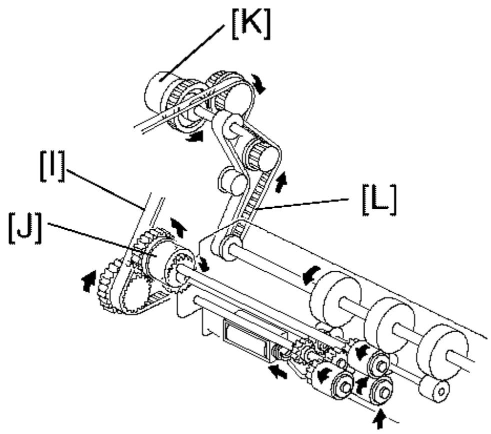
The paper feed unit consists of a pick-up roller [A], feed roller [B], separation roller [C], relay roller [D], pick-up solenoid [E], separation solenoid [F], paper upper limit sensor [G], and paper end sensor [H].



The main motor drives the pick-up, feed, and separation rollers via the timing belt [I] and the paper feed clutch [J]. The main motor also drives the relay roller. However, drive is transmitted to the relay roller via the relay clutch [K] and the timing belt [L].

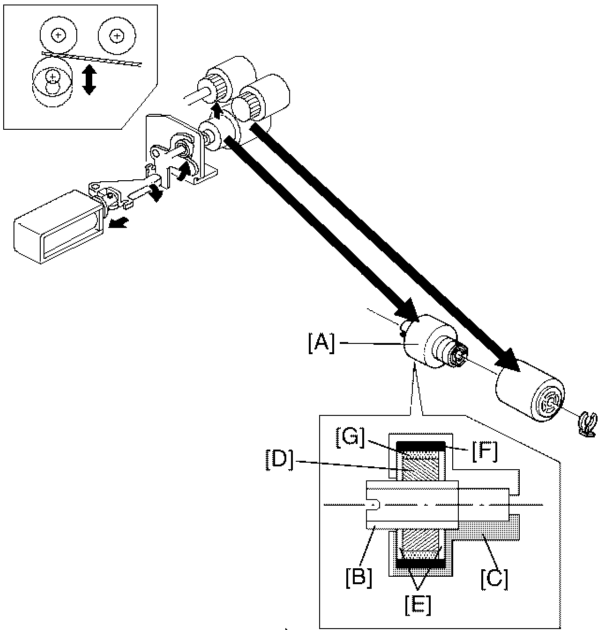
In stand-by mode, the separation roller is away from the feed roller. 50 ms after pressing the start key, the main motor and the separation solenoid turn on. Then the separation roller comes in contact with the feed roller. 100 ms after the main motor starts to rotate, the pick-up solenoid turns on. The pick-up roller lowers to make contact with the top of the paper stack. The pick-up solenoid stays on for 550 ms.

200 ms after the main motor starts to rotate, the paper feed clutch and the relay clutch turn on. The feed roller and relay rollers feed the top sheet of the paper stack to the registration rollers. When the leading edge of the paper passes through the upper relay sensor, the paper feed clutch is de-energized.



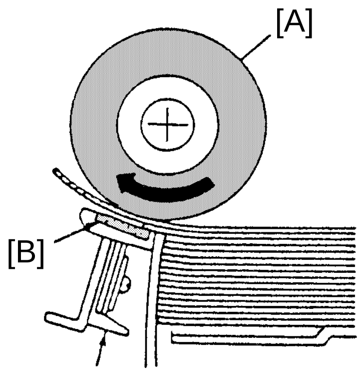
Slip-clutch Mechanism

The separation roller is mounted on a slip clutch. The slip clutch [A] consists of an input hub [B] and an output hub [C], which also acts as the case of the clutch. A magnetic ring [D] and steel spacers [E] are fitted onto the input hub. A ferrite ring [F] is fitted into the output hub. Ferrite powder [G] packed between the magnetic ring and the ferrite ring generates a constant torque due to magnetic force. The input hub and the output hub slip when the rotational force exceeds this constant torque. The constant torque prevents double feeding, because it exceeds the coefficient of friction between sheets of paper. This type of slip clutch does not require lubrication.



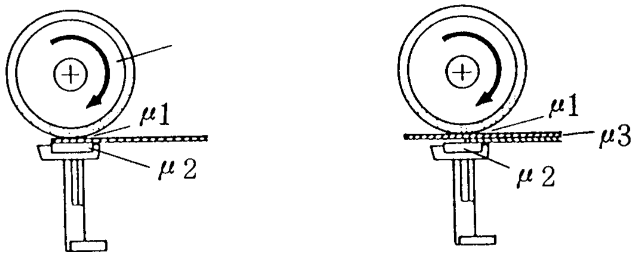
Friction Pad

The friction pad mechanism has two principle components—the paper feed roller [A] and a friction pad [B].



When the paper feed roller rotates, it feeds the top sheet of paper. The second sheet also tries to feed, but because the friction force between the friction pad and the second sheet is greater than that between the first and second sheets, the first sheet of paper is the only one that feeds.

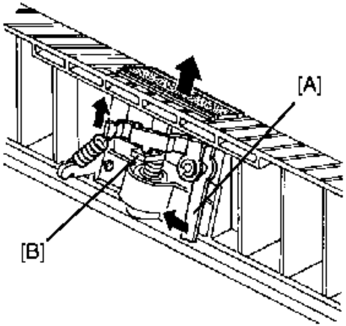
The friction coefficient applied to the surface of each sheet of paper is shown below.

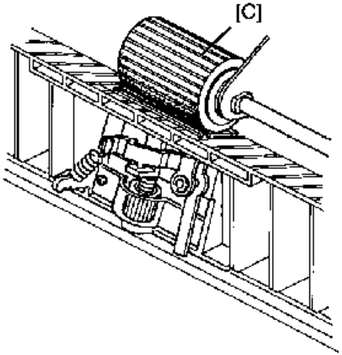


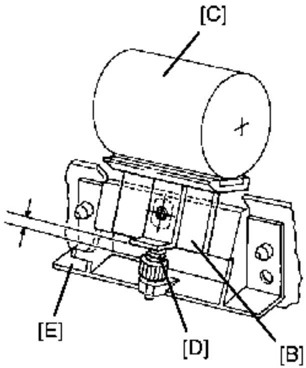
$\mu 1 > \mu 2 > \mu 3$

Example: Model A074

When the paper tray is placed in the copier, it pushes the pressure release lever [A], causing it to turn clockwise. This then causes the friction pad holder [B], holding the friction pad, to press up against the paper feed roller [C]. The friction pad pressure against the paper feed roller is determined by the friction pad pressure spring [D]. This pressure is applied evenly to the paper feed roller because the friction pad holder is mounted on the mounting bracket [E] with a swivel bushing.



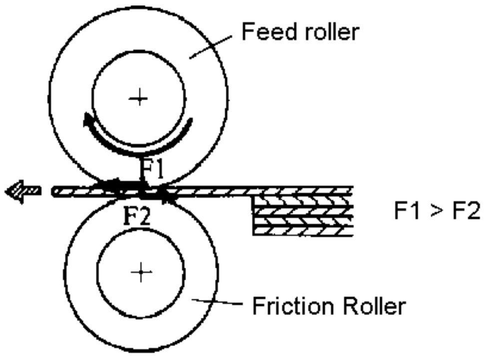


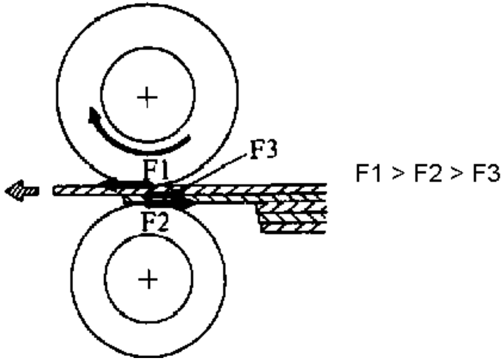


Friction roller

The paper separation mechanism for the friction roller uses the same principles as the paper separation method for the friction pad.

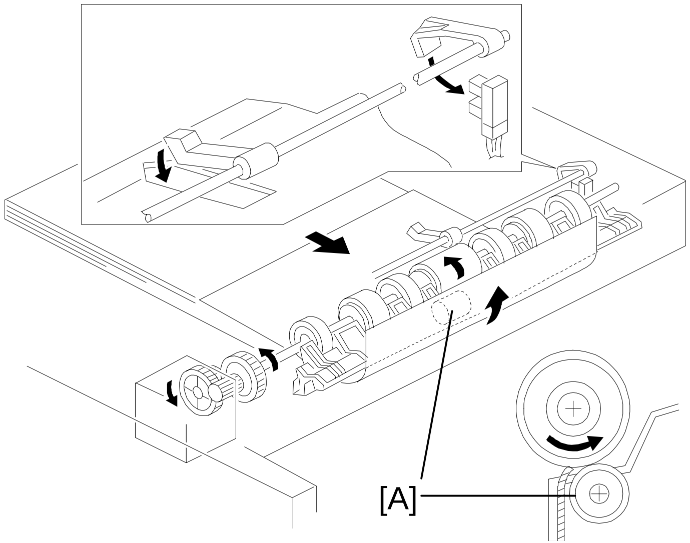
The two main components are the paper feed roller and the friction roller. When the paper feed roller rotates, the top sheet of paper is fed. The second sheet also tries to feed, but as the friction force between the friction roller and the second sheet is greater than that between the first and second sheets, only the first sheet of paper is fed.





Example: Model A133 Duplex

The duplex paper feed system consists of three sets of duplex feed rollers and a friction roller [A]. The friction roller has a one-way bearing inside; therefore, it rotates freely during paper stacking and locks during paper feeding. The duplex feed rollers can only feed the top sheet of the stack because the friction roller functions in the same way as a friction pad does.



Separation Belt

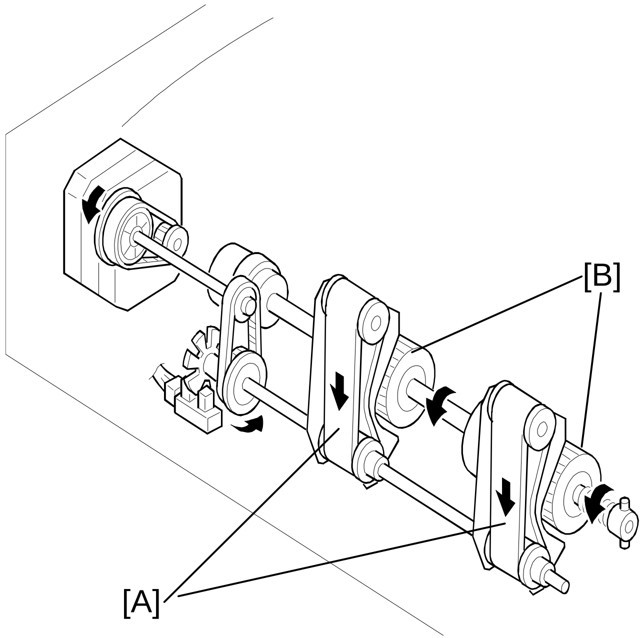
The separation belt system (also called the "friction belt" system) primarily feeds sheets from the bottom of a stack. It is commonly employed in automatic document feeders (ADFs) and in duplexing systems.

The separation belt feed mechanism is similar to the friction pad and friction roller systems; it exploits the difference in friction resistance to separate a single sheet of paper. However, unlike these two systems, the separation belt does not passively resist the passage of extra sheets of paper; it turns against the movement of the paper to feed back all but the bottom sheet.

The mechanism shown to the right is from the DF62.

[A] Separation belts

[B] Feed rollers



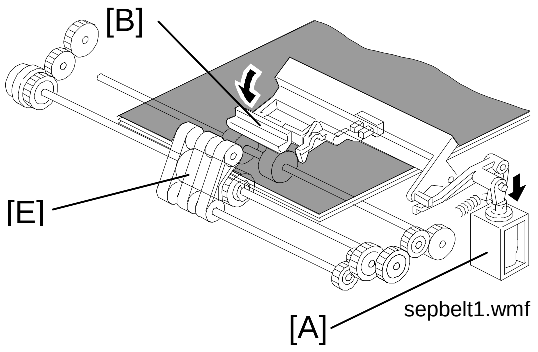
Example: Model A095 Duplex

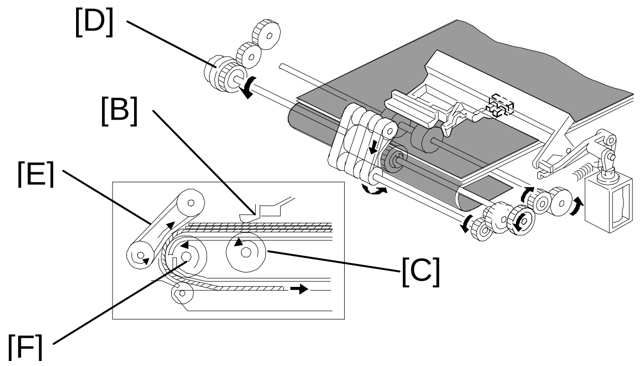
The illustrations to the right show the model A095 duplex paper feed mechanism.

The paper on the duplex tray feeds in order from the bottom to the top sheet. After all copies are stacked on the duplex tray, the duplex pressure solenoid [A] turns on to lower the pressure arm [B] causing the pressure arm to press the paper against the pick-up roller [C].

Then, the paper feed clutch [D] turns on to rotate the pick-up roller, separation belts [E] and the feed roller [F]. The separation belts and the feed roller rotate in opposite directions.

Only the bottom sheet is fed because the separation belt prevents any other sheets from feeding.

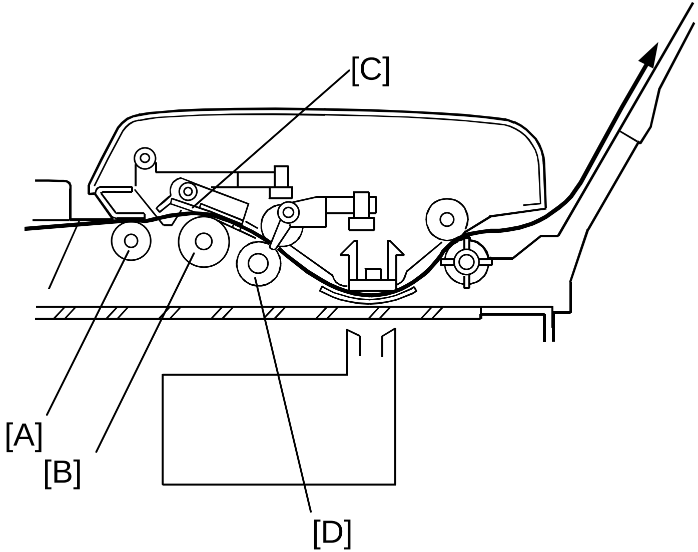




Separation Tab

The separation tab separation system is a variation of the separation belt system. It is used in slower feeding ADF units.

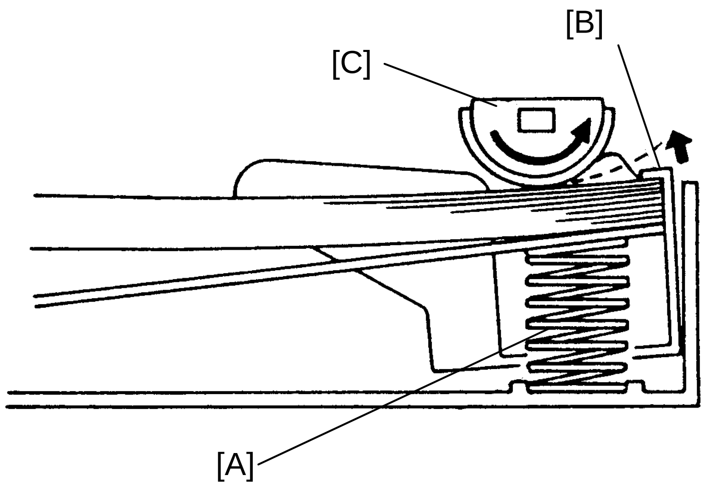
The illustration shows a document feeder using a separation tab. The pick-up roller [A] and feed roller [B] feed the document into the ADF unit. Only the bottom sheet is fed because the separation tab [C] prevents any other sheets from feeding. The document feed-in roller [D], feeds the document through the ADF unit.



Corner Separator

Corner separators provide a simple and reliable method of separating off the top sheet during paper feed. Commonly, they are used along with semicircular feed rollers in low and medium speed copiers.

A spring [A] holds the paper stack up against the underside of the corner separators [B]. As the feed rollers [C] start forcing the paper forward, the corner separators retard the movement of the paper causing the top sheet to bow up at the edges and thus separate from the lower sheets. With further feeding, the corners of the top sheet release from the corner separators. The top sheet then feeds into the paper path while the corner separators stop the lower sheets from feeding.

