

[54] SHEET STRIPPING DEVICE  
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[57] ABSTRACT

[21] Appl. No.: 251,909

A device comprising a plurality of separators each pivotally supported at the base and formed at the free end with a sheet pick-off claw and a sheet guide lip contiguous with the claw. The sheet pick-off claws are adapted to be brought into engagement with the peripheral surface of a drum to pick off the leading end of a sheet electrostatically adhering to the peripheral surface of the drum, and the leading end of the sheet thus picked off is brought into abutting engagement with the sheet guide lips to push and move the lips as the drum rotates. The separators move in pivotal motion as successive portions of the sheet are separated from the peripheral surface of the drum in a direction in which the sheet pick-off claws are brought out of engagement with the drum and the sheet is guided by the lips to change the direction of its movement and move away from the separators toward capture and conveyor means.

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[52] U.S. Cl. .... 271/80, 271/DIG. 2  
 [51] Int. Cl. .... B65h 29/56  
 [58] Field of Search ..... 271/DIG. 2, 80, 51, 64, 271/18, 53, 52, 81, 82

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13 Claims, 10 Drawing Figures

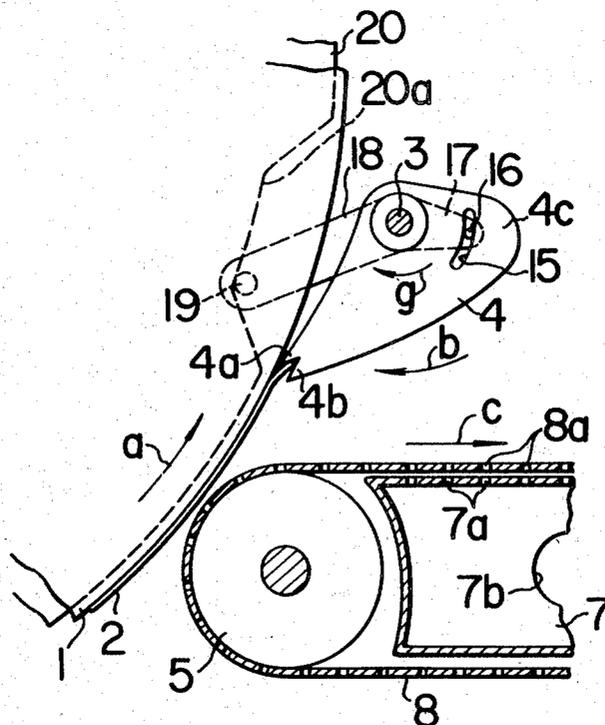


FIG. 1

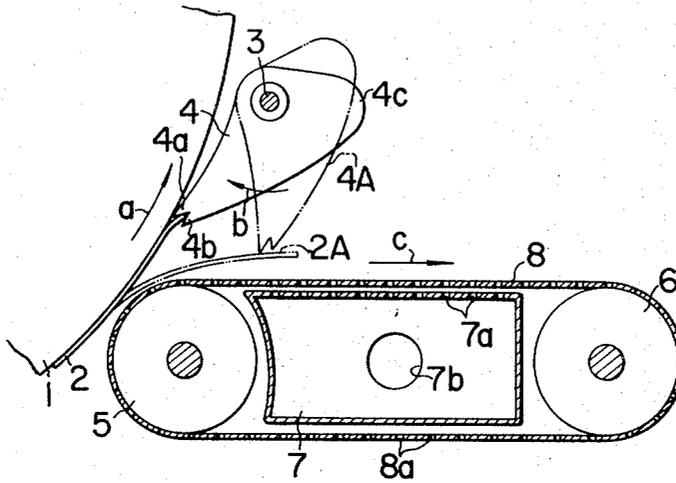


FIG. 2

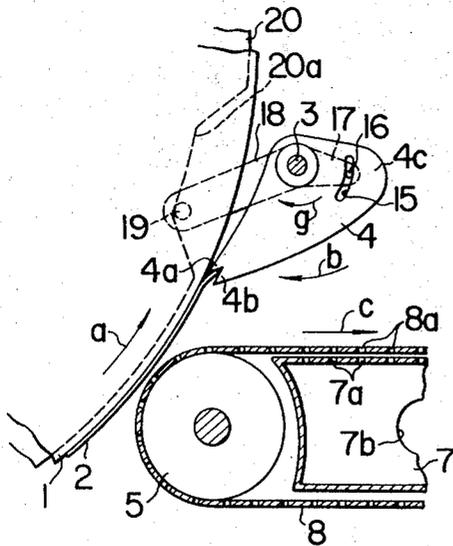


FIG. 3

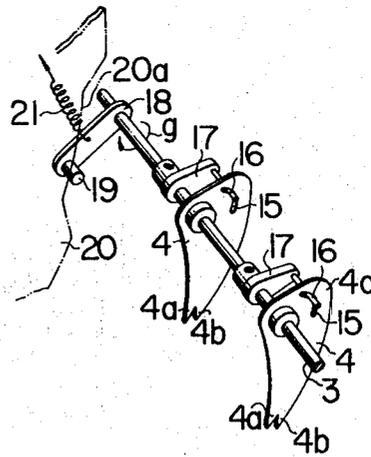


FIG. 4

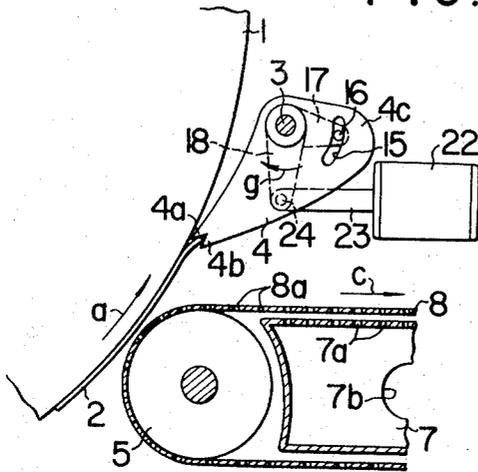


FIG. 5

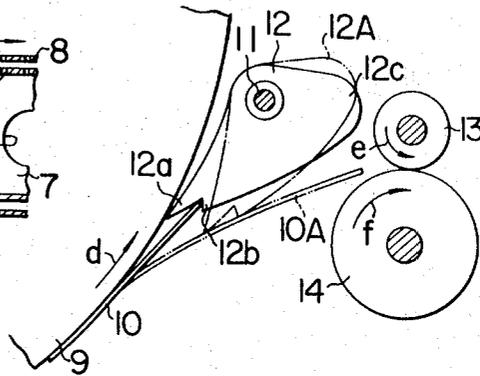


FIG. 6

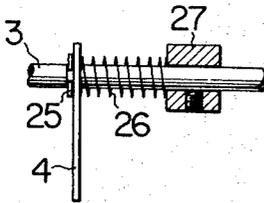


FIG. 7

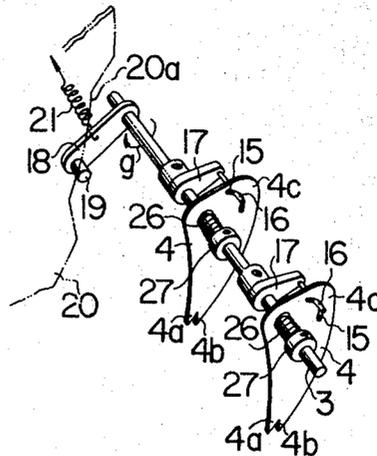


FIG. 8

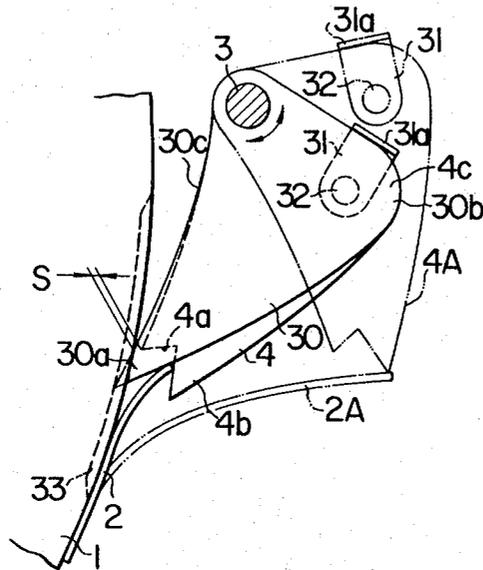


FIG. 9

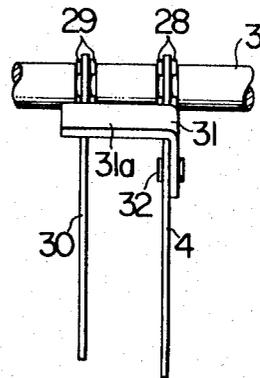
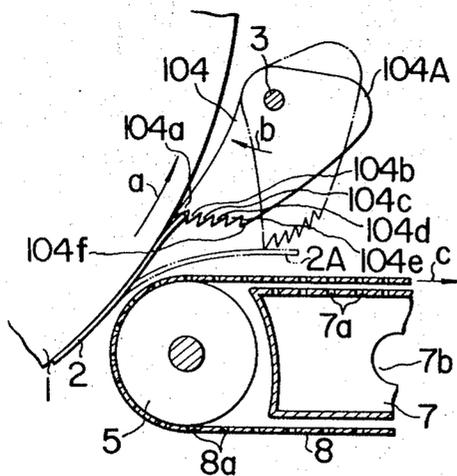


