

United States Patent  
Hisabayashi

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[54] CUTTING DEVICE OF A COPY  
MACHINE

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[52] U.S. Cl.....83/349, 83/589  
[51] Int. Cl.....B26d 1/56  
[58] Field of Search.....83/349, 568, 588, 589, 616

[56]

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[57]

ABSTRACT

An improved cutting device of a copy machine provided with a counter mechanism which eliminates play between drive engagement of elements so that jamming of paper at each time of feeding a fresh piece of paper to the cutting position of the device can be completely eliminated and temperature elevation of drive means can be prevented.

4 Claims, 15 Drawing Figures

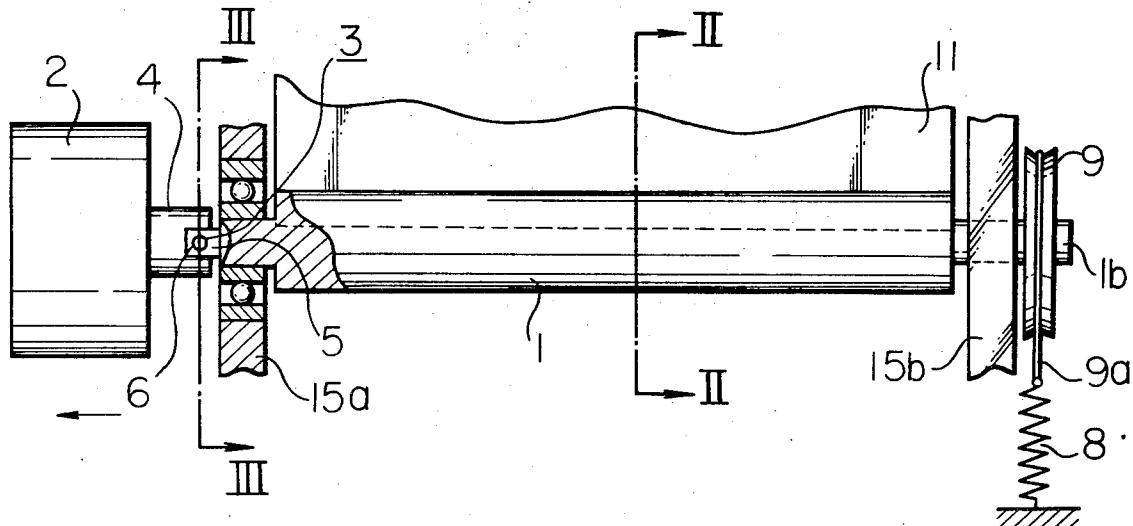


Fig. 1

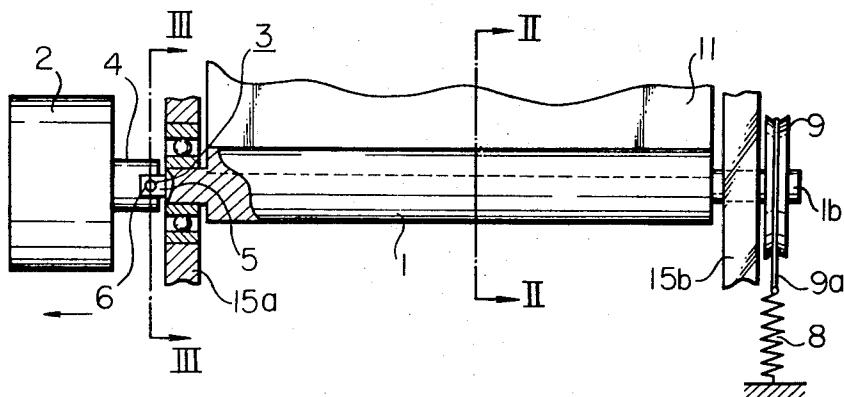


Fig. 2

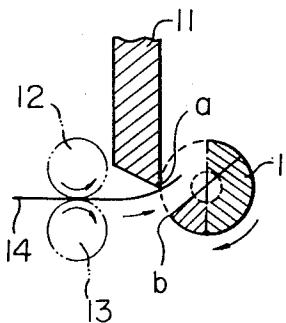


Fig. 3

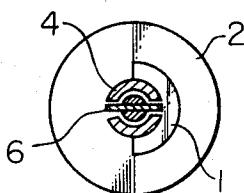
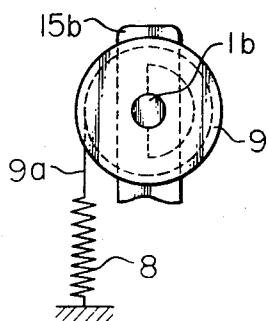