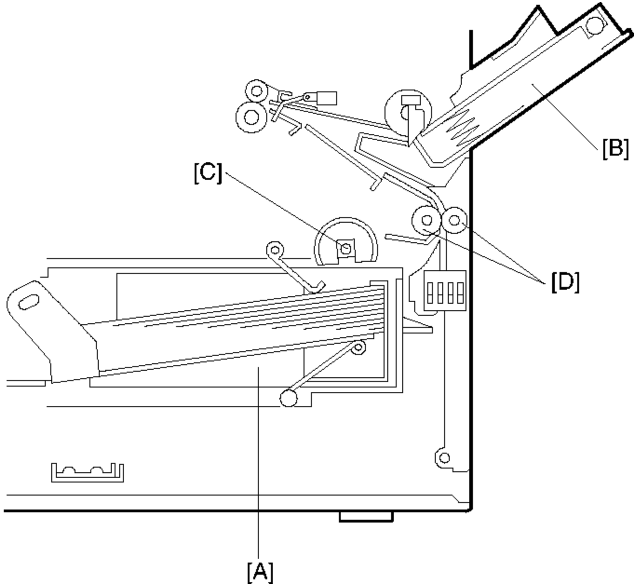


Example: Model A219

This copier has one paper feed station and a by-pass feed table. The paper feed station uses a paper tray [A] that can hold 500 sheets. The by-pass feed table [B] can hold 80 sheets.

The paper tray uses two semicircular feed rollers [C] and corner separators. The semicircular feed rollers make one rotation to drive the top sheet of the paper stack to the relay rollers [D]. The two corner separators allow only one sheet to feed. They also hold the paper stack. When the paper tray is drawn out of the machine, the spring pressure is released, and the tray bottom plate drops. In addition, there is no need to press the bottom plate down when putting the tray back in.

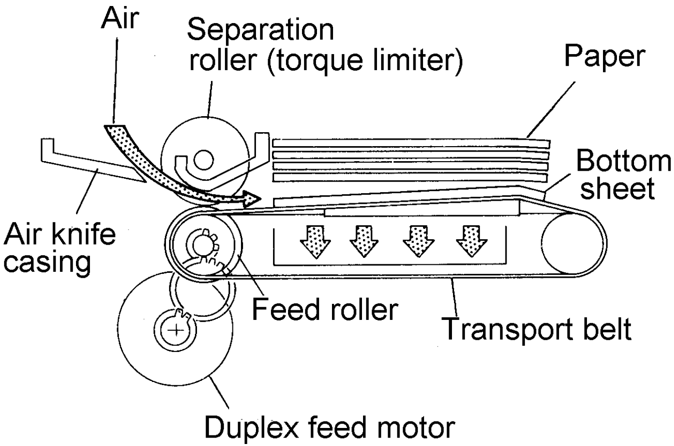
The by-pass feed table uses a feed roller and friction pad system to feed the top sheet of paper to the registration rollers.



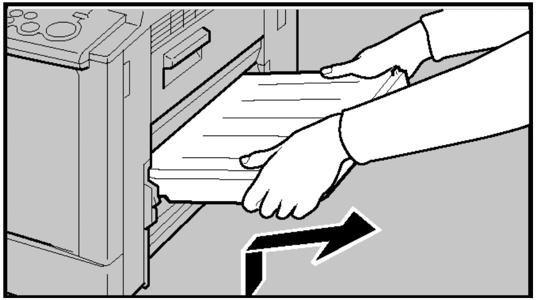
Air Knife

The air knife paper feed process uses jets of air to separate sheets of paper for paper feed. The air knife method (also called “air separation” method) is suitable for high speed copying and printing systems because it reduces the feed roller marks and paper deformation that can occur in high speed feeding.

The duplex paper feed mechanism of model *A112* (right) uses a combination of air knife and *FRR* feed mechanisms. The air knife directs jets of air at the bottom of the paper stack to separate the sheets of paper. A vacuum fan holds the bottom sheet against the transport belt. The separation roller allows only the bottom sheet to feed.



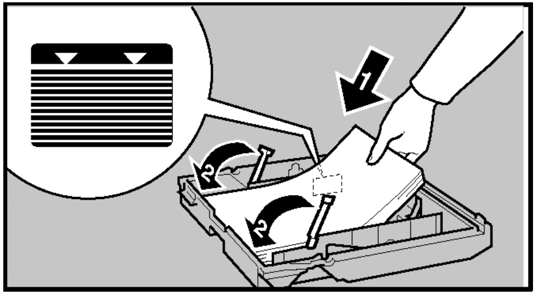
Paper Cassette



A paper cassette is a removable paper tray. A cassette is taken out of the machine to load paper and then reinserted in a cassette holder or cassette entrance.

Paper Lift Mechanism

Cassettes all have a moveable bottom plate on which the paper rests. The bottom plate must be raised to place the paper in position to be fed. Generally, this is accomplished by raising a cassette arm under the bottom plate. (Refer to the following examples.)



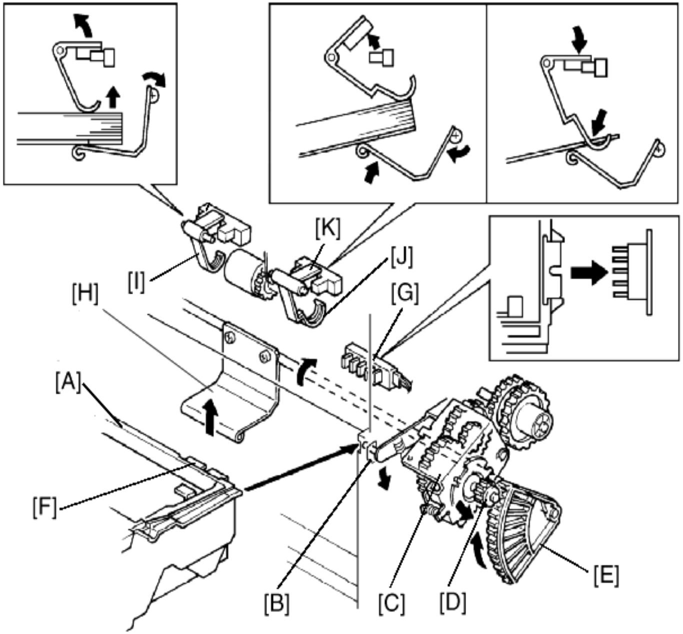
Example 1: Model A111

This is an example of the cassette arm being raised by a gear.

When inserting the cassette [A] into the copier, the cassette pushes down the cassette actuator pin [B]. The paper lift clutch unit [C] moves down and then the paper lift gear [D] engages with the sector gear [E] causing the cassette arm [H] to raise the cassette bottom plate.

Simultaneously, the paper size actuator [F] engages with and actuates the paper size switch [G].

The paper lift gear turns the sector gear and the bottom plate raises until the top sheet pushes up the paper lift sensor feeler [I].



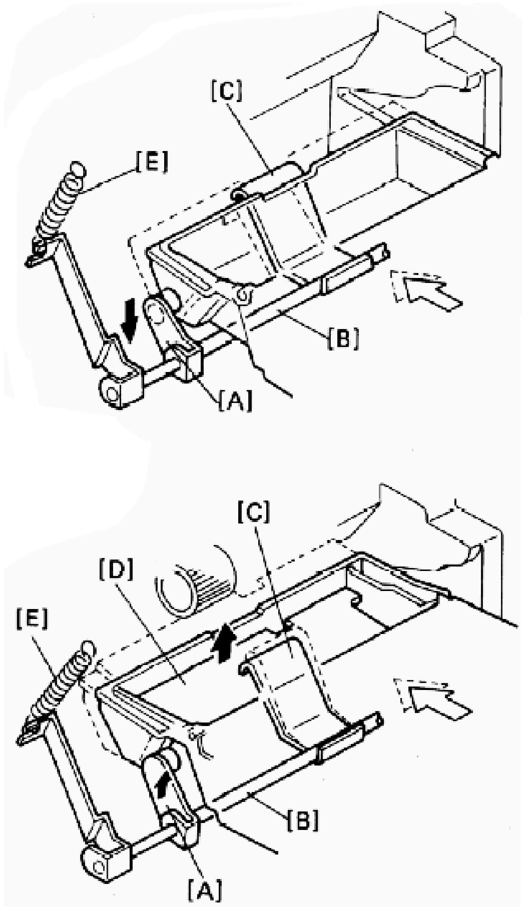
Paper end feeler: [J]
Paper end sensor: [K]

Example 2: Model A006

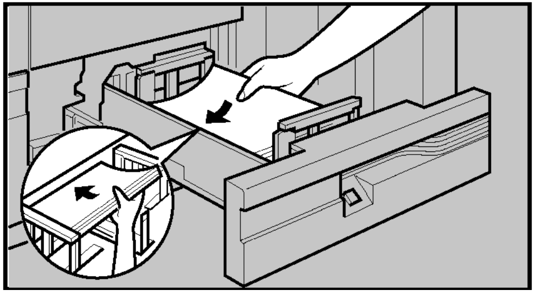
This is an example of the cassette arm being raised by a spring.

When a cassette is inserted into the copier, the curved release guides on the sides of the cassette press against the rollers on the release levers [A] and force the release levers down. The release levers rotate the cassette arm shaft [B], moving the cassette arm down and out of the way. When the cassette is fully seated, the release guides allow the release levers to move back up. The cassette arm [C] levers up the cassette bottom plate [D] until the paper contacts the paper feed roller.

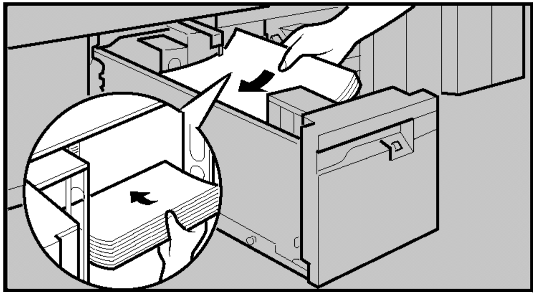
To prevent copy paper from multi-feeding or jamming, the spring [E] pressure is adjustable.



Paper Tray



A paper tray is a non-removable drawer or bin that is permanently built into or attached to the machine. The capacity of paper trays varies considerably; smaller trays typically hold 250 to 500 sheets of paper, but large capacity trays hold a paper stock of 1000 or more sheets.

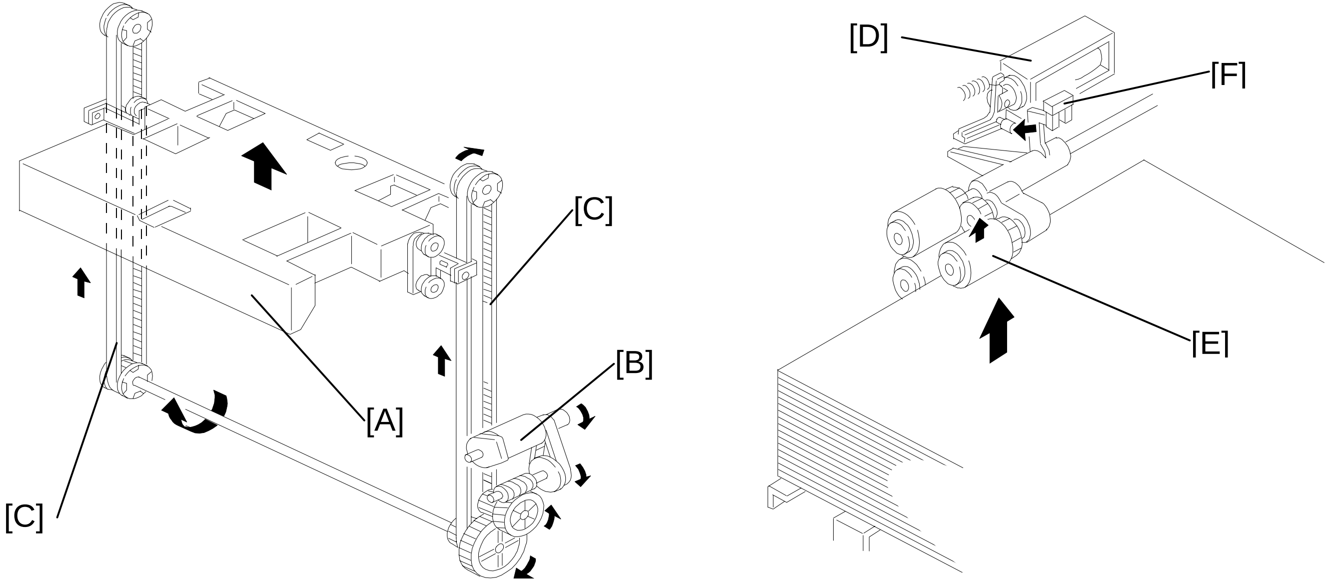


Paper Lift Mechanism

Smaller paper trays resemble *paper cassettes* and have similar paper lift mechanisms employing springs or a bottom plate lift arm.

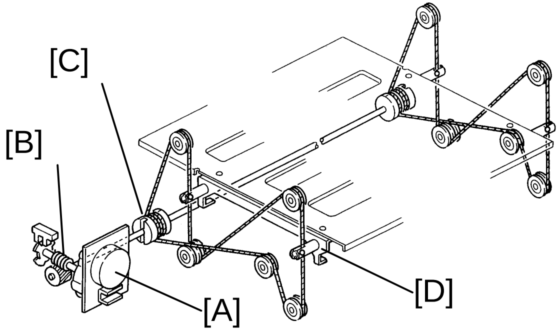
However, large capacity trays have more complicated mechanisms to raise the bottom plate and place the paper in position to be fed. Generally, this is accomplished using a wire- or belt-lift mechanism. (Refer to the following examples.)

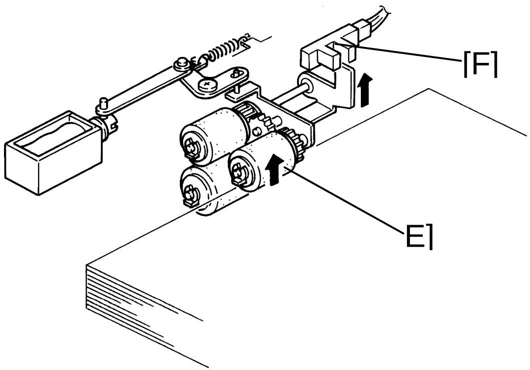
Example 1: Model A609 (belt lift)



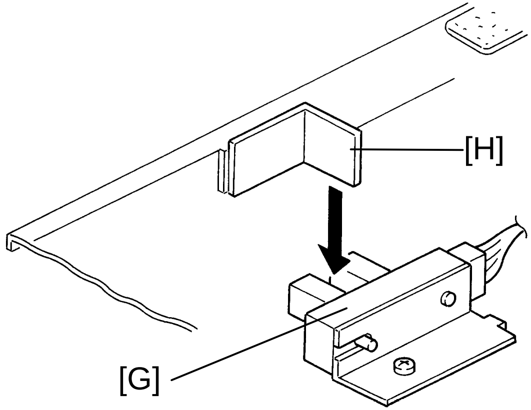
The bottom plate [A] of the LCT is raised and lowered by the LCT motor [B] and the drive belts [C]. When the main switch is on and the LCT cover is closed, the pick-up solenoid [D] activates and the LCT motor [B] rotates clockwise to raise the bottom plate until the top sheet pushes up the pick-up roller [E]. When the lift sensor [F] is de-actuated, the copier CPU de-activates the LCT motor [B] and the pick-up solenoid [D].

Example 2: Model A171 (wire lift)



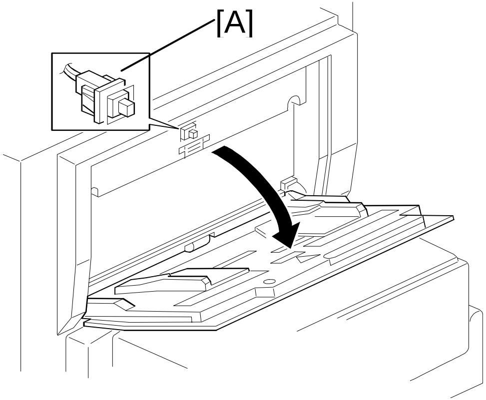


Drive from a reversible motor [A] is transmitted through a worm gear [B] to the drive pulley [C] shaft. The tray wires have metal beads on them. These beads are inserted in the slots at the ends of the tray support bracket [D] of the bottom plate; so, when the wire pulley turns (counterclockwise rear view), the beads on the wires drive the tray support bracket and the tray moves upward. The tray goes up until the top sheet pushing up the pick-up roller [E] actuates the upper limit sensor [F]. To lower the tray, the pulley turns clockwise until the lower limit sensor [G] is actuated by the of the bottom plate [H] actuator.



By-pass Feed Tray

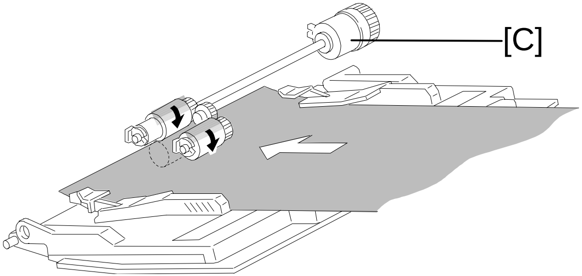
Most copiers and multifunction machines incorporate a fold-out by-pass feed table. By-pass feed is useful for casual copying on odd paper sizes. Also, on most machines, the by-pass feed tray provides a straight paper path that is suitable for stiff feed stock such as post cards or OHP transparencies.