FIG. 10



## SHEET STRIPPING DEVICE

## BACKGROUND OF THE INVENTION

This invention relates to a sheet stripping device adapted to automatically separate from the peripheral surface of a drum a sheet electrostatically adhering thereto.

In electrophotographic apparatus of the so-called transfer printing type, an electrostatic latent image or a toner image formed on the peripheral surface of a photosensitive drum (hereinafter referred to as a drum) having a peripheral photoconductive material layer is printed on a sheet of insulating recording paper or ordinary paper (hereinafter referred to as a sheet) by bringing the sheet into pressing engagement with the peripheral surface of the drum, by performing a corona discharge while the sheet is maintained in engagement with the peripheral surface of the drum or by bringing the sheet into contact with the peripheral surface of the drum electrostatically. In such apparatus, each sheet electrostatically adheres to the peripheral surface of the drum, so that means should be provided to separate the sheet therefrom without damaging the peripheral surface of the drum.

Conventional devices to accomplish the aforementioned object include a plurality of strippers each provided with a claw adapted normally to engage the peripheral surface of the drum to separate each sheet therefrom, and a suction drum disposed in the vicinity of the peripheral surface of the drum to separate the sheet from the drum by suction.

The former is required to have a sheet guide contiguous with the claws for guiding the sheet in its movement away from the drum. When no suction means is provided, the surface of the sheet on which the image is printed tends to be scratched and damaged by the sheet guide over a wide area because difficulty is experienced in deflecting the sheet away from the path along the sheet guide. The latter is free