Fig. 4



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Fig. 5A

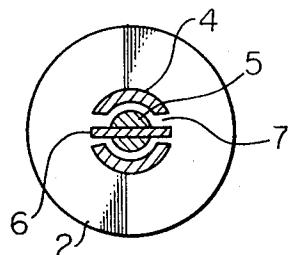


Fig. 5B

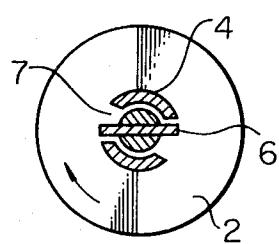


Fig. 5C

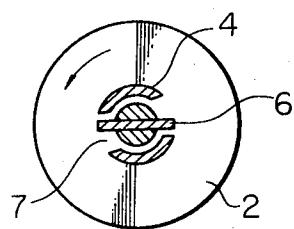


Fig. 6

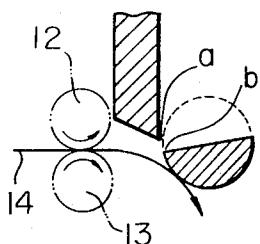
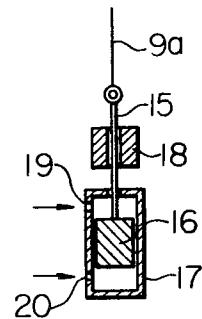


Fig. 7



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Fig. 8A

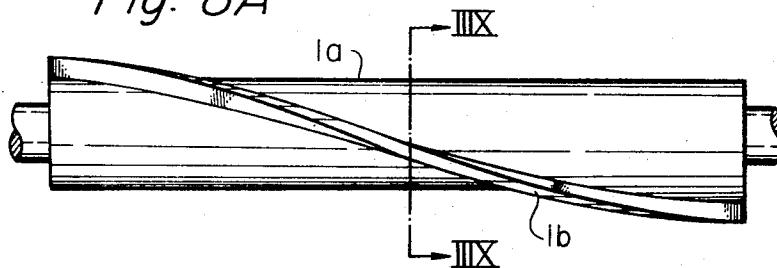


Fig. 9

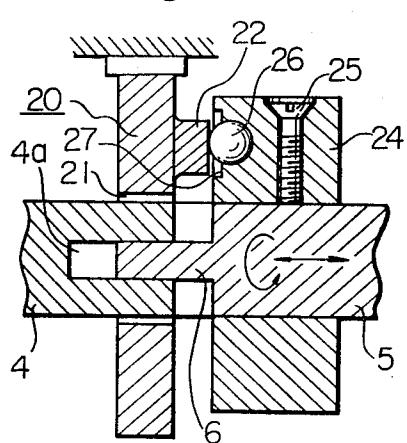


Fig. 8B

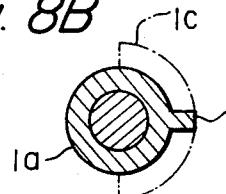


Fig. 10

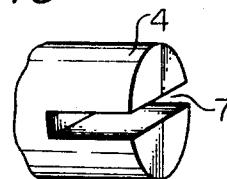


Fig. 12

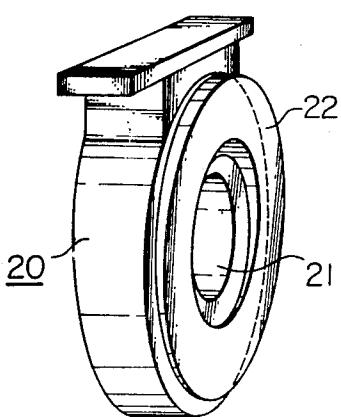
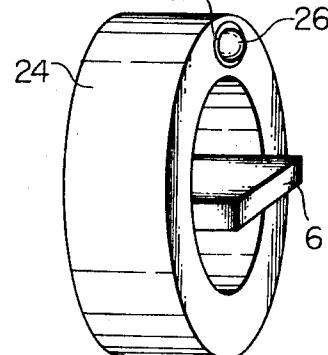


Fig. 11



## CUTTING DEVICE OF A COPY MACHINE

## SUMMARY OF THE INVENTION

The present invention relates to an improved cutting device of a copy machine.