Example: A195

The by-pass feed table switch [A] detects when the by-pass feed table is opened. Then the CPU turns on the by-pass feed indicator on the operation panel.

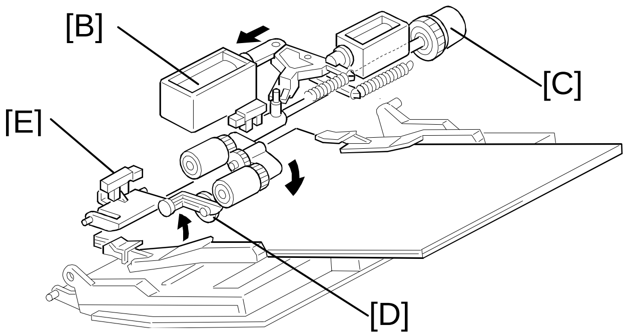
The by-pass feed table uses an FRR feed system, using the same rollers as the LCT, and one of the solenoids. Only the by-pass pick-up solenoid [B] is used, because the pick-up roller does not have to drop so far as it does when feeding from the LCT.



The user can put up to 40 sheets of paper on the by-pass feed table. Note that the paper can be pushed right into the machine, causing jams. The user must stop pushing the paper in when the by-pass feed indicator goes out.

When the Start key is pressed, the by-pass feed clutch [C] and the pick-up solenoid turn on to feed the top sheet of paper.

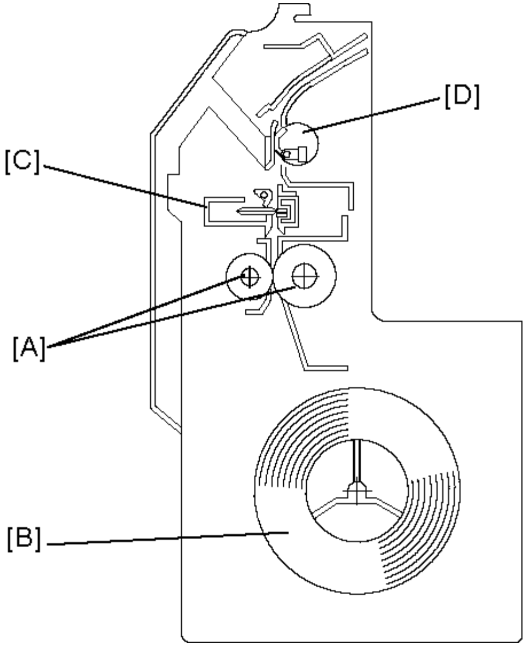
When there is no paper on the by-pass feed table, the paper end feeler [D] drops into the cutout in the lower guide plate and the by-pass feed paper end sensor [E] is deactivated.



Paper Roll

Wide format copiers and machines that use a thermal printing process commonly feed paper from a roll.

The illustration to the right shows the main components of a roll feeding system—the paper feed rollers [A], the paper roll [B], the cutter unit [C], and the paper leading edge sensor [D].

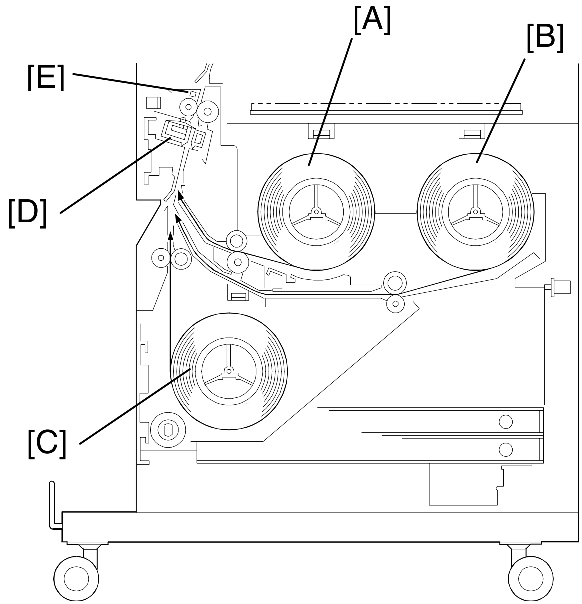


Example: A175

This machine has two standard roll feed units (1st [A] and 2nd [B]), one manual feed unit, and one optional roll feed unit (3rd [C]). The cutter unit [D] uses a sliding rotary cutting blade.

When the main switch is turned on or when roll paper is replenished, the roll feed motor rotates and the leading edge of the roll paper is fed until the roll lead edge sensor [E] is activated. Then, the leading edge of the roll paper is returned to the paper feed start position (120 mm before the cutter unit).

When the original lead edge sensor detects the leading edge of the original, the roll feed motor and the roll feed clutch turn on, and paper feed starts

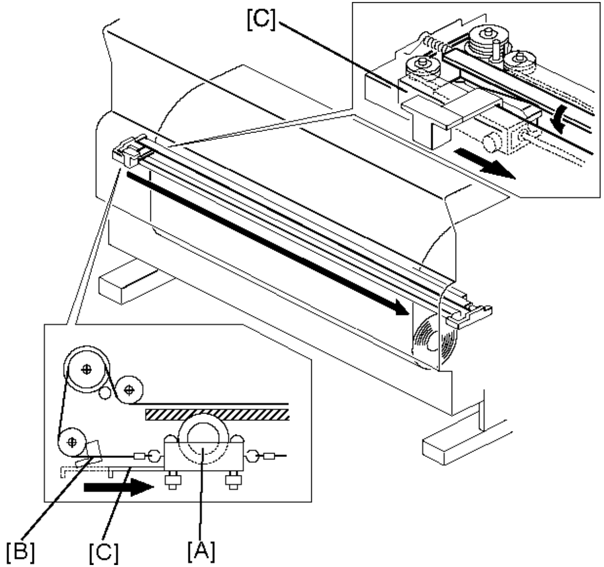


Cutter Operation

The illustration to the right shows the type of roll paper cutter used by wide format copiers.

This cutter unit uses a sliding rotary cutting blade [A] that is pulled past a fixed blade by a drive wire. The rotary cutting blade allows the cutter unit to cut paper in both directions. There are home position switches [B] at both ends of the cutter unit. The cutter motor turns off, stopping the cutting action, when the rotary cutting blade knob plate [C] turns off one of these switches.

Some smaller products such as thermal fax machines and white-board printers use similar cutters to cut roll thermal paper.



Paper Size Detection

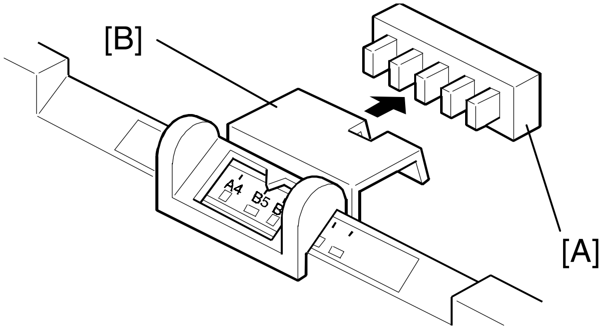
For many copy processes, operation timing depends on paper size. Machines can detect paper size in a number of different ways. Here are some common ones.

NOTE: Sometimes there isn't a paper size detection mechanism. For example, for the 3rd tray of model A171, the paper size must be input using the SP mode.

Switch Combination

The illustration to the right shows a paper size detection mechanism commonly used with cassettes and smaller paper trays.

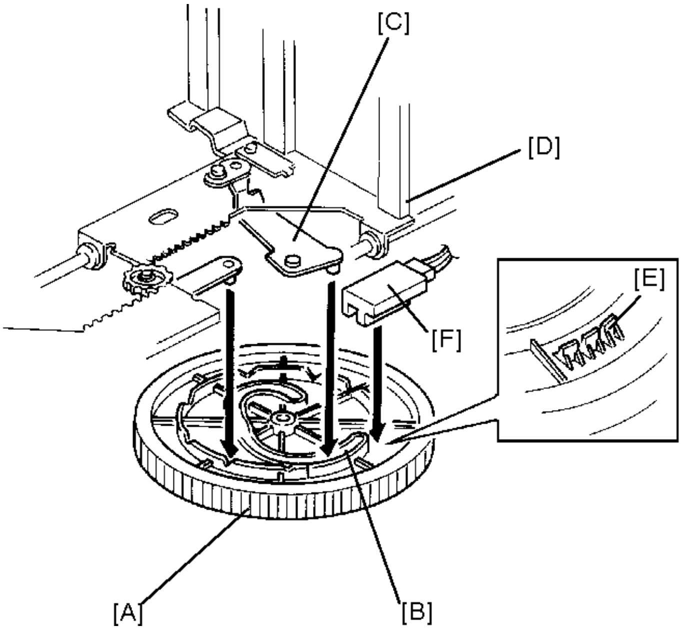
A block of five microswitches [A] detects the paper size. The switches are actuated by an actuator plate [B] on the cassette or tray. (Generally, such an actuator is set manually.) Each paper size has its own unique switch combination and the CPU determines the paper size by the combination.



Paper Size Dial

Some paper trays use a dial to change paper size.

The illustration to the right shows a case where the paper dial changes both the guide posts position and paper size. When the paper size dial [A] is rotated, the cam groove [B] moves the size lever [C], which repositions the guide posts [D]. When the dial reaches a standard paper size, one of the actuator plates [E] enters the paper size sensor array [F]. The combination of sensors activated tells the CPU the paper size.

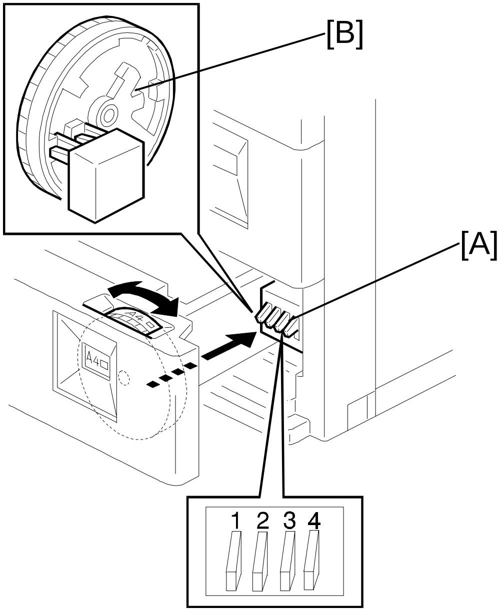


Paper Size Detection Table

Paper Size	Sensor				
	1	2	3	4	5
B4	0	0	0	1	1
A4 Sideways	0	0	1	0	0
A4 Lengthwise	0	0	1	0	1
B5 Sideways	0	0	1	1	0
B5 Lengthwise	0	0	1	1	1
11" x 81/2"	1	0	0	0	1
81/2" x 11"	1	0	1	1	0
81/2" x 14"	1	0	1	0	0

This illustration shows a paper size dial that is used to change only the paper size setting for the CPU. The paper side fences are set manually.

There are four microswitches [A] on the front right plate of the machine that detect paper size. The switches are actuated by a paper size actuator [B] on the inside of the paper size dial, which is on the front right of the tray. Each paper size has its own unique combination of notches. To determine paper size, the CPU reads which microswitches the actuator has switched off.

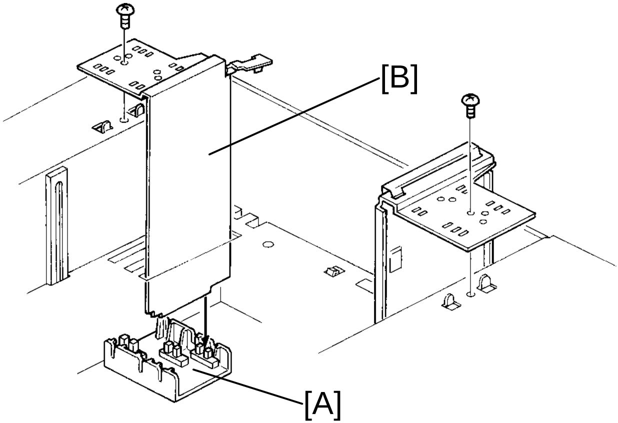


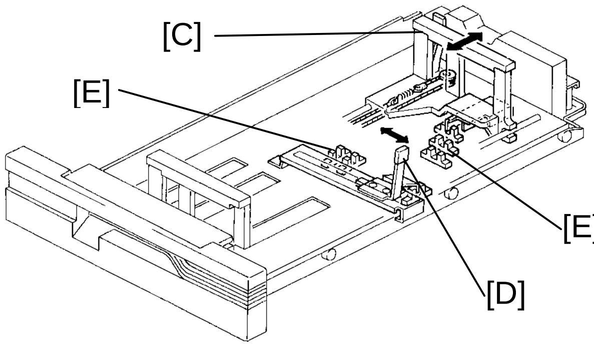
Side Fence Detection

Many trays have sensors to detect the side fence position.

In the upper example, the paper size detection sensors [A] are mounted under the paper tray bottom plate. When the rear side fence [B] is inserted into one of the paper size positions, it enters a *photointerrupter*. The signal from this sensor informs the CPU which size paper is in the tray.

The lower example is a tray that can be easily adjusted for different paper sizes by moving the guide post brackets [C] and the end post [D]. The guide post brackets and end post have actuator plates mounted on their bottoms. These plates activate sensors [E] (photointerrupters) mounted under the bottom plate. The CPU determines the paper size by reading the combination of sensors activated.



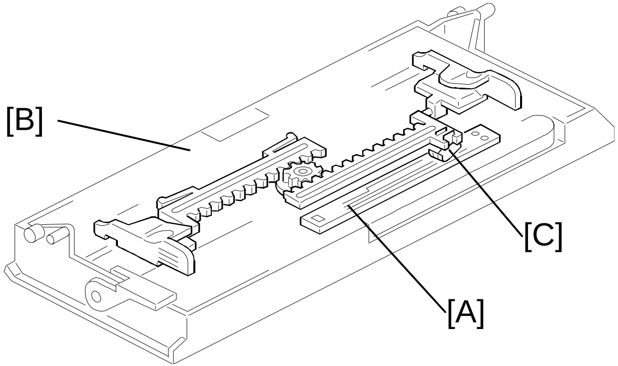


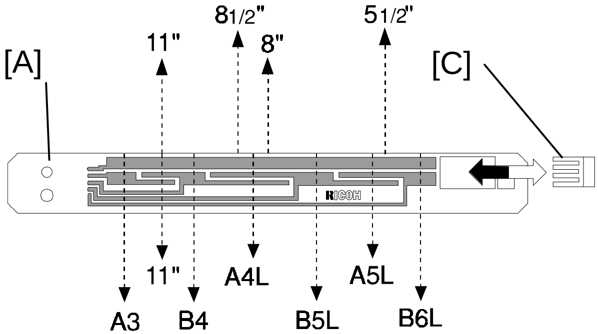
By-pass Size Detection

By-pass paper size detection has to be able to handle various paper sizes and orientations.

Many machines measure paper width with a slide switch [A] located inside the by-pass tray [B]. The side fence is connected to a terminal plate [C]. When the side fences are moved to match the paper width, the terminal plate slides along the wiring patterns on the detection board. The patterns for each paper width on the detection board are unique. Therefore, the machine determines the width of the paper placed in the by-pass tray by the signal output from the board.

However, the by-pass tray cannot determine the paper length. A4 paper set sideways is determined to be A3 paper. Generally, the registration sensor or paper feed sensor measures the length of the paper (using pulse count) so the various copy processes cut off at the proper time.



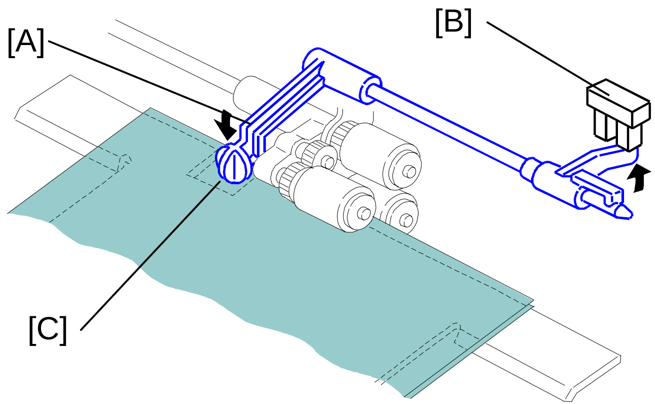


Paper End Detection

No matter what the paper source—cassette, tray, by-pass, or roll—the machine has to detect when paper runs out. This can be done in many ways. Here we will look at some of the most common.

Paper End Feeler Method

Cassettes generally detect the paper end condition through the use of a feeler which drops through the cassette's bottom plate when paper runs out. The illustration shows a typical mechanism.