from the danger of damaging the sheet, but a pump of very high force need be used to provide a sufficiently high suction force to separate the sheet from the peripheral surface of the drum. If the suction force is not high, it will not be possible to separate the sheet from the peripheral surface of the drum.

## SUMMARY OF THE INVENTION

An object of this invention is to provide a sheet stripping device comprising a plurality of separators made of metal or a synthetic resinous material each pivotally supported at the base and formed at the free end with a sheet pick-off claw and a sheet guide lip contiguous with the claw. The sheet pick-off claws are adapted to be brought into engagement with the peripheral surface of a drum to pick off the leading end of a sheet electrostatically adhering to the peripheral surface of a drum and separate successive portions of the sheet therefrom. The leading end of the sheet separated from the peripheral surface of the drum in this way is brought into abutting engagement with the sheet guide lips and moves the separators in pivotal motion as the successive portions of the sheet are separated from the drum, so that the pick-off claws are brought out of engagement with the peripheral surface of the drum and the sheet is guided by the lips to change the direction of its movement. If means for catching the leading end of the

sheet and transporting the sheet is provided, the sheet which has the direction of its movement changed by the separators will be conveyed by this means while the separators are restored to the original positions in which the sheet pick-off claws are maintained in engagement with the peripheral surface of the drum. Thus, it is only the leading end of the sheet that is scratched by the rear edges of the sheet pick-off claws and no other portion of the surface thereof is scratched by any parts.

