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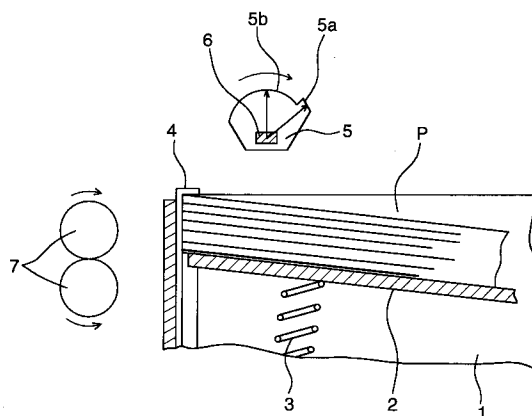
(11) Publication number:

**0 578 143 A1**

(12)

**EUROPEAN PATENT APPLICATION**(21) Application number: **93110560.5**(51) Int. Cl.<sup>5</sup>: **B65H 3/06, B65H 3/56**(22) Date of filing: **02.07.93**(30) Priority: **08.07.92 JP 181169/92**(43) Date of publication of application:  
**12.01.94 Bulletin 94/02**(84) Designated Contracting States:  
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**D-40593 Düsseldorf (DE)**(54) **Paper feeding device.**

(57) A paper feeding apparatus includes a rotatable member (5) having an arcuate portion. The rotatable member (5) is associated with the pile of papers so that the arcuate portion comes in contact with the uppermost paper and moves it with the rotation of the rotatable member. The arcuate portion includes a second arcuate portion (5b) arranged to follow a first arcuate portion (5a) in relation to a rotating direction of the rotatable member. The second arcuate portion having a shorter arm length and a longer arc length in comparison with the first arcuate portion.

**FIG. 1****EP 0 578 143 A1**

## BACKGROUND OF THE INVENTION

The present invention relates to a paper feeding device used for a copier or printer that feeds the uppermost paper of a paper stack one by one.

The paper feeding device constituted in the following manner is widely used: stacked papers on a tray that are pushed upward by a spring are engaged with separation claws; each time a semi-circular feeding roller is rotated by one revolution, an arcuate portion of the feeding roller is contacted with the upper surface of an uppermost paper of the paper stack, so that the uppermost paper is disengaged from the separation claws; and the paper is sent to a pair of conveyance rollers. The arcuate portion of the semicircular feeding roller of the paper feeding device is formed from a single arc.

In the paper feeding device described above, a problem of double feeding occurs, in which a plurality of papers are sent out to the conveyance rollers when the feeding roller is rotated by one revolution. The present invention has been achieved to solve the problem described above. It is an object of the present invention to provide a paper feeding device in which only the uppermost paper is sent to a pair of conveyance rollers from a paper stack when the conveyance roller is rotated by one revolution.

## SUMMARY OF THE INVENTION

The present invention is to provide a paper feeding device characterized in that: stacked papers on a tray pushed upward by a spring are engaged with separation claws; each time a semi-circular feeding roller is rotated by one revolution, an arcuate portion of the feeding roller is contacted with the upper surface of an uppermost paper of the paper stack, so that the uppermost paper is disengaged from the separation claws; and the paper is sent to a pair of conveyance rollers, wherein the arcuate portion of the feeding roller includes a large diameter arcuate portion, the arc length of which is short, and a small diameter arcuate portion that comes into contact with the upper surface of the stacked paper after the large diameter arcuate portion has come into contact.

That is, according to the paper feeding roller of the present invention, double feeding can be prevented in the following manner: first, the large diameter arcuate portion, the arc length of which is short, comes into contact with the upper surface of a stacked paper with relatively high pressure at high speed, so that the uppermost paper is disengaged from the separation claws; and then the small diameter arcuate portion comes into contact with the upper surface of the stacked paper with

relatively low pressure at low speed, so that the paper disengaged from the separation claws is sent to a pair of conveyance rollers.

## BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a sectional view showing an example of the paper feeding device of the present invention; and

Fig. 2 is a partial perspective view showing an example of the feeding roller of the invention.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference to the attached drawings, an example of the present invention will be explained as follows.

Fig. 1 is a sectional view showing an example of the paper feeding device of the present invention, and Fig. 2 is a partial perspective view showing an example of the feeding roller of the invention.

In Fig. 1, numeral 1 is a paper feeding cassette, numeral 2 is a tray, the left end of which is pushed upward by a spring 3, P represents stacked papers on the tray 2, numeral 4 represents separation claws mounted on the paper feeding cassette 1 wherein the separation claws 4 are engaged with the upper surface on both sides of stacked paper P so that the ascent of stacked paper P pushed upward by the spring 3 can be restricted, numeral 5 is a semicircular feeding roller supported by a shaft 6 in such a manner that it can be located in an appropriate position on the shaft wherein the semicircular feeding roller is rotated by one revolution in the arrowed direction, and numeral 7 is a pair of conveyance rollers rotated in the arrowed direction.