When paper is loaded in the cassette, the paper holds up the feeler [A] and the actuator stays out of the slot of the paper end sensor [B] *(photo-interrupter*). When the paper runs out, the feeler drops through a cut-out [C] in the bottom plate and the actuator enters the paper end sensor, thus notifying the CPU that paper has run out.

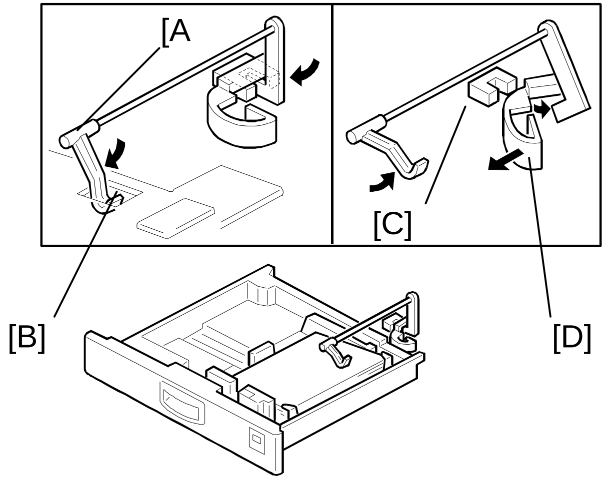
Trays also often use paper end feelers.

It is necessary to have some mechanism to move the feeler out of the cut-out in the bottom plate when the tray or cassette is pulled out.

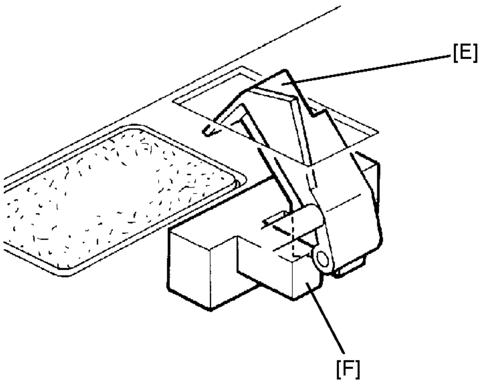
The illustration to the right shows a typical paper end detection mechanism for a small paper tray.

When the paper tray runs out of paper, the paper end feeler [A] drops into the cutout [B] in the tray bottom plate, and the paper end actuator activates the paper end sensor [C].

The paper end actuator is in contact with a lever [D]. When the tray is drawn out, the lever turns as shown by the arrow and pushes up the actuator. As a result, the feeler rotates upwards. This mechanism prevents the feeler from getting damaged by the paper tray body.

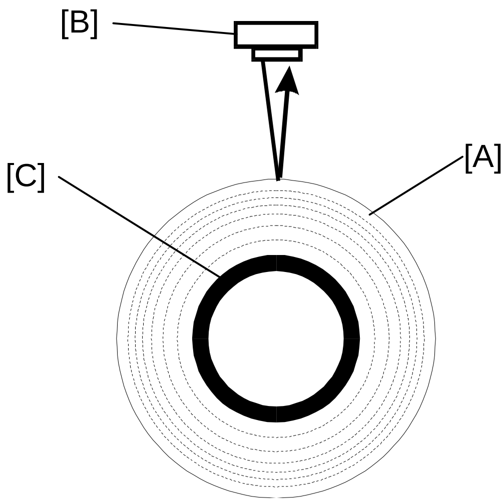


Some trays have the paper end detection mechanism under the tray bottom plate. To the right is one possible configuration. (paper end feeler: [E], paper end sensor: [F])



Roll end detection

Roll paper end is detected by a reflective photosensor. When paper [A] is present, light reflects back to the sensor [B]. When paper runs out the black core [C] doesn't reflect light and paper end is detected.



Registration

Overview

There is often some slippage during paper feed. As a result, paper cannot be transported directly to the image transfer or printing position, because the image position on the paper would not be stable. After paper feed starts, its transport timing requires adjustment to match it with the imaging process timing. This alignment is called “image registration” or just “registration”. Generally the registration process also removes any skew that the paper may have acquired during paper feed.

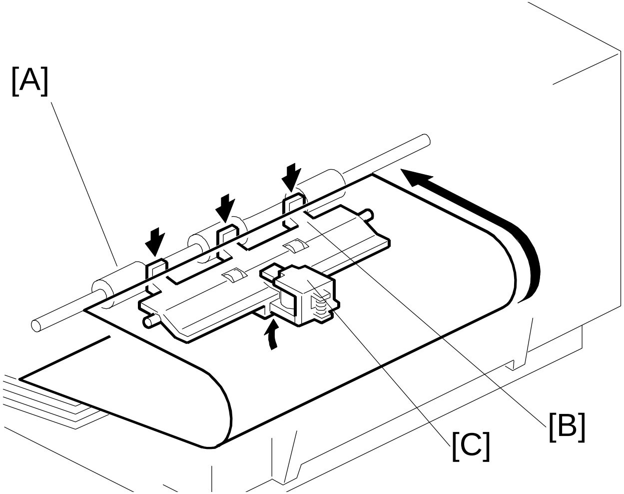
Registration Using A Stopper

Some machines use a stopper to delay the paper at the registration rollers. It allows a simplified drive mechanism where the registration rollers are not stopped during feeding. This method is used mainly with low speed machines.

Example: Model A226/A227

The registration rollers [A] always rotate while the main motor rotates. Relay rollers (not shown) transport the paper to the registration rollers.

There is a paper stopper [B] between the relay rollers and the registration rollers. After the leading edge of the paper reaches the stopper, the paper buckles slightly to remove skew. Then, 2.9 seconds after the paper feed clutch is turned on, the registration solenoid [C] is energized to move the stopper down, releasing the paper. This synchronizes the paper feeding with the image on the drum. After 0.6 seconds, the registration solenoid is de-energized.

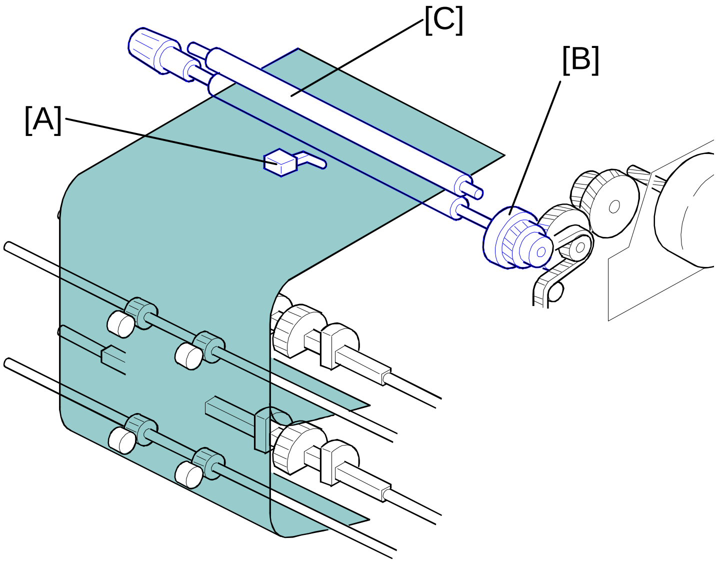


Registration Using Rollers

Most copiers and printers use registration rollers to match the paper timing to the image and remove skew.

Example: Model G020

The registration sensor [A] is positioned just before the registration rollers. When the paper leading edge activates the registration sensor, the registration clutch [B] turns off and the registration rollers [C]s stop turning. However, the relay clutch stays on for a bit longer. This delay allows time for the paper to press against the registration rollers and buckle slightly to correct skew. The registration clutch energizes and the relay clutch re-energizes at the proper time to align the paper with the image on the drum. The registration and relay rollers feed the paper to the image transfer section.



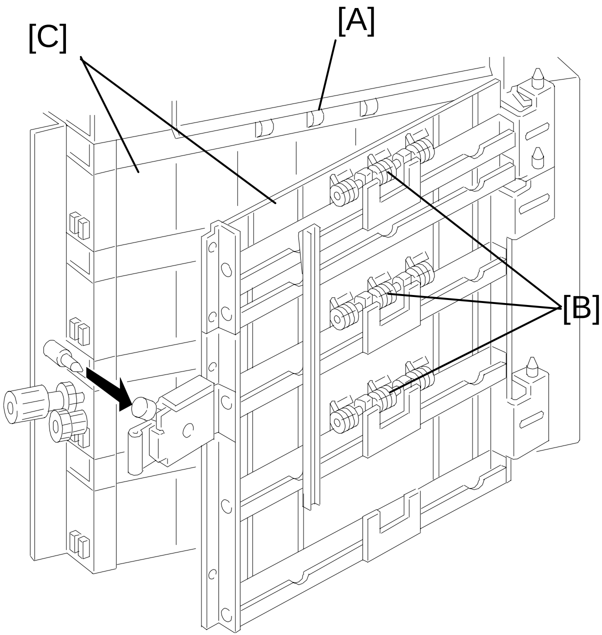
Paper Transport

Roller Transport

The illustration to the right shows a typical vertical transport mechanism that is used in several models.

Three sets of vertical transport rollers [A], driven by the paper feed motor, and their opposing idle rollers [B] are mounted in vertical guide plates [C]. They transport the paper from each feed unit to the registration rollers.

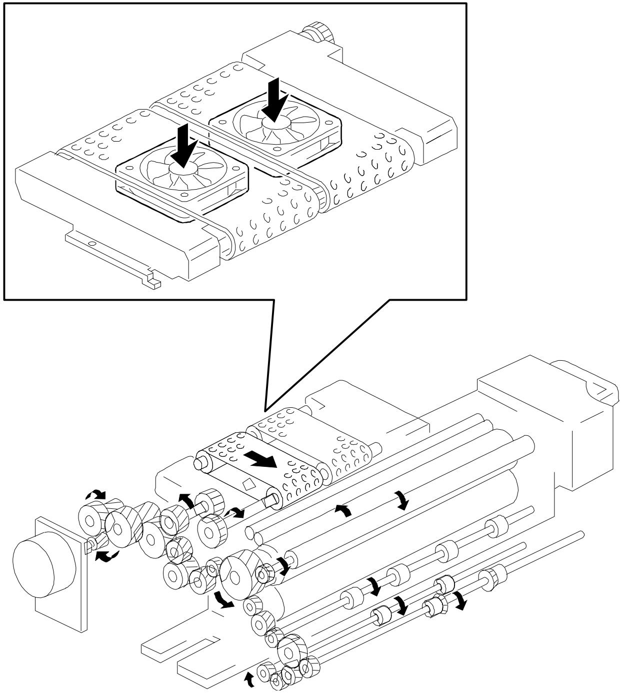
The vertical transport guides can be opened to access jammed paper in the vertical transport area.



Belt + Vacuum Transport

Many photocopiers use a combination of belts and vacuum fans to transport paper from the drum to the fusing unit. The vacuum holds the paper firmly against the transport belts. This method has the advantage of holding the paper secure to prevent vibrations or slippage that might disturb the as yet unfused toner image.

The number of transport belts and fans varies depending on the product. A single vacuum fan with multiple transport belts is common. The illustration to the right (from model *A166*) shows a mechanism employing two belts and two vacuum fans.



Duplex

Duplexing mechanisms can take many forms. However, they have the following things in common.

- They all have some way of sending copies or prints to the duplex mechanism. This is usually accomplished by a “junction gate”, which redirects the paper as it exits from the fusing unit.
- There is a mechanism that turns the paper over (reverses it) so that it is ready to receive an image on the reverse side. This can occur before the paper enters the duplex tray or after it exits the duplex tray.

Duplexing systems in most machines also have the following mechanisms.

- There is a tray to hold the sheets of paper to be duplexed. Usually, it is simply "called the “duplex tray”.
- There is a mechanism, usually called a jogger, to align the sheets of paper in the duplex tray.
- There is a paper feed mechanism employing one of the standard paper separation techniques.

Duplex Tray

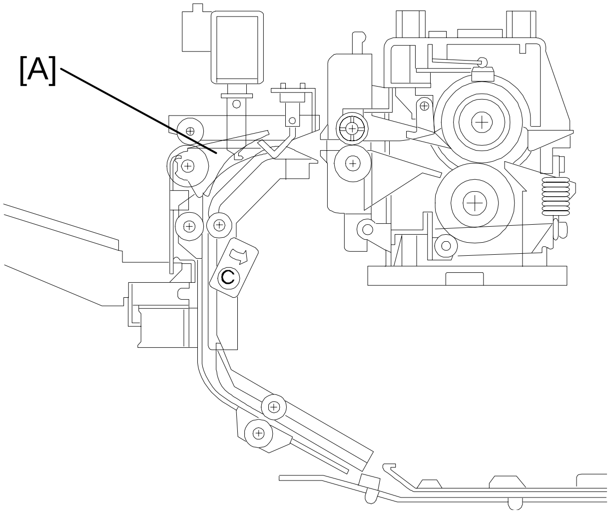
A duplex tray holds sheets for multi-copy duplexing. The following example illustrates the basic operation of a commonly used duplex tray system.

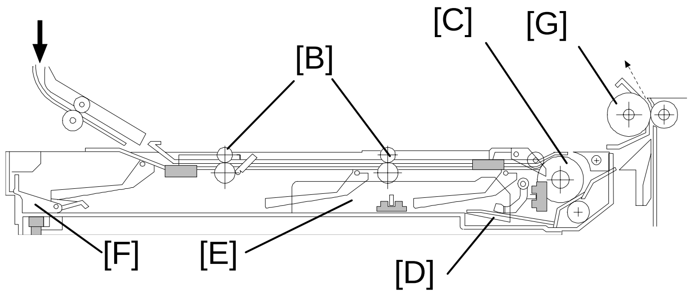
Example: Model A195

The junction gate [A] rotates up 1.1 seconds after the registration clutch turns on to direct copies to the duplex tray. Shortly after the fusing exit sensor detects the leading edge of the paper, the entrance rollers [B] and duplex feed roller [C] start to rotate. At the same time, the duplex bottom plate [D] lowers.

The copy feeds over the duplex feed roller and into the tray, thus reversing the copy. The jogger fences [E] and end fence [F] move inward to square the copy stack, then they move back 10.5 mm from the paper stack. After the final copy is delivered to the stack area, the jogger and end fences remain against the paper stack.

Soon after the final copy is squared, the duplex bottom plate lifts to the paper feed position and the duplex feed roller starts rotating counterclockwise to feed the top copy to the relay rollers [G]. The second side is then copied with the copy following the paper tray feed station paper path.





Duplex Stacking (Jogger)

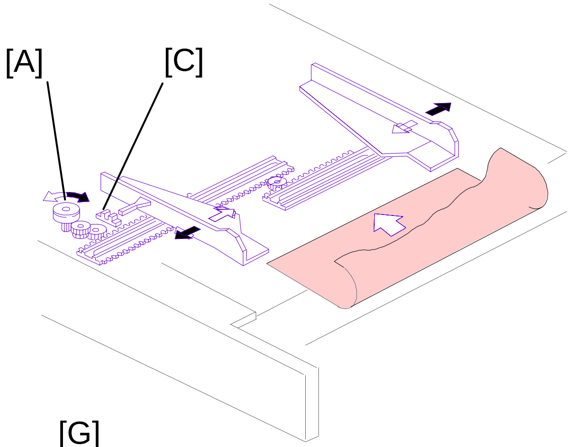
When sheets of paper enter a duplex tray they tend to become misaligned. A “jogger” aligns the sheets of paper before printing on the reverse side starts.

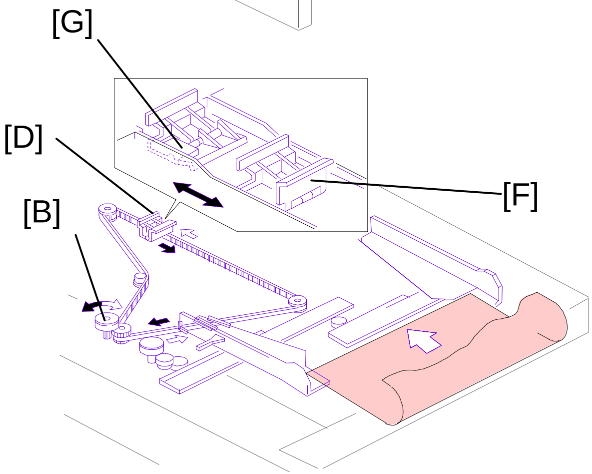
Example 1: Model A195

Two motors drive the fences—the side-fence jogger motor [A], and the end-fence jogger motor [B]. Using two motors for the side and end fences allows the duplex tray to handle all paper sizes from A3/11" x 17" to A5/ 8½" x 5½" sideways.

There are two home position sensors. One is for the jogger fences [C], and the other is for the end fence [D]. When the main switch turns on, the side fence jogger motor and the end fence jogger motor rotate to place the jogger fences and the end fence at their home positions.