Another object of the invention is to provide a sheet stripping device which is provided with means to prevent the sheet pick-off claws from impinging on the peripheral surface of the drum when the separators are restored to the original positions after the direction of movement of the sheet is changed, so that damage to the drum can be precluded. The end can be attained according to this invention by reducing the force with which the separators are restored to the original positions or limiting the range of return movement itself. Thus, the invention is effective to prevent deep holes from being formed on the peripheral surface of the drum as a result of the sheet pick-off claws periodically impinging on the same place on the peripheral surface of the drum in their return movements.

Another object of the invention is to provide a sheet stripping device which is formed with a plurality of sheet guide lips in each separator so that the sheet may be positively guided thereby to move away from the separators. Thus, the invention is effective to positively separate and guide the leading end of the sheet even if the leading end of the sheet buckles up away from the peripheral surface of the drum.

Other and additional objects as well as features and advantages of the invention will become evident from the description set forth hereinafter when considered in conjunction with the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view of one embodiment of the sheet stripping device comprising one form of separators according to this invention;

FIG. 2 is a sectional view showing the rotation of means for actuating the separators of FIG. 1 in synchronism with the rotation of the drum;

FIG. 3 is a perspective view of the sheet stripping device comprising the separators of FIG. 1 showing their arrangement;

FIG. 4 is a sectional view showing another means for actuating the separators in synchronism with the rotation of the drum;

FIG. 5 is a sectional view of another embodiment of the invention comprising separators distinguished from the separators of FIG. 1;

FIG. 6 is a plan view of one form of restoring force reducing means;

FIG. 7 is a perspective view of the sheet stripping device provided with restoring force reducing means;

FIG. 8 is a side view of another form of restoring force reducing means;

FIG. 9 is a fragmentary rear end view of the restoring force reducing means shown in FIG. 8; and

FIG. 10 is a side view of still another embodiment of the sheet stripping device according to the invention.

## DESCRIPTION OF PREFERRED EMBODIMENTS

In FIG. 1, a drum 1 is adapted to rotate in the direction of an arrow *a*, and a sheet 2 on which an electrostatic latent image or toner image has been printed from the drum 1 electrostatically adheres to the peripheral surface thereof. A plurality of separators 4 of a number suiting the width of the sheet 2 each formed of a thin sheet of a metal or synthetic resinous material are disposed in the vicinity of drum 1, each separator 4 being pivotally supported at the base by a shaft 3 and formed at the front end with a sheet pick-off claw 4*a* and a lip 4*b* for guiding the sheet which is contiguous with the claw 4*a*.

The claw 4*a* of each separator 4 is normally maintained in engagement with the peripheral surface of drum 1 by the tendency of a shoulder 4*c* of separator 4 projecting rightwardly in the figure to move angularly in the direction of an arrow *b*. It is to be understood that a spring may be employed to urge the sheet pick-off claw 4*a* into engagement with the peripheral surface of drum 1.

The leading end of sheet 2 adhering to the peripheral surface of drum 1 rotating in the direction of arrow *a* is picked off by the claws 4*a* of separators, and the leading end of sheet 2 is brought into abutting engagement with lips 4*b* as drum 1 rotates to push and move the lips as the drum 1 rotates.

The separators 4 having lips 4*b* pushed and moved by the leading end of sheet 2 angularly rotate in a direction opposite to the direction of arrow *b* as successive portions of sheet 2 are separated from the peripheral surface of drum 1 till they move to dash-and-dot line positions 4*A*, so as to cause the leading end of the sheet to move to a dash-and-dot line position 2*A*.