In a conventional cutting device of a copy machine, wherein a rotary cutter is actuated by way of a rotary solenoid, a pin shaft, axially projected from the rotary cutter, engages with a slot formed in a shaft of the rotary solenoid so that the pin shaft is reciprocally turned in accordance with the reciprocal turning motions of the rotary solenoid. However, it is impossible to prevent creation of play between the pin shaft and edges of the slot, in other words, time delay of the motion of the pin shaft from the starting time of the turning motion of the rotary solenoid shaft can not be prevented. Consequently, a distance between a knife edge of a stationary knife and a knife edge of a rotary cutter blade varies, and in a worse condition, the intervened space between the knife edge of the stationary knife and the knife edge of the rotary cutter blade may become so narrow that feeding of paper into the above-mentioned intervened space is interfered with by these knife edges.

Therefore, supplying a sheet of paper into the above-mentioned intervened space can not always be accomplished satisfactorily. The principle object of the present invention is to eliminate the above-mentioned drawback.

To attain the above-mentioned object, in the cutting device according to the present invention, a rotary cutter blade is always restricted in its free turning motion about its turning axis by means of a counter mechanism such as a spring means so that the rotary cutter is provided with a spring resistance against a free turning motion thereof, thereby any play between the pin shaft and edge of the slot is always eliminated. In other words, the intervened space between the knife edges of the stationary knife and the rotary cutter blade is maintained constant so that the intervened space is sufficiently large to allow free feeding of the paper when a fresh piece of paper is fed into the cutting device.

Further, in the cutting device of the present invention, if it is required to operate the cutter at very high speed, a certain modified cutter, which functions a combined cutting action with shear, is preferably applied.

## BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

FIG. 1 is a schematic side view of a rotary cutter of a copy machine according to the present invention.

FIG. 2 is a schematic section view of a portion of the rotary cutter, taken along line II—II in FIG. 1.

FIG. 3 is a schematic section view of an engaging portion of the cutter with a rotary solenoid, taken along line III—III in FIG. 1.

FIG. 4 is a schematic side view of a right end portion of the rotary cutter shown in FIG. 1.

FIGS. 5A, 5B, 5C are schematic section views of an engaging portion of the cutter with a rotary solenoid, utilized for a conventional rotary cutter.

FIG. 6 is a schematic sectional view of a portion of the rotary cutter wherein the engaging condition with the rotary solenoid is shown in FIG. 5.

FIG. 7 is a schematic side view of another embodiment of a counter mechanism according to the present invention.

FIG. 8A is a side view of another embodiment of rotary cutter according to the present invention.

FIG. 8B is a sectional view of the rotary cutter, taken along line VII—VII in FIG. 8A.

FIG. 9 is a sectional view of another embodiment of engaging portions of the rotary solenoid and the rotary cutter, taken along axial direction thereof, according to the present invention.

FIG. 10 is a perspective view of an engaging portion of the rotary solenoid, shown in FIG. 9.

FIG. 11 is a perspective view of an engaging portion of the rotary cutter, shown in FIG. 9.

FIG. 12 is a perspective view of a stationary can shown in FIG. 9.

## DETAILED DESCRIPTION

5 For the convenience of illustration of the present invention, a rotary cutter applied for a conventional copy machine is firstly illustrated.

In the rotary cutter applied to the conventional copy machine, a counter mechanism such as a spring means as shown in FIG. 1, is omitted. Therefore, the mechanism and function of the rotary cutter applied to the conventional copy machine can be illustrated by using the drawing shown in FIG. 1, if the spring means composed of elements 8, 9 and 9a is considered as omitted. In this prior art, a rotary cutter 1 is engaged with the rotary solenoid 2 in such a way that a pin shaft 6 laterally secured to a shaft 5 of the rotary cutter 1 engages a slot 7 formed in a shaft 4 of the rotary solenoid 2.