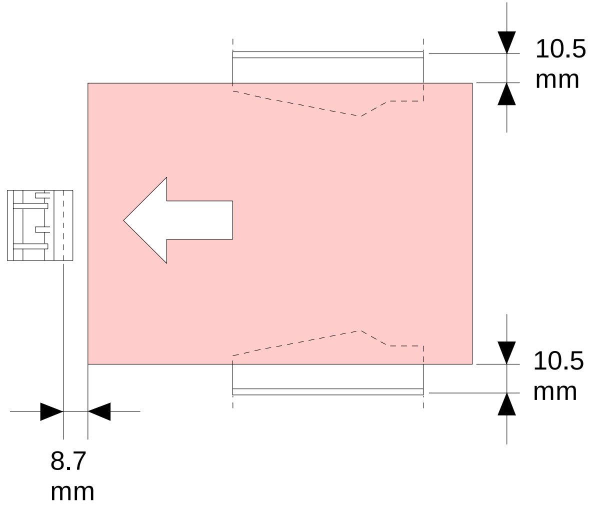
There are two end fences. One [E] is for A3/11 x 17" size paper. The other [F] is for sizes smaller than B4. They are included as a unit. When A3/11 x 17" size paper is in the duplex tray, the end fence unit moves to the left (as seen from the





operation side of the machine) and the B4 end fence rotates down as it is pressed against the end fence stopper [G].

When the registration clutch turns on, the side fences move 10.5 mm, and the end fence moves 8.7 mm away from the selected paper size. Then, when the copy paper is delivered to the duplex tray, the jogger fences move inward to square the paper after the duplex turn sensor detects the trailing edge of the copy paper. Shortly after this, the jogger fences move back to their previous positions. After the last copy of the first side copy run enters the duplex tray, the jogger fences remain against the paper stack.



Example 2: Model A171

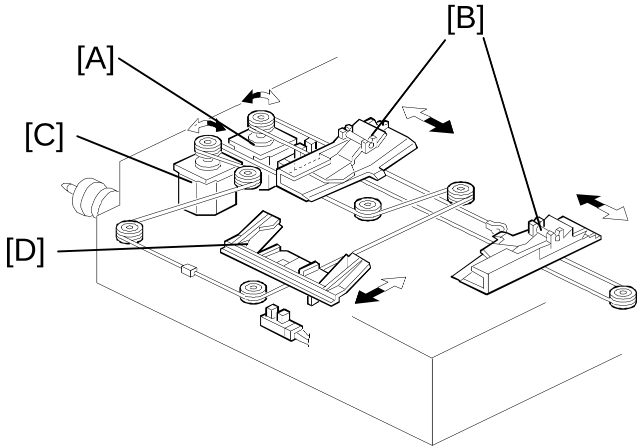
As in the previous example, model A171 uses two motors in the duplexing mechanism. The jogger fence drive motor [A] positions the side fences [B] and the end fence drive motor [C] positions the end fence [D].

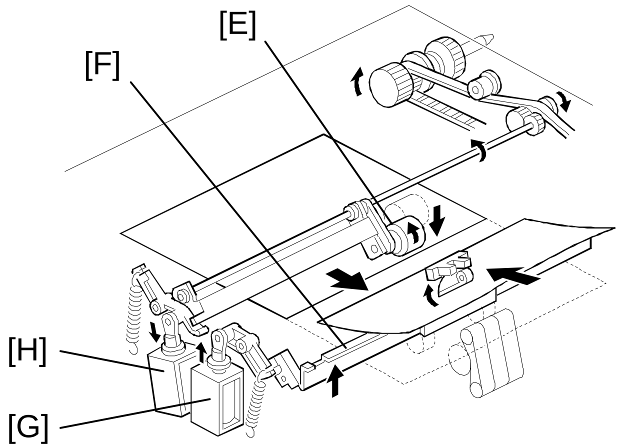
During the copy cycle, the side fences wait 10 mm away from the selected paper size position. After a sheet enters the duplex tray, the jogger fence drive motor moves the jogger fences in to align the paper stack and then moves them back out to the 10 mm position.

The end fence, however, does not have a jogging function. Instead, this model uses a positioning roller [E] to move the paper to the feed position.

A pressure plate [F] prevents the paper stack from moving while the sheet enters the duplex tray. After it is released, the positioning roller moves down and drives the sheet to the feed position.

(Pressure plate solenoid: [G], positioning roller solenoid: [H])





Interleave Duplexing

Overview

Some digital machines have a lot of RAM and a large capacity hard disk that can store many pages. This allows a different method of duplexing called “interleave duplexing”, in which sheets are not stacked. Instead, in interleave duplexing, sheets are continuously fed through the machine and the correct image is selected from memory or disk depending on which sheet and side is in the imaging section.

This type of mechanism allows more than one page to be processed at once, and it increases the productivity of duplex imaging, especially when making multiple duplex copies. Also, in the case of making copies from paper originals, it decreases the cycling of and the wear on originals.

Example: Model A229

For paper lengths up to A4/Letter lengthwise, the top duplex speed is possible, with the duplex unit processing three sheets of copy paper at the same time.

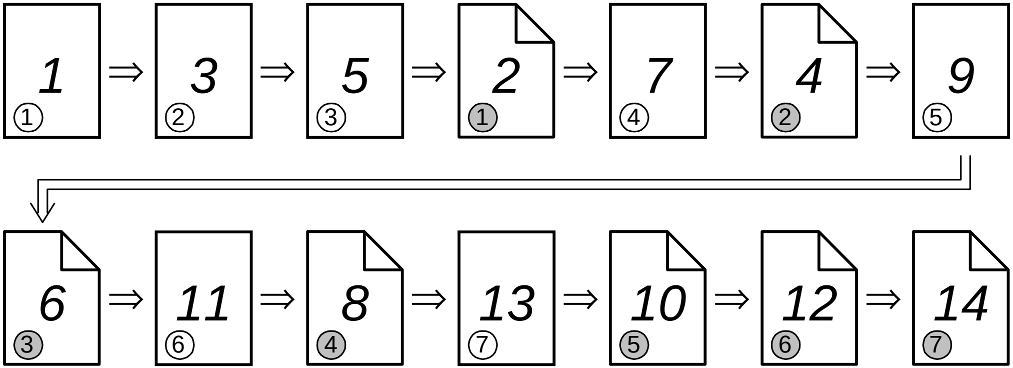
For paper longer than this, the duplex tray can still process two sheets of copy paper at once.

In case of single-set duplex copy job, the duplexing processes only one sheet of copy paper at a time.

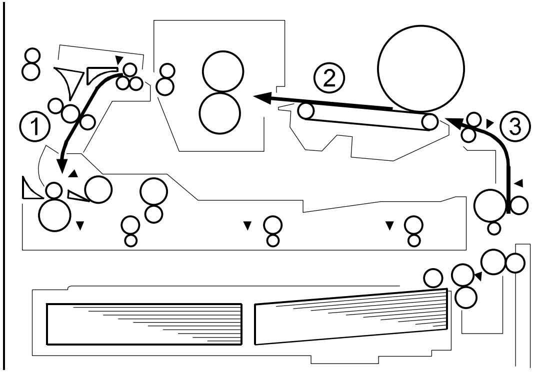
Up to A4/Letter lengthwise

The duplex unit can process three sheets at of copy paper at once.

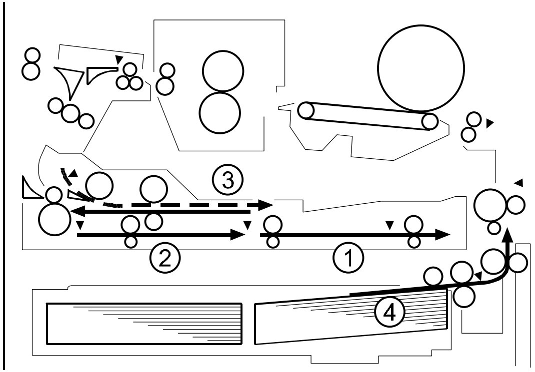
Example: A 14-page copy. The large numbers in the illustration show the order of pages. The small numbers in circles show the order of sheets of copy paper (if shaded, this indicates the second side).



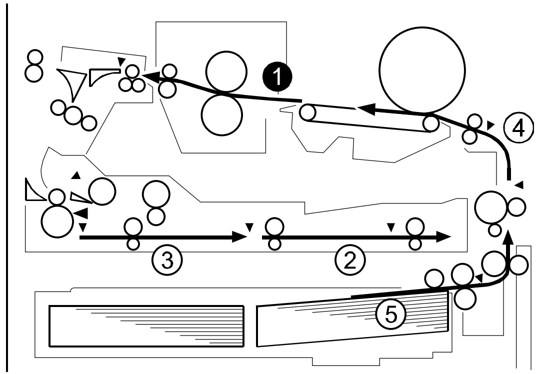
1. The first 3 sheets are fed and printed.
   1) 1st sheet printed (1st page)
   2) 2nd sheet printed (3rd page)
   3) 3rd sheet printed (5th page)



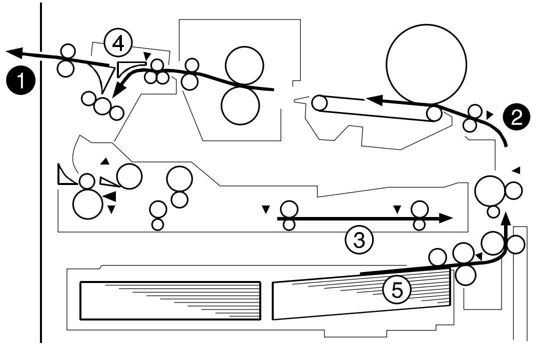
2. The first 3 sheets go into the duplex unit.
3. The 4th sheet is fed in.



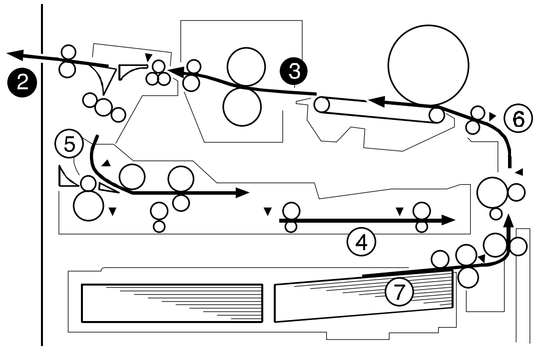
4. The back of the 1st sheet is printed (2nd page).
5. The 4th sheet is printed (7th page).



6. The 1st sheet is fed out (1st and 2nd pages printed).
7. The 4th sheet is directed to the duplex unit.
8. The back of the 2nd sheet is printed (4th page).
9. The 5th sheet is fed.

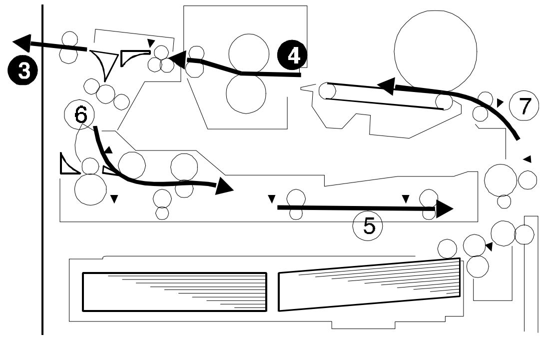


10. The 2nd sheet is fed out (3rd and 4th pages printed).
11. The 5th sheet is printed (9th page) and directed to the duplex unit.
12. The back of the 3rd sheet (6th page) is printed.
13. The 6th sheet is fed and printed (11th page).

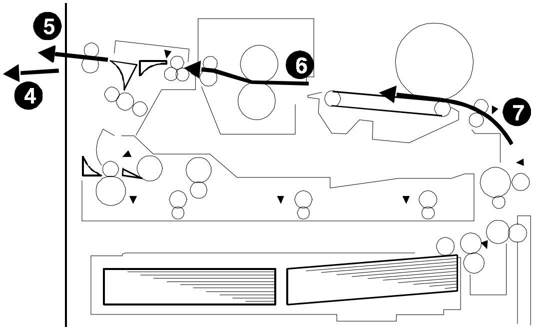


14. The 3rd sheet (5th and 6th pages) is fed out
15. The back of the 4th sheet (8th page) is printed.
16. The 7th sheet is fed and printed (13th page).

17. The back of the 5th sheet (10th page) is printed.



18. The 4th and 5th sheets are fed out (pages 7 to 10).
19. The back of the 6th (12th page) and 7th (14th page) sheets are printed.



20. The 6th and 7th sheets are fed out (pages 11 to 14).

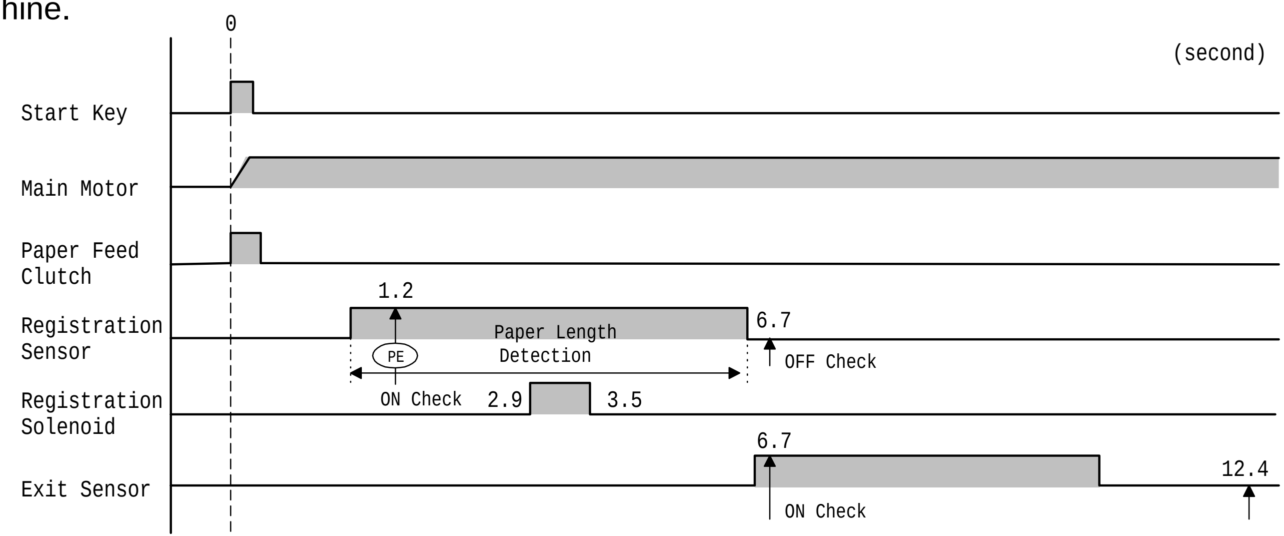
When copying on A3 or 11” x 17” paper, the process is similar, but only two sheets at a time can be processed. For details, refer to the service manual for model A229.

For another example of interleave duplexing, refer to the service manual of the A687 duplex unit.

Misfeed Detection

Office machines that print images on paper (copiers, fax, laser printers, etc.) have to detect paper misfeeds and jams and take appropriate action. One or more sensors placed along the paper path accomplish misfeed detection. Typically, *photointerrupters* with feeler actuators are used for misfeed detection because they are unaffected by the reflectivity or transparency of the feed stock.

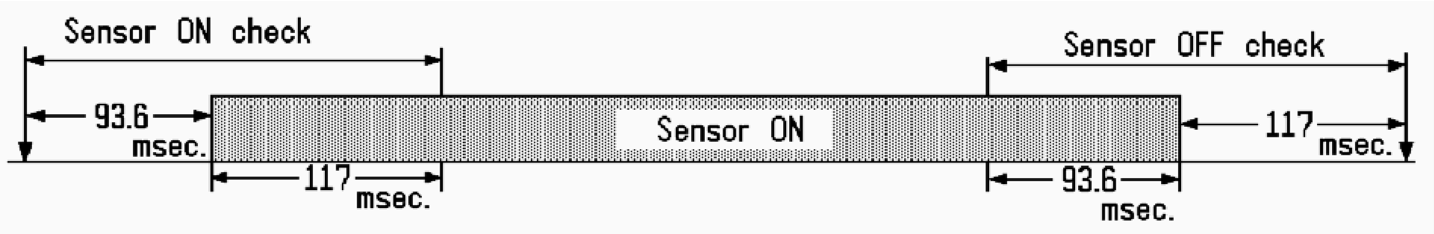
The number of misfeed detectors used depends on the length and complexity of the paper path. The following timing chart, from *model A226/A227*, is an example of misfeed check timing in a low-end machine.