The dash-and-dot line position 2*A* is disposed above capture and conveyor means comprising a suction box 7 disposed between the upper and lower runs of an endless belt 8 trained about belt rollers 5 and 6. The sheet 2 disposed in position 2*A* is drawn by suction into contact with the upper run of endless belt 8 and placed thereon. Since endless belt 8 rotates in the direction of an arrow *c*, the sheet is conveyed to the next following device, such, for example, as a developing or fixing device (not shown).

Suction box 7 is formed with a multiple of small openings 7*a* in the upper surface and maintained in communication with a suction pump (not shown) through a port 7*b*. Endless belt 8 may consist of a plurality of belts of a small width formed therein with a number of suction openings 8*a* as shown in FIG. 1 or a single large width belt formed therein with a multitude of suction openings. Alternatively, a plurality of small width belts having no suction openings may be mounted such that they are spaced apart from one another a small distance and the suction openings 7*a* of suction box 7 are arranged in rows each disposed in one of the spaces between the belts.

The capture and conveyor means may consist of a pair of conveyor rollers maintained in pressing engagement with each other as shown in FIG. 5, in place of the suction box 7 and endless belt 8 shown in FIG. 1. In FIG. 5, a sheet 10 adhering to a drum 9 is picked off by separators 12 each pivotally supported by a shaft 11 and formed at the free end with a sheet pick-off pawl 12*a* and a sheet guide lip 12*b*, the separators being adapted to move in pivotal motion as drum 9 rotates in

the direction of an arrow *d*. When separators 12 pivot to dash-and-dot line positions 12*A*, the leading end portion of sheet 10 is disposed in a dash-and-dot line position 10*A*. A pair of conveyor rollers 13 and 14 rotating in the directions of arrows *e* and *f* respectively while being maintained in pressing engagement with each other are disposed in position 10*A*, so that the leading end portion of sheet 10 is nipped by rollers 13 and 14 to be caught and conveyed to the next following device.

The separators according to this invention are capable of picking off the leading end of the sheet and moving the sheet away from the separators as successive portions of the sheet are separated from the drum as aforementioned. Thus, if the aforementioned capture and conveyor means is arranged along the path of movement of the sheet, the sheet can be moved away from the separator without providing additional suction means for changing the direction of movement of the sheet and the separators can be returned to the original positions as soon as the sheet is released from engagement therewith, thereby permitting to minimize the scratching of the sheet by the separators. It should be noted that no other known separators have hitherto been capable of performing the function of releasing the sheet from engagement with the drum, changing the direction of its movement and releasing itself from engagement with the sheet so that the sheet may not be scratched by the separators.

Two separators shown and described in FIG. 1 are normally maintained in engagement with the peripheral surface of the drum. Two embodiments of the separators which are adapted to be brought into engagement with the drum only when the sheet is picked off will now be described with reference to FIG. 2 to FIG. 4. If the separators are brought into engagement with the drum only when the sheet is picked off, it will be possible completely to preclude the damage to the periphery of the drum which might otherwise be caused. The parts shown in FIG. 2 to FIG. 4 and designated by the same reference numerals as the parts shown in FIG. 1 have similar constructions and operate in like manner.

In FIG. 2 and FIG. 3, separators 4 are pivotally supported by shaft 3. Each separator 4 is formed in a shoulder 4*c* with a slot 15 in which is received one end portion of a pin 16 which is attached at the other end to a free end of an arm 17 disposed adjacent each separator 4 and supported by shaft 3. Shaft 3, which is rotatably supported at opposite ends to immovable parts (not shown), has an elongated arm 18 secured at one end thereof to one end portion of shaft 3. Attached to the other end of elongated arm 18 is a pin 19 which bears at a free end thereof against the peripheral surface of a cam 20 formed integrally with drum 1. A spring 21 shown in FIG. 3 may be mounted on elongated arm 18 to urge the free end of pin 19 into pressing engagement with the peripheral surface of drum 1 as shaft 3 rotates in the direction of an arrow *g*.