The separation claw 4 is held so that it can be vertically moved. It moves upward together with the stacked papers P by the pushing force of the spring 3, and stops at a predetermined upper limit when it comes into contact with a stopper. While the stacked papers P stop at this upper limit position, the uppermost paper of the paper stack P is pushed by the separation claw 4 due to the action of the pushing force.

When the stacked papers P are pushed downward by the pushing-down roller 5, the separation claw 4 is released from the spring force. Then, the separation claw 4 is lowered by its own weight, and stops on the uppermost surface of the stacked papers P.

When the feeding roller 5 is rotated by the shaft 6 by one revolution in Fig. 1, the large diameter arcuate portion 5a, the arc length of which is short, comes into contact with the upper surface of

stacked paper P with relatively high pressure at high speed proportional to the diameter, and the stacked papers P are pushed downward against the spring force. As a result of the foregoing, the uppermost surface of the stacked papers P is not pushed against the separation claw 4 when it is separated from the paper stack P. Under the above condition, the uppermost paper is moved forward when the large diameter arcuate portion 5a is rotated, so that the uppermost paper is disengaged from the separation claws 4. Then the small diameter portion 5b comes into contact with the upper surface of paper P with low pressure at low speed proportional to the diameter so that the movable uppermost paper disengaged from the separation claws 4 is sent to the pair of conveyance rollers 7. Then, the paper is successively sent to the left by the conveyance rollers 7. Therefore, after the trailing end of the paper has passed through a position where the separation claw 4 is located, the next paper P can be positively sent out from the paper stack when the conveyance roller 5 is further rotated by one revolution.

As shown in Fig. 2, grooves 5c are provided in the small diameter arcuate portion 5b on the feeding roller 5, wherein the grooves 5c are formed in the axial direction of the feeding roller 5, so that the drive force given to a paper can be increased. A resilient engagement arm 5d is provided in a square hole of the paper feeding roller 5 on the upper side of the square hole, wherein the resilient engagement arm 5d is formed in parallel with the shaft 6. A hook portion is formed at the end of the resilient engagement arm 5d and engaged with a groove formed on the shaft 6 so that the feeding roller 5 can be fixed in a predetermined position on the shaft 6.

The paper feeding roller 5 constituted in the manner described above can be made of resin by means of molding, however, the present invention is not limited to the specific paper feeding roller. It is preferable that the surfaces of the large diameter arcuate portion 5a and the small diameter arcuate portion 5b are made of a material, the coefficient of friction of which is high when it comes into contact with a paper. The aforementioned effect can be sufficiently provided when the paper feeding roller 5 is constituted in the following manner, depending on the resilience of the spring 3; for example, the radius of the large diameter arcuate portion 5a is set at 20 mm; the radius of the small diameter arcuate portion 5b is set at a value smaller than that of the large diameter arcuate portion 5a by 10 to 20 %; and the length of the arc of the large diameter arcuate portion 5a is set at several millimeter. However, it should be understood that the size of the feeding roller of the present invention is not limited to the specific value.

According to the paper feeding device of the present invention, the following remarkable effect can be provided: an uppermost paper on a paper stack can be positively sent out one by one, so that double feeding can be prevented.

## Claims

1. An apparatus for feeding a paper from a pile of papers, comprising:
  - a tray including
  - a floor plate on which the pile of papers are stacked,
  - a bias member to push the pile of papers on the floor plate upwardly, and
  - a claw member to come in engagement with a leading edge of the uppermost paper in the pile of papers;
  - a rotatable member having an arcuate portion, the rotatable member arranged to associate with the pile of papers so that the arcuate portion comes in contact with the uppermost paper and moves it with the rotation of the rotatable member;
  - the arcuate portion including
    - a first arcuate portion having a first arm length corresponding to a distance between a periphery surface thereof and the rotation center of the rotatable member and a first arc length, and
    - a second arcuate portion arranged to follow the first arcuate portion in relation to a rotating direction of the rotatable member, the second arcuate portion having a second arm length shorter than the first arm length and a second arc length longer than the first arc length so that the first arcuate portion deflects the leading edge of the uppermost paper so as to release it from the engagement with the claw member and the second arcuate deliver the uppermost paper from the tray.
2. The apparatus of claim 1, wherein the periphery surface of the second arcuate portion is provided with a plurality of groove in the axial direction.
3. The apparatus of claim 1, wherein the arm length of the second arcuate portion is smaller 1.1 to 1.2 times than that of the first arcuate portion.