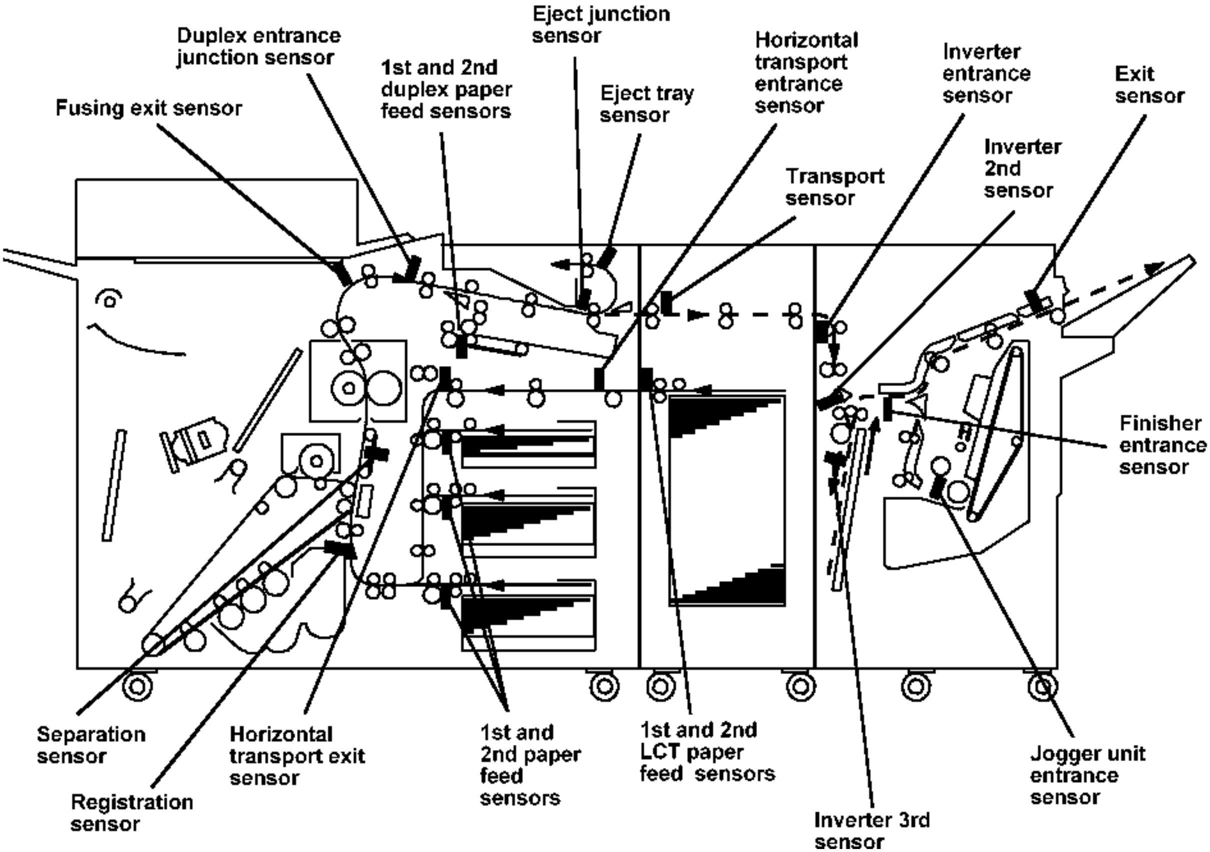


This machine uses the registration sensor and the exit sensor to detect misfeeds. The CPU checks each sensor twice—first it does an ON check to confirm paper arrival and then it performs an OFF check to confirm that the paper has passed the sensor.

Larger machines have more complex paper paths and transport paper at higher speeds. The illustration on the following page shows the misfeed sensors along the paper path of model *A112*.

Model *A112* uses 20 sensors to detect misfeeds. This is a high-speed machine (101 cpm) and, therefore, paper transport timing is much more critical than in a low-speed machine. For that reason the CPU does not just perform simple ON and OFF checks at points during the copy cycle. Instead, for each sensor, it monitors two critical periods. For both the ON and OFF checks, the sensor may change state within a period that is -93.6 ms and +117 ms from the standard check timing.

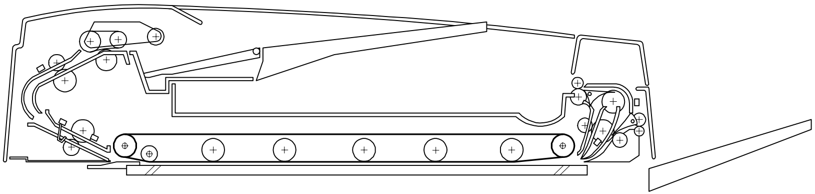



Eject junction sensor
Duplex entrance junction sensor
1st and 2nd duplex paper feed sensors
Fusing exit sensor
Eject tray sensor
Horizontal transport entrance sensor
Inverter entrance sensor
Exit sensor
Transport sensor
Inverter 2nd sensor
Finisher entrance sensor
Separation sensor
Registration sensor
Horizontal transport exit sensor
1st and 2nd paper feed sensors
1st and 2nd LCT paper feed sensors
Inverter 3rd sensor
Jogger unit entrance sensor

Handling Originals

Most office machines that scan or copy paper documents are equipped with a document feeder. These feeders are variously called automatic document feeders (ADF), auto reversing document feeders (ARDF), or automatic document handlers (ADH); however, we will refer to them all as “document feeders” in this section. While document feeders vary in mechanical and operational details, they generally have to do the following basic tasks:

- Feed documents one at a time from a stack of documents
- Detect the document size
- Transport the documents to the scan position
- Invert the documents (if reverse side scanning is necessary)
- Feed out the documents (original exit)



A typical document feeder

In this section, we will look at typical ways that these tasks are accomplished, and at specific examples of each.

Document Feed

Document feed is a special case of ***paper feed***, which was covered earlier in this chapter. Most document feeders use one of three paper-feed methods. These are:

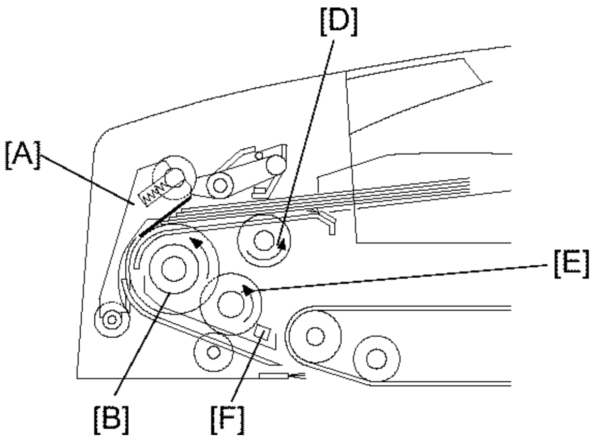
- The ***separation belt*** system
- The ***separation tab*** system
- A modified ***feed and reverse roller*** system using a feed belt rather than a feed roller

The following pages briefly cover the separation belt and separation tab systems, and cover more in depth the FRR with feed belt system.

Separation Belt

The ***separation belt*** system is covered earlier in this chapter. This system is also called the "friction belt" system. This system is mainly used in document feeders that feed sheets from the bottom of the original stack.

The illustration to the right shows the feed system of the DF61/DF64. For details on the feed mechanism of this ADF, refer to the service manuals for the DF61 and DF64 (used with ***model A133***).

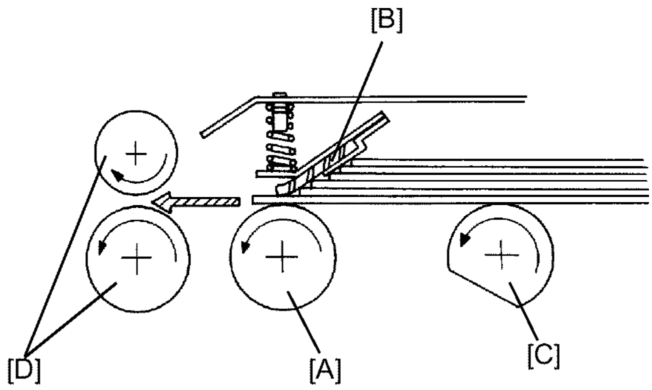


[A] Separation Belt
[B] Feed Roller
[D] Pick-up Roller
[E] Pull-out Roller
[F] Registration Sensor

Separation Tab

The ***separation tab*** system is covered earlier in this chapter. This system, which is also called the "friction tab" system, is used in document feeders when a straight paper feed path is required.

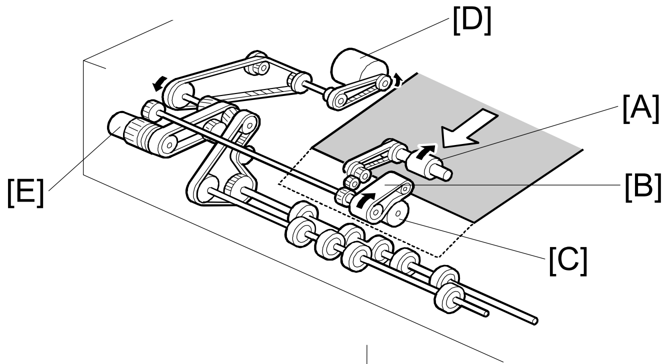
The illustration to the right shows the feed system of the document feeder of ***model A084***. For more details, refer to the ARDF section of the service manual for ***model A084***.



[A] Feed Roller
[B] Separation Tab
[C] Pick-up Roller
[D] Relay Rollers

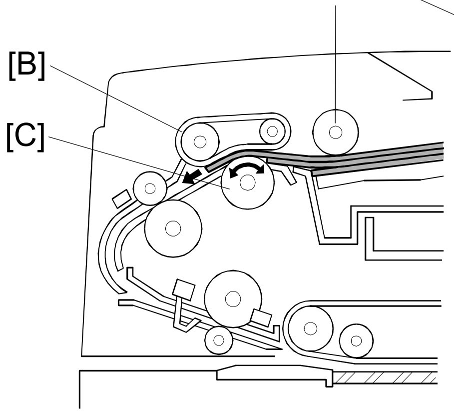
FRR with Feed Belt

Some document feeders, especially those used with higher throughput machines, use a version of the ***FRR*** (feed and reverse roller) system that employs a feed belt rather than a feed roller. A feed-belt type FRR provides more contact area than a roller type. This makes it more reliable for feeding original documents, which can vary over a wide range of types, sizes, and conditions. However, feed-belt type FRR is rarely used for primary paper feed (where feedstock quality can be controlled and throughput is much higher) because it is relatively expensive in terms of parts and maintenance.



Example: Model A294

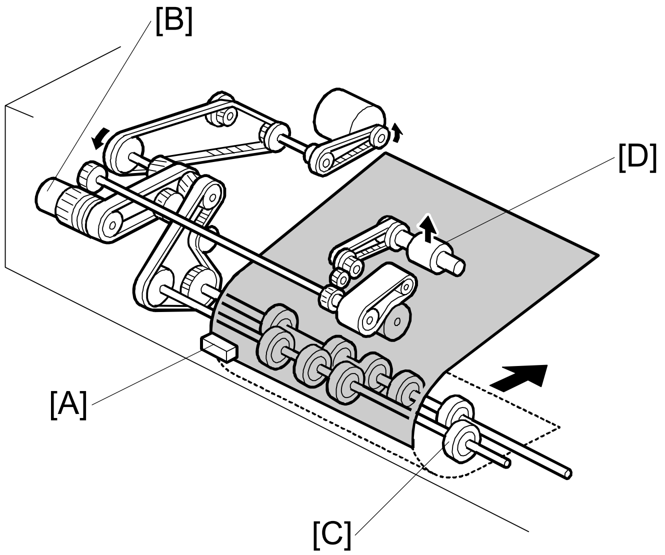
The pick-up roller [A], feed belt [B], and separation roller [C] are driven by the feed-in motor [D]. The feed-in motor [D] and feed-in clutch [E] turn on to supply the drive for the separation process.



Basic operation is the same as for standard FRR. When two originals are fed by the pick-up roller, the separation roller will turn opposite the feed belt direction and the 2nd sheet will be pushed back into the original tray. When there is only one original between the feed belt and separation roller, the separation roller will then rotate in the same direction as the feed belt and feed the original through to the platen glass. The separation roller contains a ***torque limiter*** so that it can rotate in both directions.

When the leading edge of the original activates the entrance sensor [A], the feed-in clutch [B] turns off and the drive for the feed belt is released. The original is now fed by the transport rollers [C] to the platen glass.

At the same time, the pick-up motor starts again and the pick-up roller [D] is lifted up. When the pick-up roller HP sensor turns on, the pick-up motor stops.



Original Size Detection

Most Ricoh made document feeders use one of two main methods to detect original size.

One method dynamically detects the original size using sensors to detect the width and length of the original "on the fly" as the DF feeds it in. This method allows the user to copy a stack of mixed size originals. However, the drawback is that it may not be possible to start paper feed until after the original has been fed (in auto paper size selection mode, for example).

The other method is a static detection system. It detects the original size prior to feeding. Generally this is done by sensing the position of the side fence to determine the original width and by sensing the original length with ***reflective photosensors*** on the original tray. Naturally, only the largest sheet will be detected by this method; so, mixing different size originals isn't recommended.

This following pages look at an example of each method.

Some document feeders, especially those used with low copy rate machines, do not measure original size. The DF40 is an example. It is the user's responsibility to ensure that the paper size matches the original size on such machines.

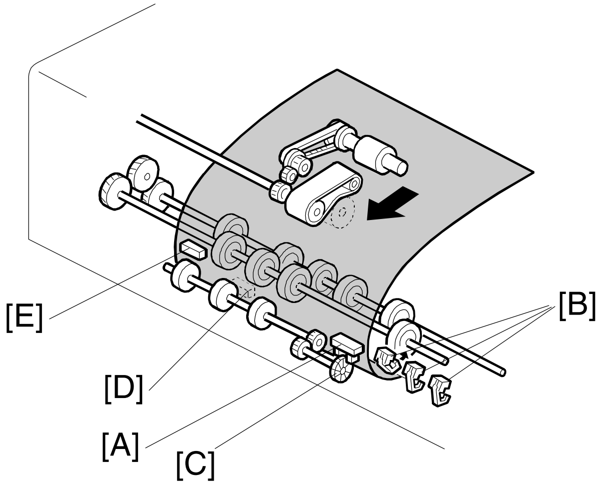
Dynamic Original Size Detection

The original size is sensed “on the fly” as it feeds in.

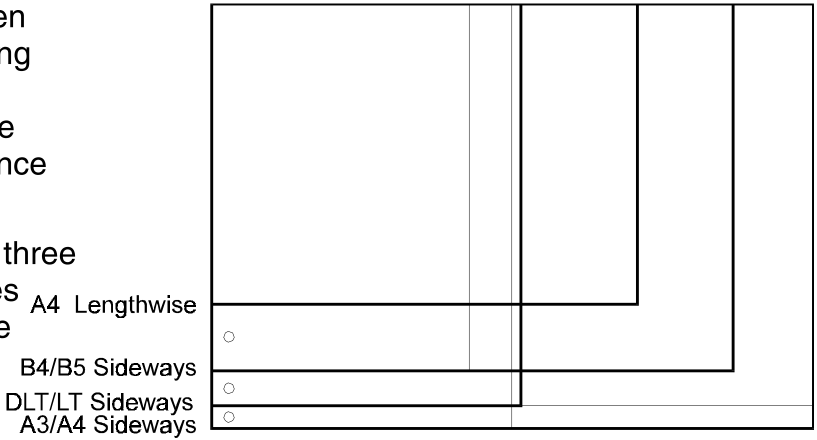
Example: Model A294

Model A294 (Bellini) detects the original size by combining the readings of the original length sensor [A] and three original width sensors [B] while the original feeds in.

The original length sensor generates pulses as a slotted disk [C] rotates. The slotted disk engages with the shaft of the driven transport rollers, so it turns as the paper moves past. The CPU then counts these pulses, starting when the leading edge of the original turns on the registration sensor [D]. Pulse counting continues until the trailing edge of the original passes the entrance sensor [E].



The CPU detects original width by using the three original width sensors. The three small circles shown in the diagram to the right indicate the positions of these sensors.

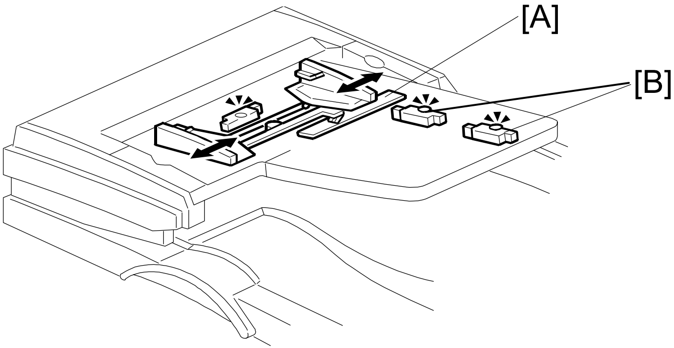


Static Original Size Detection

The original size is sensed prior to feeding while the originals are on the document feed table.

Example: DF68

DF68 has one sensor [A] to detect the original width and two sensors [B] to detect the original length. The DF detects the original size through the combination of inputs from those sensors.



The original width sensor [A] is actually a slide switch with four possible outputs (P1 to P4). The output depends on the position of the sliding contact on the original rear fence.

The original length sensors [B] are two reflective photosensors.

When using an original of a non-standard size, the user needs to input the original length at the operation panel.

Original Transport

This section deals with transporting the document after document feed.

Original Transport falls into two major classes based on the document scanning method. One type of document feeder transports the document past fixed optics. In such document feeders the document never stops; transport and feed-out occur as one continuous process. This will be the first mechanism examined in this section.