When pin 19 is maintained in pressing engagement with a major diameter portion of cam 20, the upper end portions of slots 15 are moved upwardly by pins 16 and consequently the free ends of separators 4 are released from engagement with the peripheral surface of drum 1.

Cam 20 is formed with a minor diameter portion 20*a* in a position which corresponds to the position of the

leading end of sheet 2 adhering to drum 1. If pin 19 is brought into engagement with minor diameter portion 20a, pins 16 will move downwardly in slots 15 to render separators 4 free and permit the same to be brought into pressing engagement at the free ends with the peripheral surface of drum 1 to perform a sheet separating operation.

The use of cam 20 permits separators 4 to be actuated and brought into engagement with drum 1 in synchronism with the operation of drum 1. In place of using cam 20, an electromagnet 22 adapted to be energized when the leading end of sheet 2 is indexed with the pick-off position may be used to attain the same end.

In FIG. 4, an electromagnet 22 is shown as having an actuator 23 to which is pivotally connected elongated arm 18 through a shaft 24. When electromagnet 22 is de-energized, elongated arm 18 is pivoted in a direction opposite to the direction of arrow g. When elongated arm 18 is in this position, pins 16 push and move the upper end edges of slots 15 upwardly, so that the free ends of separators 4 are released from engagement with the peripheral surface of drum 1.

If electromagnet 22 is energized, actuator 23 will be moved away from electromagnet 22 and move elongated arm 18 in pivotal motion in the direction of arrow g. Elongated arm 18 is maintained in this position by continuous energization of electromagnet 22, so that pins 16 move slightly downwardly in slots 15 to permit separators 4 to pivot freely. Thus, by energizing electromagnet 22 when the leading end of sheet 2 is indexed with the pick-off position separators 4 bring the pick-off claws 4a into engagement with the peripheral surface of drum 1 only when the sheet 2 is to be separated from drum 1.

Any other known means may be used to actuate separators 4 and bring sheet pick-off claws 4a into engagement with the peripheral surface of drum 1 only when the sheet is to be separated from the periphery of drum 1.

The sheet stripping device provided with restoring force reducing means for the separators according to this invention will now be described with reference to FIG. 6 to FIG. 8. The parts shown in FIG. 6 to FIG. 8 and designated by the same reference numerals as the parts shown in FIG. 1 to FIG. 5 have similar constructions and operate in like manner.

In FIG. 7, separators 4 are pivotally supported by shaft 3, each separator 4 being held on one side by a stopper 25 (E-ring, for example) while a coil spring 26 held at its rear end by a collar 27 mounted on shaft 3 bears at its front end against the other side of each separator 4 as shown in detail in FIG. 6. Each coil spring 26 exerts on the respective separator 4 a frictional force sufficiently great to reduce the restoring force with which the pick-off claw 4a of separator 4 returns toward the periphery of drum 1 after the separators are released from engagement with the sheet 2 which has changed the direction of its movement. Coil springs 26 may be plate springs of the ring shape or any other suitable friction members.

The provision of restoring force reducing means according to this invention permits pick-off claws 4a to be brought into engagement with the periphery of drum 1 with a low force, thereby precluding damage to the periphery of drum 1 which might otherwise be caused by claws 4a striking the drum. When such restoring force

reducing means is provided, the speed at which pick-off claws 4a are restored to positions in which they are in engagement with the peripheral surface of drum 1 is reduced. However, since it is about 1 to 4 seconds later that the next following sheet is brought into index with this position, there is no trouble involved in performing the stripping operation satisfactorily.

The restoring force reducing means for the separators may be in the form of stoppers instead of springs or friction members as aforementioned. The use of stoppers permits a restoring force to be drastically reduced. In FIG. 8 and FIG. 9, a plurality of separators 4 each pivotally supported by shaft 3 through an E-ring 28 are each provided with a pick-off claw member 30 firmly secured to shaft 3 and formed at its front end with a pick-off claw 30a shown as being fully in engagement with the peripheral surface of drum 1. Each separator 4 has secured to its shoulder 4c by a rivet 32 a stopper 31 formed by bending a plate and including an arm 31a which extends at right angles to pick-off claw member 30 and disposed above a shoulder 30b of member 30.