Therefore, when the rotary solenoid 2 is energized by electric power, the rotary solenoid 2 is actuated to turn by way of their connection 3 which is composed of the pin shaft 6 and the slot 7. In this case, the rotary solenoid 2 can be displaced forward or rearward so that the engagement of the pin shaft 4 with the slot 7 is made or released. Since, the lateral space of

25 the slot 7 is larger than the cross-sectional diameter of the pin shaft 6, there is so-called play between the edges of the slot 7 and the pin shaft 6, as shown in FIG. 5A. Therefore, the pin shaft 6 is turned by the shaft 4 in a contacting condition as shown in FIG. 5B when the rotary solenoid 2 is actuated to 30 operate the cutter 1. On the other hand, when the rotary solenoid 2 is actuated to return the cutter 1 in its released position, the pin shaft 6 is turned in a condition shown in FIG. 5C. In the latter released condition, it is rather possible to position 35 the rotary cutter at an indefinite position in the slot 7 so that an intervened space between the edges of a stationary knife 11 and the rotary cutter blade 1 (in other words, distance between points a and b in FIG. 6) is insufficiently small to permit free passing of a leading edge portion of a paper 14 which 40 is supplied from a pair of feed rollers 12, 13. Therefore, jamming of paper 14 at this intervened space frequently occurs. Further, the leading edge portion of the paper 14 is frequently led toward a position below the rotary cutter blade 1, as shown in FIG. 6 so that it is impossible to cut the paper.

45 As already illustrated, the cutting device of the present invention eliminates the above-mentioned trouble. Referring to FIGS. 1, 2, 3 and 4, a rotary cutter according to the present invention comprises a rotary cutter blade 1 turnably supported by a pair of bearings 15a and 15b, and a stationary knife 11

50 closely disposed above the rotary cutter blade 1, and the rotary solenoid 2 for turning the rotary cutter blade 1. The cutter blade 1 is provided with the axial projection 5 which supports a pin shaft 6. A pair of side shafts 1a, 1b are turnably supported by a pair of bearings 15a and 15b, respectively. The

55 pin shaft 6 extends laterally from the axial projection 5 at an outside of the bearing 15a. The rotary solenoid 2 is provided with an inward projection 4 provided with a lateral slot 7 which engages with the pin shaft 6. This engagement can be released by displacing the rotary solenoid 2 toward outside of 60 the cutting device 6. This direction is shown by an arrow in FIG. 1. At the other end of the rotary cutter blade 1, a grooved pulley 9 is secured on the shaft 1b outside of the bearing 15b. A spring 8 is disposed under the pulley 9 in such a way that an

65 end thereof is connected to the pulley by way of a string 9a and another end thereof is fixed to a portion of the machine frame so that the rotary cutter blade 1 is always turned counterclockwise (in FIG. 4). Therefore, the space distance between the edge point "a" of the stationary knife 11 and the

70 edge point "b" of the rotary cutter blade 1 is kept at a predetermined size when a leading end of the paper 14 is fed into the space by the feed rollers 12 and 13. The size of this space is sufficiently large to allow free passing of paper 14 when the paper 14 is fed from the feed rollers 12, 13. The rotary cutter blade 1 is provided with reciprocal turning motion

by the rotary solenoid 2, in other words, the cutter blade 1 is turned counterclockwise (in FIG. 2) after completion of one step of feeding the paper through the above-mentioned space so that a piece of paper is cut from the continuous paper 14 by the cutting action created with the knife edges of the stationary knife 11 and the rotary cutter blade 1. The feed rollers 12, 13 are rotated intermittently so as to feed the continuous paper 14. A length of feeding paper by one step of feeding can be adjusted in accordance with requirement by an adjusting means (not shown). It is also required to use the spring 8 having a suitable resilient force for eliminating only the play between the edges of the slot 7 and the pin shaft 6 so that the turning torque of the cutting blade 1 created by the rotary solenoid 2 is not weakened. Since the play between the above-mentioned two edges of slot 7 and the pin shaft 6 can be completely eliminated, the turning torque of the cutter blade 1 at the time of the cutting operation is rather increased in comparison with the cutting device which omits the above-mentioned spring means. Consequently, the power consumption of the rotary solenoid 2 can be reduced so that temperature elevation of the solenoid 2, which is created by sequential cutting operations, can be prevented.