The second type of document feeder positions the document on an exposure glass, where it is scanned by moving optics. Such document feeders usually have several other transport functions. We will look at belt transport, skew correction, document inversion, and feed-out as separate original transport processes in such machines.

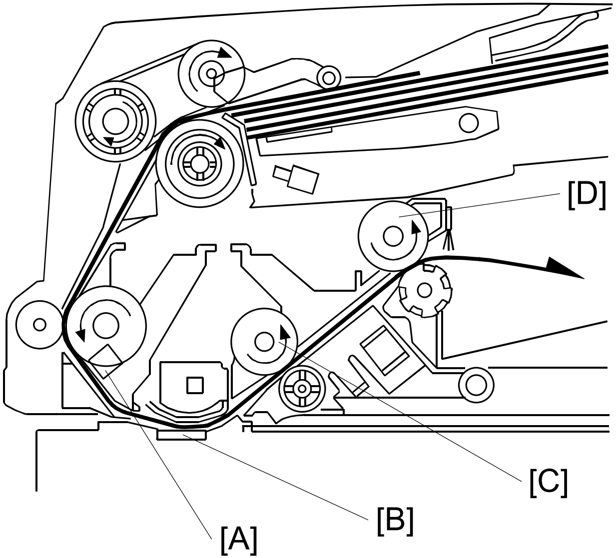
Transport Past Fixed Optics

When the optics are fixed, scanning is done by moving the document past the reading mechanism at a constant rate. This is the basic way that fax machines work, but it is also used in some multifunction machines. The basic requirements are that the paper transport speed and the distance from the document to the exposure glass both remain constant. Such document feeders are simple in design and operation. The major drawback is that they cannot easily be designed for duplexing.

Example: DF68

When the leading edge of the original reaches the registration sensor [A], the DF transport motors turn off. At the proper registration timing, the DF transport motors turn on again. The original is fed past the DF exposure glass [B], where it is scanned. The original is fed through to the 2nd transport roller [C] and fed out by the exit rollers [D].

The DF transport motor speed, while feeding the original to the registration sensor, is constant. However, when the motor turns on again to feed the original to the exposure glass, the speed depends on the selected reproduction ratio. At 100%, it is 90 mm/s.



Transport Belt

Most document feeders use a roller driven belt to position documents on the exposure glass.

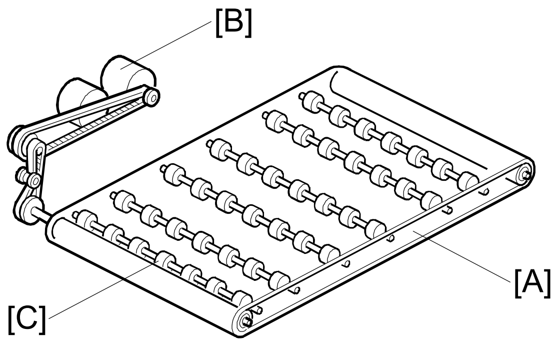
Example: Model A294

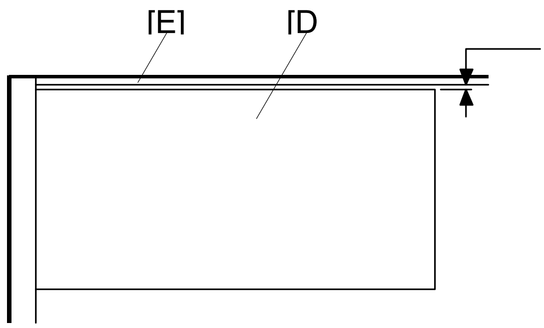
The transport belt [A] is driven by the transport belt motor [B]. The transport belt motor starts when the copier sends an original feed-in signal.

Inside the transport belt are six pressure rollers which maintain the correct pressure between the belt and original. The pressure roller [C] closest to the left original scale is made of rubber for the stronger pressure needed for thick originals. The other rollers are sponge rollers.

Normally, originals are manually placed at the left rear corner, so an original [D] fed from the DF must also be at this position. But if the original is fed along the rear scale [E], original skew, jam, or wrinkling may occur.

To prevent such problems, the original transfer position is set to 3.5 mm away from the rear scale as shown. The 3.5 mm gap is compensated for by changing the starting position of the main scan.



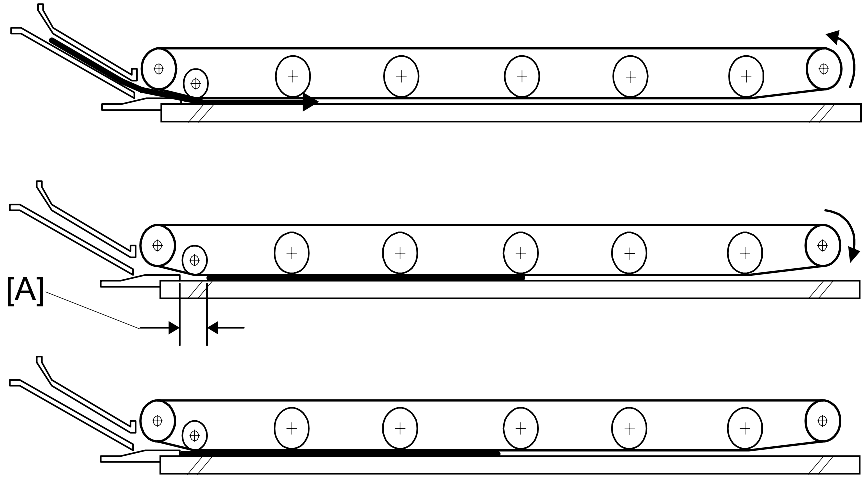


Skew Correction

Skew correction compensates for any misalignment (original skew) that occurs when the original is transported to the exposure glass by the document feeder. The original is pushed against a scale, after transport to the exposure glass, to align it properly.

Example: Model A294

The transport belt motor remains energized to carry the original about 7 mm past the left scale [A] (see the middle drawing). Then the motor stops and reverses to feed the original back against the left scale (see the bottom drawing). This forces the original to hit the left scale, which aligns the trailing edge to minimize original skew on the exposure glass.



After a two-sided original has been inverted to copy the 2nd side, it is fed in from the inverter against the left scale (see the bottom drawing; the top two drawings do not apply in this mode).

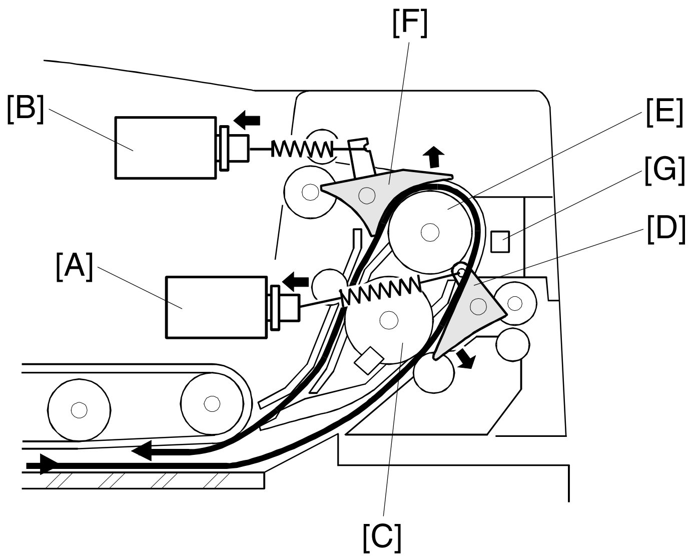
If a thin original mode is available (and is selected), skew correction does not occur. This prevents damage to the thin originals.

Original Inversion

Document feeders must invert (or turn over) documents to copy the reverse side or—with some designs—to return documents to their original order. Document feeders have various mechanisms for inverting originals. Most involve routing the document around a roller (or rollers) using solenoid-actuated gates. The example shown below is typical.

Example: Model A294

When the DF receives the original invert signal from the copier, the transport belt motor, feed-out motor, exit gate solenoid [A], and inverter gate solenoid [B] turn on and the original is fed back to the exposure glass through the inverter roller [C], exit gate [D], inverter guide roller [E], inverter gate [F], and inverter roller.
The transport belt motor turns in reverse shortly after the leading edge of the original turns on the inverter sensor [G], and feeds the original to the left scale.



Original Exit

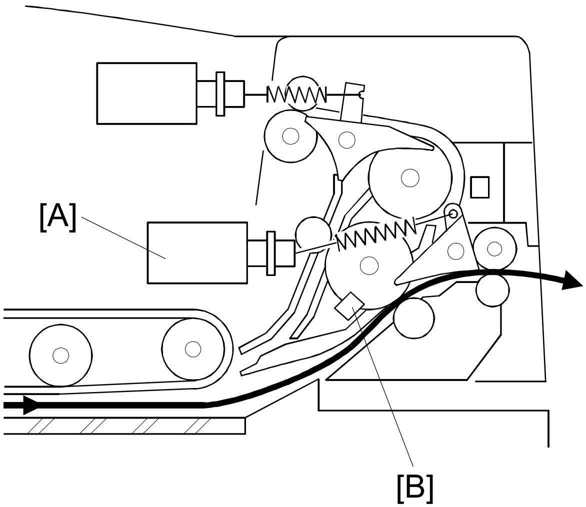
Document feeders switch gates within the exit/inverter section to direct documents to the exit tray.

Most document feeders have only one exit tray, which necessitates inverting the documents twice to keep them in proper order. However, the example below has two exit trays one for duplex mode and the other for normal mode; so, throughput can remain high with only a single inversion required in duplex mode.

Example: Model A294

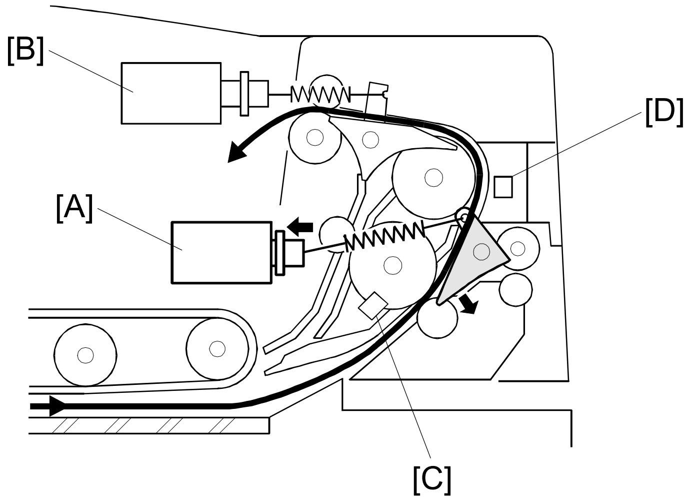
Single-sided Original Mode

The exit gate solenoid [A] remains off and the original is fed out to the right exit tray. The transport belt motor turns off after the exit sensor [B] turns off.
To stack the originals neatly on the exit tray, the feed-out motor speed is reduced about 30 mm before the trailing edge of the original turns off the exit sensor.



Double-sided Original Mode

The exit gate solenoid [A] turns on and the inverter gate solenoid [B] remains off, and the original is fed out to the upper tray. The transport belt motor turns off when the trailing edge of the original passes through the exit sensor [C].
To stack the originals neatly on the upper tray, the feed-out motor speed is reduced shortly after the trailing edge of the original turns off the inverter sensor [D].



Handling Finished Copies/Prints

Handling finished copies and prints involves sorting and stacking with various tray types (fixed, moving, and shift), as well as stapling and punching. Finished copies and prints are usually handled with a finishing or sorting unit. All finishing and sorting units do not have the same functions, but generally there is some sort of stacking and sorting on all basic units with stapling and punching as added features.

This section will discuss sorting and stacking using the various tray types, stapling and punching processes, and the exiting of the finished copy or print.

Sorters and finishers can be categorized into three basic types as follows:

- Those using fixed position trays or bins. These machines move the finished copies to the appropriate bin after it exits the copier.
- Those using moving bins. These move the trays to the copier exit at the appropriate time to receive the copy as it exits the copier.
- Those using shift trays.

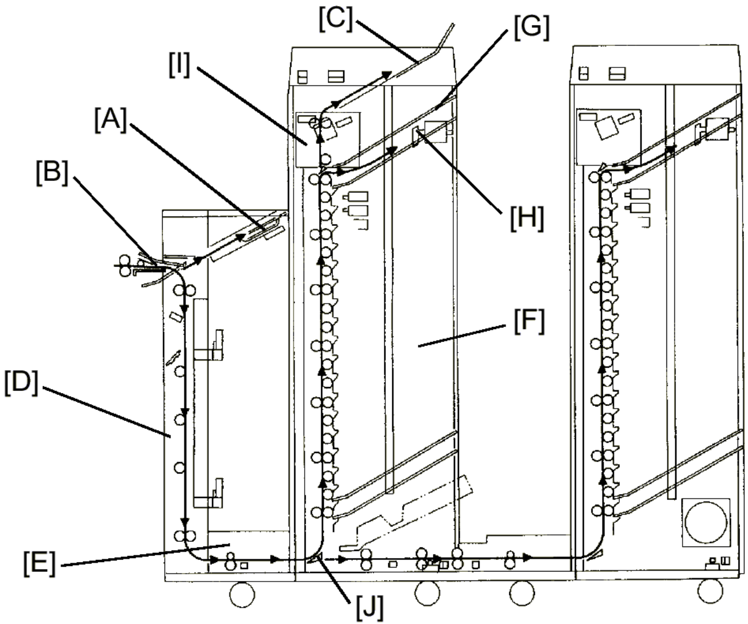
The following pages cover examples of each type.

Sorting/Stacking with Fixed Trays

Machines that Sort and Stack with Fixed Trays are usually medium or high speed machines. In fixed-tray sorters, the copies are moved to the trays after exiting the copier by belts or rollers. Fixed trays tend toward Analog machines rather than Digital ones.

Example: Model ST23

The general concept of the fixed tray has the print or copy transported individually to an exit tray (usually one of many), which does not move, through a series of rollers. Transportation is usually by a vertical, diagonal [D] and/or horizontal transport unit [E] with a distribution unit [F] that contains distribution rollers, and bin gates operated by bin solenoids.



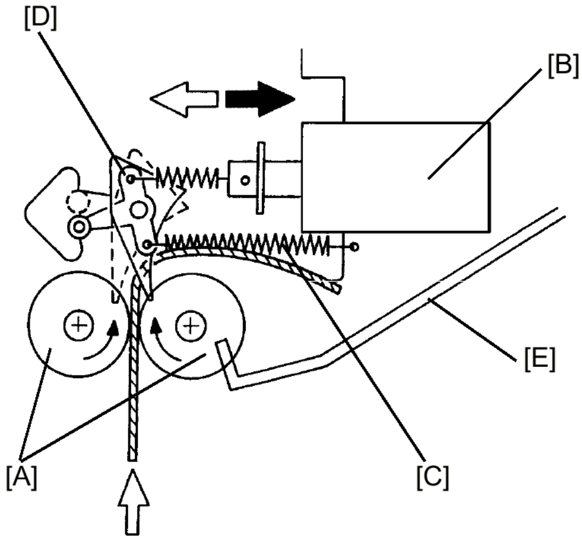
The Sorter Mechanism

Example: Model ST23

Copies exiting the copier enter the sorter. They are then delivered to the bins in order. The jogger arm arranges the copies in the bins. The distribution section has the distribution rollers [A], bin gates, and bin solenoids.

When a bin gate solenoid [B] is off, the return spring [C] holds the bin gate [D] out of the paper path, allowing the copies to pass to the upper bin.

The appropriate bin gate solenoid turns on and opens the bin gate. The other solenoids are off. The copies go to the bin [E] through the gate.

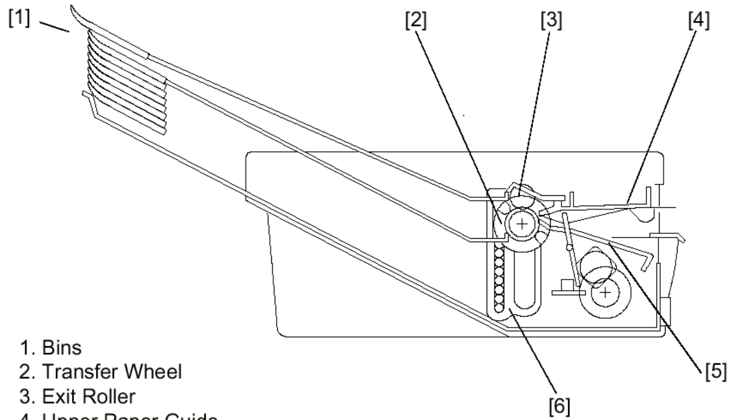


Sorting/Stacking with Moving Trays

Sorters with Moving Trays tend to be smaller and less expensive. They are used with lower-end models. These machines usually have one of two types of mechanisms for moving trays—wheel drive or screw drive (sometimes called a helical wheel).

Wheel Drive

The bin drive mechanism moves the bins up and down to receive copies or prints. This movement is made by a wheel mechanism that is explained in the following example.