The claw 4a of each separator 4 is spaced apart from the peripheral surface of drum 1 a distance S which is smaller than the thickness of the sheet when arm 31a is in engagement with pick-off claw member 30. A portion of the peripheral surface of drum 1 in which the leading end of each sheet is picked off is formed with a plurality of grooves 33 of a small depth which correspond in position to the claws 30a of member 30. The leading end of each sheet is picked off by the claws 30a of members 30 which drop into respective grooves 33 each time drum 1 makes one complete revolution. After the leading end of the sheet is picked off in this way, separators 4 function in the same manner as described previously so as to change the direction of movement of the sheet and cause the same to move toward capture and conveyor means.

When each separator 4 returns to its original position from a dash-and-dot line position 4A after being released from the sheet, each arm 31a is brought into engagement with respective pick-off claw member 30 which is firmly fixed to shaft 3 as aforementioned so as to thereby cause each separator 4 to stop in a solid-line position as shown, thereby precluding the impinging of claws 4a on the peripheral surface of drum 1. Experiments have shown that the use of this means is effective to prevent the claws from impinging on the drum.

Each stopper 31 may be secured to a front side 30c of each member 30 to cause each separator 4 to stop. In the embodiment shown, pick-off claw members 30 may be eliminated and pins, plates or other members which can serve as the shoulders 30b of members 30 may be used instead. When this is the case, the separators may be brought into and out of engagement with the peripheral surface of drum 1 by means substantially similar to the means described with reference to FIG. 3.

From the foregoing description, it will be appreciated that the sheet stripping device provided with restoring force reducing means according to this invention permits each sheet to be separated completely from the drum while preventing damage to the peripheral surface of the drum which might otherwise be caused by the pick-off claws impinging thereon.

FIG. 10 shows the sheet stripping device provided with a plurality of separators 104 each formed with a

plurality of lips. In the figure, separator 4 is shown as being formed with lips 104b, 104c, 104d, 104e and 104f which are contiguous with a claw 104a. If the leading end of a sheet to be stripped off were buckled up away from the drum, the leading end of the sheet would not come into engagement with the single lip and might move in an unexpected direction. In worst cases, the sheet might find its way into the heater of the fixing device to cause a fire to break out. The provision of a plurality of lips can obviate this problem, because the buckled leading end of the sheet will be brought into engagement with one of such lips, so that the device can function positively and the aforementioned problem can be obviated. Separators 104 are made of the same material as the separators 4 described previously.

What we claim is:

1. A sheet stripping device for removing copy sheets from the surface of a rotating electrophotographic drum comprising:

- a. a rotatable shaft disposed parallel to the axis of said drum;
- b. a plurality of separators, each having one end pivotally supported on said shaft and biased by its own weight to cause its free end to be brought into engagement with the peripheral surface of the drum, which free end comprises:
  - i. a pick-off claw for engagement with the peripheral surface of the drum to pick off a leading end of a copy sheet thereon; and
  - ii. a lip portion contiguous with said pick-off claw for engagement with and guiding the leading end of a copy sheet picked off by said claw;
- c. means for synchronizing the rotational movements of said shaft with the rotation of the drum such that said shaft is rotated just before the leading end of a copy sheet reaches a pick-off position during drum rotation;
- d. coupling means acting between said shaft and said separators for restraining said separators at a standby position from dropping into engagement with the peripheral surface of the drum until said shaft is rotated in response to said synchronizing means;
- e. sheet capture and conveyer means disposed substantially below the plurality of separators, so that when the drum rotates and the leading end of the sheet adhering to the peripheral surface of the drum is brought to said pick-off position said pick-off claws are dropped into engagement with the peripheral surface of the drum and the leading end of the sheet is picked off by the claws and brought into abutting engagement with the lip portions whereby the separators are moved in pivotal motion away from the drum as the lip portions guide the sheet and change the direction of movement of the leading end of the sheet to direct the sheet toward said capture and conveyer means.