In the above-mentioned embodiment, a spring means comprising the pulley 9 and the spring 8 and a string 9a connecting the pulley 9 with the spring 8 is used. However, another counter mechanism which eliminates the play of engagement of the rotary cutting blade 1 with the rotary solenoid can be applied instead of the above-mentioned spring means. In FIG. 7, another embodiment of the counter mechanism is shown. In this embodiment, the string 9a is connected to a thin shaft 15 which is connected to a dead weight 16 having a circular cross section. The motion of the thin shaft 15 is guided by a guide member 18. To prevent jumping of the shaft 15, the dead weight 16 is encased in a cylindrical casing 17 wherein the dead weight 16 can be displaced like a piston. A pair of small apertures 19 and 20 are formed at an upper and lower position of the cylindrical casing 17 so that air in the upper or lower space in the casing 17 does not disturb the upward or downward motion of the dead weight 16, but eliminates jumping thereof. By applying this counter mechanism instead of the above-mentioned spring means, the same effect as the first embodiment can be attained.

If the sheet of paper has stiff quality to cut or it is required to operate the cutter at high speed, the cutter having a certain combined cutting action with shear is preferably used. Referring to FIGS. 8A and 8B, which shows a main portion of the rotary cutter 1, the cutting edge of the rotary cutter 1 is modified as follows; that is the main portion of the rotary cutter 1 is composed of a stem shaft 1a and a cutting blade 1b radially projected from the circumferential surface of the stem shaft 1a in such a way that a line of the cutting edge of the blade 1b forms a half of a unit helical line so that the contacting point of the edge of the stationary cutter 11 (FIGS. 1 and 2) with the edge of the cutting blade 1b moves along the axis of the rotary cutter 1 at a constant speed in accordance with the rotation thereof at a constant rotation speed. The above-men-

tioned motion of the rotary cutter 1 creates a combined cutting action with shear which is similar to the action of scissors so that the above-mentioned object can be easily attained.

Further, a modified rotary cutter provided with a particular driving means can be used. A drive means for turning the rotary cutter simultaneously with reciprocal lateral movement along an axis thereof can be used.

Referring to FIGS. 9, 10, 11 and 12, a coupling means of the rotary cutter comprises a stationary cam 20 provided with an aperture 21 for rotatably supporting the shaft of the rotary solenoid 2 and a ring shaped cam surface 23 projected from a side surface thereof, and a cylindrical attachment 24 rigidly secured on the bearing portion 5 of the rotary cutter 1. The attachment 24 turnably supports a ball 26 in a spherical recess formed at a side portion thereof. A ring retainer 27 engages with an edge portion of the recess so as to prevent the escape of the ball 26 from the recess. When the above-mentioned elements are assembled, the pin shaft 6 is slidably engaged with a horizontal slot 7 formed at the end portion of the shaft 4 and the ball 26 is always urged to the surface of the ring shaped cam 22 by a spring (not shown). Consequently, the rotary cutter 1 is driven by the turning motion of the rotary solenoid 2 by way of the sliding contact of the pin shaft 6 with the slot 7 and reciprocally moved along its axis by means of sliding contact of the ball 26 with the surface of the cam 22. The profile of the cam 22 is so formed that the above-mentioned reciprocal movement of the rotary cutter 1 along its axis is completed once 360° turning of the shaft 4 of the rotary solenoid 2. In the above-mentioned case, the shape of the cutting edge of the rotary cutter 1 shown in FIG. 1 or 8A can be used to attain combined cutting action with shear.

What is claimed is:

1. In a cutting device of a copy machine provided with a rotary cutting blade and a stationary knife closely disposed above said rotary cutter and a rotary solenoid for actuating said rotary cutting blade, an improvement comprising a counter mechanism connected to a free axial end of said rotary cutting blade so that an engaging element formed on the other axial end of said rotary cutting blade always directly follows a reciprocal turning motion of an engaging element of said rotary solenoid without play.

2. An improved cutting device according to claim 1, wherein said counter mechanism imparts a suitable counter turning force to said cutter blade, said counter turning force does not actually weaken turning torque of said cutting blade by turning motion of said rotary solenoid.

3. An improved cutting device according to claim 2, wherein said counter mechanism comprises a spring means resiliently connected to said free axial end of said rotary cutting blade with a part of a machine frame.

4. An improved cutting device according to claim 2, wherein said counter mechanism comprises a dead weight which is pneumatically supported in an air cylinder, and is connected to a string connected to a pulley secured on said free axial end of said cutting blade.

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