1. Bins
2. Transfer Wheel
3. Exit Roller
4. Upper Paper Guide
5. Lower Paper Guide
6. Bin Guide

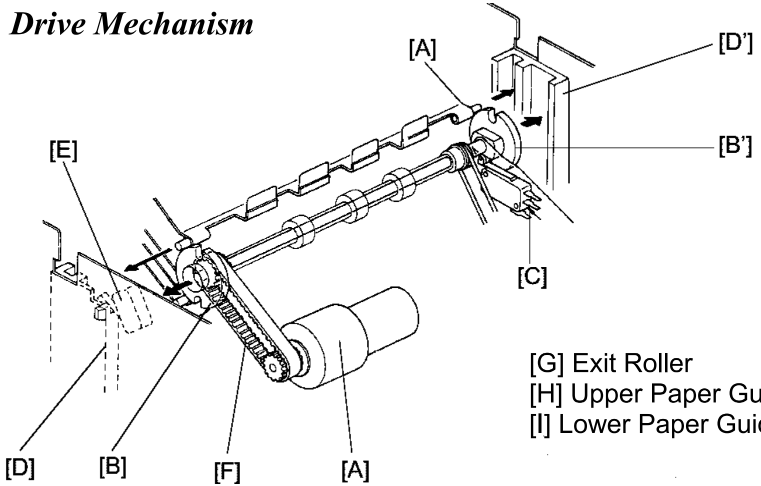
Example: Model CS130

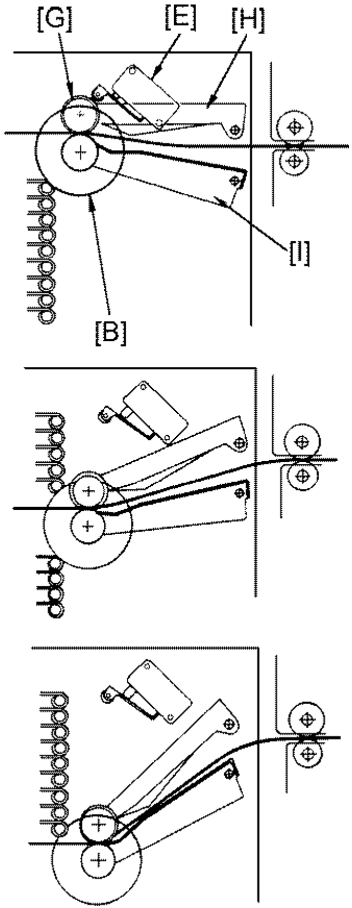
Basic Operation

- Sort Mode –In this mode, all copies of the first original are delivered to separate bins starting from the top. The copies of the second original are delivered to the same bins, but starting from the bottom. The copies of the third original start from the top and so on. At 250 milliseconds after the copy has gone through the paper sensor, the bin drive motor turns on to advance the bin one step.

- Stack Mode –In this mode, all copies of the first original are delivered to the first bin, all copies of the second original are delivered to the second bin, and so on. At 250 milliseconds after the last copy of the original has gone through the paper sensor, the bin drive motor turns on to advance the bin one step.

Bin Drive Mechanism





[G] Exit Roller
[H] Upper Paper Guide
[I] Lower Paper Guide

The bin drive mechanism moves the bins up and down to receive copies under the direction of the copier CPU. The main components in this mechanism are the bin drive motor [A], two transfer wheels [B,B'], the wheel switch [C], and the bins themselves.

Pins on either side of each bin are inserted into slots called bin guides [D,D']. The bins slide up and down in the bin guides. The bins sit on each other with the lower bin resting on the 10th bin (the 10th bin is permanently fixed in position). The upper and lower paper guides pivot up and down depending on the height of the bin to be picked up or released.

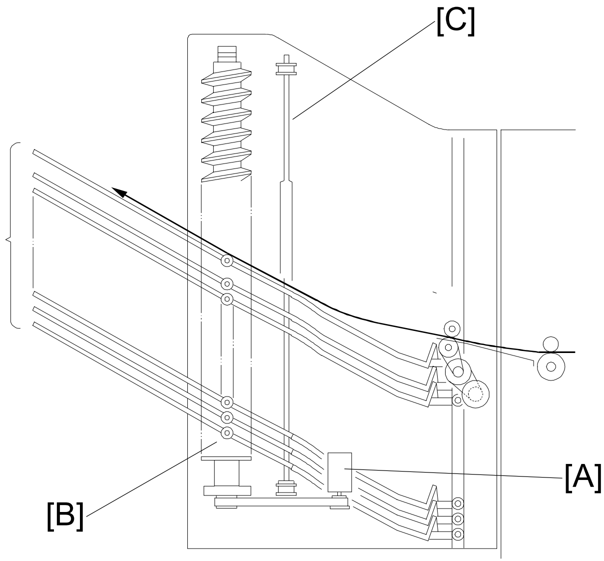
Screw Drive (helical wheel drive)

Screw drive provides a bin drive mechanism that is more robust than the wheel drive method and is suitable for heavier workloads.

Example: Model ST10

Basic Operation

When sort mode is selected, the bin drive motor [A] energizes to rotate the helical wheels. The helical wheels [B] rotate twice to move the top bin to the transport roller position, then the first copy is delivered to the top bin.



After the first copy of the first original has been fed to the top bin, the bin drive motor moves the bins up one step (the helical wheels rotate once) so that the second copy of the first original will be delivered to the next bin. The jogger plate [C] squares the copies after each copy has been fed to a bin. After the copies of the first original have been delivered to each bin, the sorter stapler maintains its status (the bin drive motor does not rotate). The first copy of the second original is delivered to the final bin that was used for the first original, then the final bin descends one step. The bins descend each time a copy of the second original is delivered.

The direction of motion of the bins alternates for each page of the original until the copy run is finished.

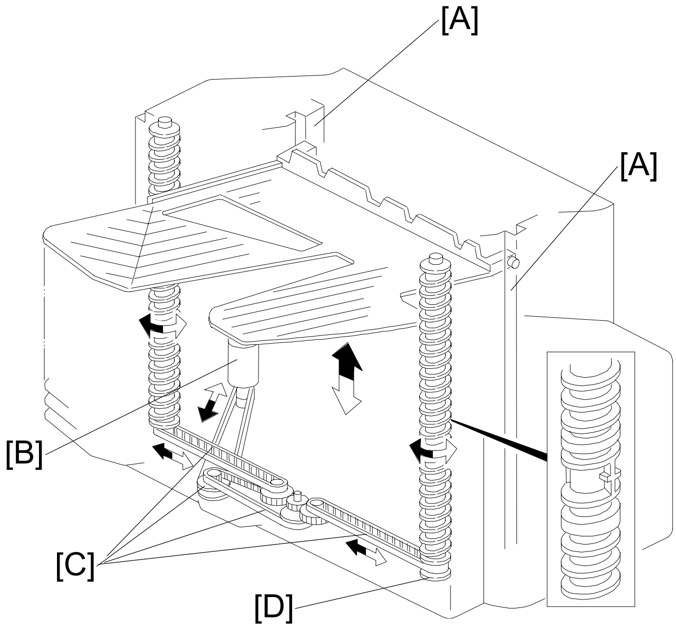
Stack mode is similar to sort mode. However, the bins move upward only.

Bin Drive Mechanism

The bin drive mechanism moves the bins up and down to receive copies.

There are four pins on each bin. Two pins fit into the slots [A] in both the front and rear side frames; the pins slide up and down in these slots. The other two pins fit into the slot in the helical wheels; as the helical wheels turn, these pins move up and down, and the other pins move up and down in the slots at the other end of the bin.

The bin drive motor [B] drives the helical wheels through four timing belts [C]. When the motor rotates clockwise, the bins lift; when it rotates counterclockwise, the bins lower. There is a wheel sensor actuator [D] on the front helical wheel; the



actuator has a slot that detects when the helical wheel has rotated once.

When the bins are advanced, the helical wheels rotate once for each step. As the pitch of the spiral on the helical wheel is greater when the bins are at the staple and paper exit area than when the bins are elsewhere, the amount of bin shift is greater when the bins are at the staple and paper exit area. This leaves enough space to staple and stack the copies. Also, this reduces the total machine height.

Sorting/Stacking with Shift Trays

Machines with Shift trays tend toward medium-sized, middle segment to upper segment machines. Recently, most digital machines are using this type of tray. Shift trays usually have up/down and side-to-side movement. This facilitates the sorting and stacking of copies or prints. The up/down movement allows for a large number of copies to stack in the shift tray. The side-to-side movement separates sets of copies by alternating the position of the shift tray for each set.

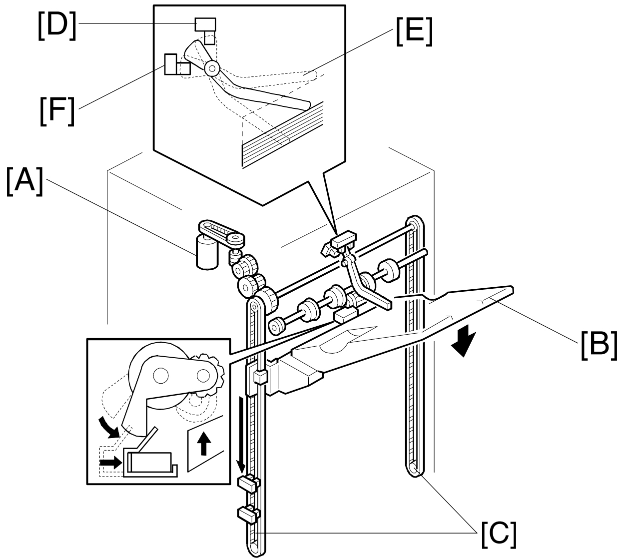
Example: SR810 Finisher

Up/Down Movement

The shift tray lift motor [A] controls the vertical position of the shift tray [B] through gears and timing belts [C]. When the main switch is turned on, the tray is initialized at the upper position. The tray is moved up until stack height sensor 1 [D] is de-actuated.

As paper feeds into the tray the stack height feeler [E] raises; when it actuates stack-height sensor 2 [F] the shift tray lift motor lowers the shift tray. (Exact timing and amount of movement depends on the mode. See the SR810 service manual for more details.)

The shift tray rises until stack height sensor 1 is de-actuated when the user takes the stack of paper from the shift tray.

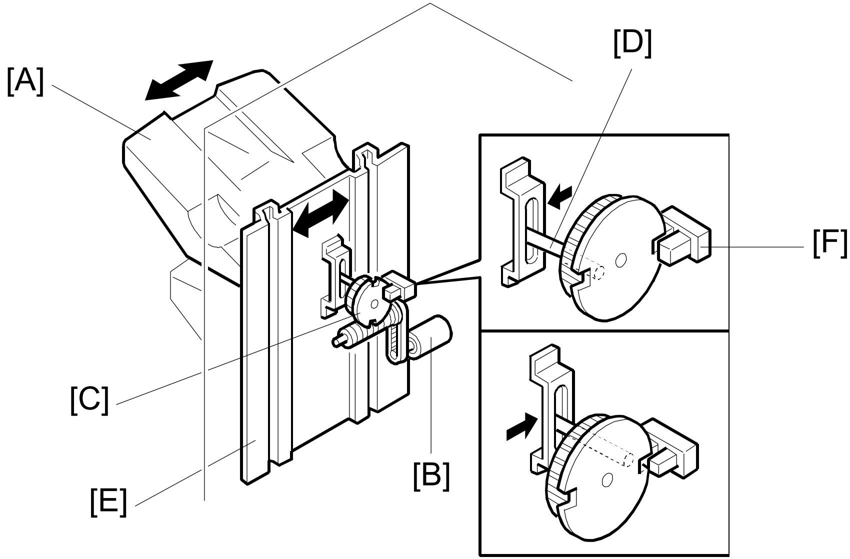


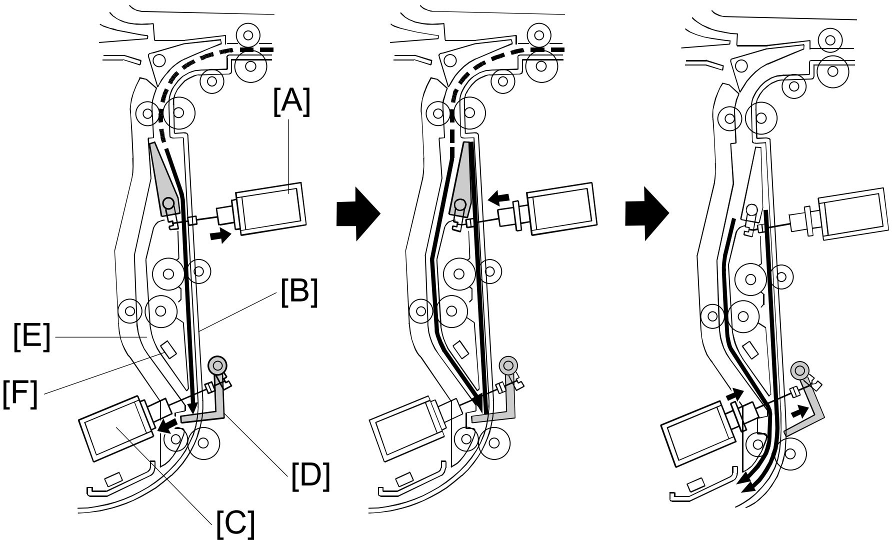
Side-to-Side Movement

In sort/stack mode, the shift tray [A] moves from side to side to separate the sets of copies.

The horizontal position of the shift tray is controlled by the shift motor [B] and shift gear disk [C]. After one set of copies is made and delivered to the shift tray, the shift motor turns on, driving the shift gear disk and the shaft [D]. The shaft positions the end fence [E], creating the side-to-side movement.

When the shift gear disk has rotated 180 degrees (when the shift tray is fully shifted across), the cut-out in the shift gear disk turns on the shift tray half-turn sensor [F] and the shift motor stops. The next set of copies is then delivered. The motor turns on, repeating the same process and moving the tray back to the previous position.





Paper pre-stacking

This mechanism improves productivity in staple mode.

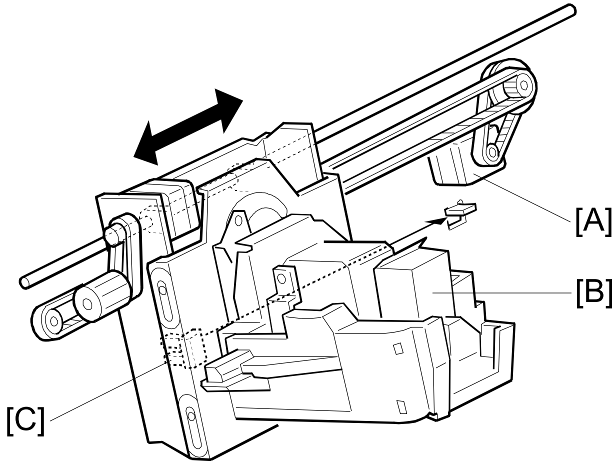
During stapling, the copier has to wait. This mechanism reduces the wait by holding the first two sheets of a job while the previous job is still being stapled. It only works during the second and subsequent sets of a multi-set copy job.

The pre-stack junction gate solenoid [A] turns on about 230 ms after the 1st sheet of paper turns on the entrance sensor, and this directs the sheet to the pre-stack tray [B]. (This sheet cannot be fed to the stapler yet, because the first set is still being stapled.) The pre-stack paper stopper solenoid [C] turns on about 680 ms after the 1st sheet turns on the entrance sensor. The pre-stack paper stopper [D] then stops the paper.

The pre-stack junction gate solenoid turns off 450 ms after the trailing edge of the 1st sheet passes through the entrance sensor, and the 2nd sheet is sent to the paper guide [E]. The pre-stack paper stopper is released about 50 ms after the 2nd sheet turns on the pre-stack stopper sensor [F], and the two sheets of copy paper are sent to the stapler tray. All sheets after the 2nd sheet go to the stapler tray via the paper guide [E].

Stapling and Punching

Stapling and punching go through a fairly set process. The copies are collected in a bin, stack correction occurs so that all of the copies are aligned properly for the punch and staple units, and finally the stapler and/or punch moves to one of usually three positions for stapling and/or punching. After stapling/punching is complete, the document is transported to the exit tray.



Example: SR810 Finisher

Stapler Unit

The stapler motor [A] moves the stapler [B] from side to side. After the start key is pressed, the stapler moves from its home position to the stapling position.

If two-staple-position mode is selected, the stapler moves to the front stapling position first, then moves to the rear stapling position. However, for the next copy set, it staples in the reverse order (at the rear side first then at the front side).

After the job is completed, the stapler moves back to its home position. This is detected by the stapler HP sensor [C].

Punch Unit

The punch unit makes 2 or 3 holes (depending on the type of punch unit) at the trailing edge of the paper.

The punch unit is driven by the punch motor [A]. The punch motor turns on 78 ms after the trailing edge of the paper passes through the entrance sensor [B], and makes the punch holes.

The home position is detected by the punch HP sensor [C]. When the cut-out in the punch shaft gear disk [D] enters the punch HP sensor, the punch motor stops.