2. A sheet stripping device as set forth in claim 1 wherein said synchronizing means comprises a cam mounted for rotation with the drum, and an elongated arm firmly secured to the shaft acting as a follower of said cam.

3. A sheet stripping device as set forth in claim 1 wherein said coupling means comprises a plurality of slots, one being formed in each of said separators, a plurality of arms mounted on the supporting shaft for

rotation therewith and one being disposed adjacent each of said separators, and a plurality of pins, one each being attached at one end to one of said arms and having its other end extending through said slot.

4. A sheet stripping device as set forth in claim 1 wherein said synchronizing means comprises an electromagnet, and an elongated arm firmly secured to the shaft supporting the separators and coupled to said electromagnet.

5. A sheet stripping device as set forth in claim 1 wherein said sheet capture and conveyer means comprises an endless belt, and a suction box disposed between an upper run and a lower run of said endless belt to draw by suction the sheet guided by the lips of said plurality of separators toward the upper run of said endless belt.

6. A sheet stripping device as set forth in claim 1 wherein said sheet capture and conveyer means comprises a plurality of rollers adapted to rotate while being maintained in pressing engagement with each other.

7. A sheet stripping device as set forth in claim 1 wherein said plurality of separators are each formed with a plurality of lips.

8. A sheet stripping device as set forth in claim 1 further comprising restoring force reducing means for reducing the force with which the separators are returned to the standby position in which they are maintained out of engagement with the peripheral surface of the drum after each sheet has had the direction of its movement changed by the separators, so that violent impinging of the pick-off claws of the separators on the peripheral surface of the drum is precluded.

9. A sheet stripping device as set forth in claim 8 wherein said restoring force reducing means comprises:

- i. a plurality of collars mounted on said shaft each adjacent a respective separator;
- ii. a plurality of stoppers, each associated with a respective separator; and
- iii. a plurality of coil springs mounted on the shaft supporting the separators and abutting at one end a respective one of said separators and at the other end a respective collar mounted on the separator supporting shaft, said coil springs urging by their biasing force each separator to move toward a stopper.

10. A sheet stripping device for removing copy sheets from the surface of an electrophotographic drum comprising:

- a. a rotatable shaft disposed parallel to the axis of said drum;
- b. a plurality of separators, each having one end pivotally mounted on said shaft and biased by its own weight to cause its free end to pivot toward the peripheral surface of the drum, which free end comprises:
  - i. a pick-off claw for engagement with the leading end of a copy sheet carried on the peripheral surface of the drum; and
  - ii. a lip portion contiguous with said pick-off claw for guiding the leading end of a copy sheet engaged by said claw;
- c. means for synchronizing the pivotal movements of said separators with the rotation of the drum comprising:

- i. means for indicating when the leading end of a copy sheet reaches a pick-off position during drum rotation;
- ii. a plurality of pick-off claw members firmly secured to the shaft supporting said separators and pivotable in response to said indicating means to rotate said shaft when said copy sheet leading end reaches said pick-off position, each of said plurality of pick-off claw members forming a pair with one of said plurality of separators and formed with a claw at its free end which is biased by the weight of said member to be maintained in engagement with the peripheral surface of the drum;
- iii. stopper means provided on each of said separators and engaging the ends of each of said pick-off claw members opposite their free ends for re-

straining said separators from pivoting toward the peripheral surface of said drum in an original standby position until said pick-off claw members are pivoted in response to said indicating means.

11. A sheet stripping device as set forth in claim 10 wherein said plurality of separators are each formed with the plurality of lip portions.

12. A sheet stripping device as set forth in claim 10 wherein said indicating means comprises a plurality of grooves in the peripheral surface of the drum in alignment with said pick-off claw members.

13. A sheet stripping device as set forth in claim 10 wherein said stopper means comprises an arm member extending from the ends of each of said separators opposite their free ends.

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