FIG. 1

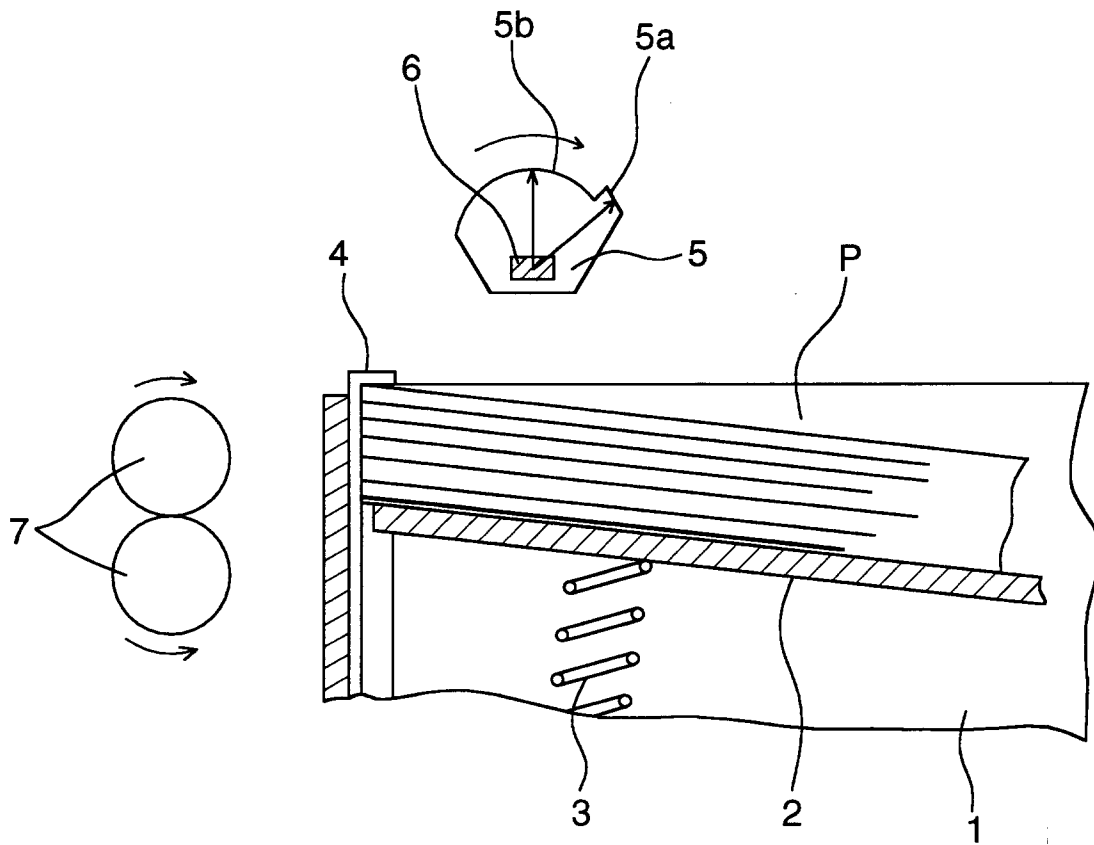
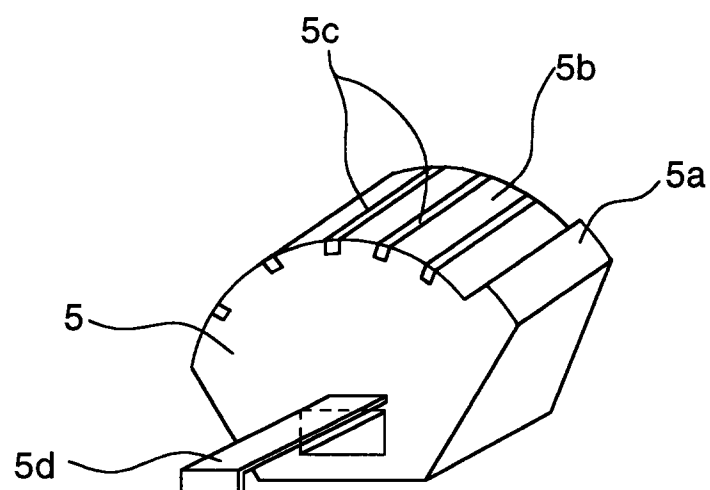


FIG. 2





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## EUROPEAN SEARCH REPORT

Application Number

EP 93 11 0560

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	PATENT ABSTRACTS OF JAPAN vol. 013, no. 500 (M-891)10 November 1989 & JP-A-12 031 128 (FUJI PHOTO FILM CO LTD) 15 August 1989 * abstract *	1-3	B65H3/06 B65H3/56
A	--- US-A-3 649 003 (MULLER ET AL.) * the whole document *	2	
A	--- US-A-2 200 842 (E. E. GRAY) * the whole document *	2	
A	--- US-A-1 416 404 (FAY AND GRABERGER) * the whole document *	2	
A	--- PATENT ABSTRACTS OF JAPAN vol. 014, no. 351 (M-1003)30 July 1990 & JP-A-21 23 037 (NONAMI HIDETAKA) 10 May 1990 * abstract *	1,2	
A	--- PATENT ABSTRACTS OF JAPAN vol. 014, no. 075 (M-0934)13 February 1990 & JP-A-12 94 133 (CANON INC) 28 November 1989 * abstract *	1	TECHNICAL FIELDS SEARCHED (Int. Cl.5)
A	--- PATENT ABSTRACTS OF JAPAN vol. 007, no. 163 (M-229)16 July 1983 & JP-A-58 069 644 (HITACHI SEISAKUSHO) 24 April 1983 * abstract *	1,2	B65H
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The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 04 OCTOBER 1993	Examiner MEULEMANS J.P.
<b>CATEGORY OF CITED DOCUMENTS</b> X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document			