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CUTTING, COUNTING AND CLASSIFYING APPARATUS

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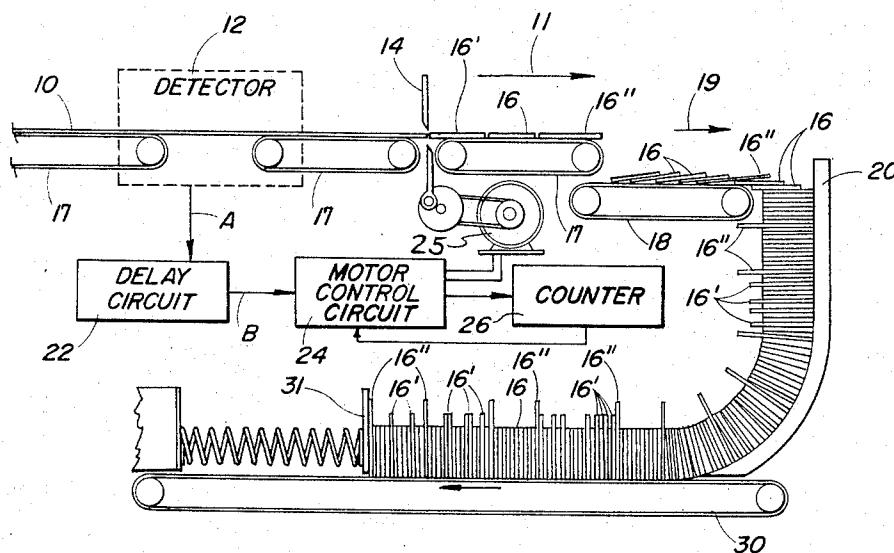


FIG. 1

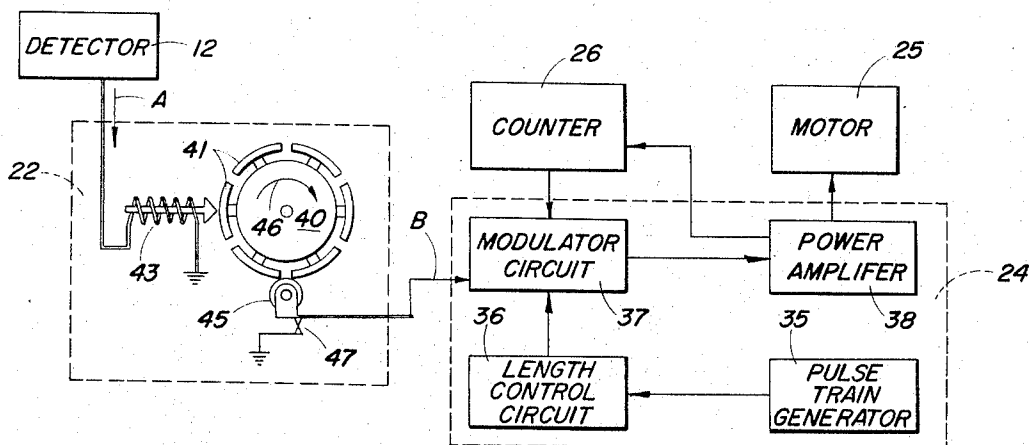


FIG. 2

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CUTTING, COUNTING AND CLASSIFYING
APPARATUS

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ABSTRACT OF THE DISCLOSURE

A web chopper having a defect detector which causes the area of the web containing the defect to be cut to a length different from normal to permit later removal of the defective sheet. The defect signal is utilized to vary the synchronized chopper cycle for the respective web region.

The present invention relates to a sheet cutting, counting and classifying apparatus and more particularly, to a high speed chopper operable to make a sheet having a defect distinguishable so that such a sheet is easily separable after stacking.

In the art of chopping inspected sheets, such as sheets of coated metal or paper, useful for making non-rusting items or photographic prints and the like, numerous attempts have been made to speed up the chopping rate to match the increased production and inspection rates because of increased market demand for such products. A presently popular approach to detecting and separating defective sheets is to inspect the continuous webbing prior to its being chopped, store the defective sheet signal information in a delay system prior to the chop, and then store the defect signal information in a delay system corresponding to each defective chopped sheet. Finally, this delayed defect signal information is used to energize some type of trap door or deflector, whereby the defective sheet is removed from the moving stream of good sheets. However, as the speed of the moving web and the stream of sheets is increased to a high magnitude, the movement of the trap door or deflector must be exceedingly rapid to deflect a single sheet. Because of this difficulty, some high speed inspection systems are operated to remove a series of sheets for each defect detected. Thus several good sheets are removed with each defective sheet to assure removal of every defective sheet by a deflector which is incapable of moving into and out of and into again the sheet flow stream fast enough to deflect two adjacent defective sheets. When this approach is used, the good and bad sheets have to be separated by a slow speed sorter. If it happens that a particular web has numerous defects, such high speed sorting becomes quite inefficient. This problem is further aggravated by the fact that high speed impact between the deflector and the good sheets near the defective one tends to damage some of the good sheets. Another problem is attempting to maintain synchronism of the defective sheet deflector at various web speeds, such as during start up. Obviously, increase of speed of sorting using this prior art approach is fraught with frustration.

Therefore, an object of the present invention is to provide an improved cutting, counting and defect sorting and removal system.

A further object is to provide an improved method and apparatus for counting good sheets and indicating counted groups of sheets produced by a high speed chopper.

In accordance with one embodiment of my invention, a continuous web is moved rapidly past a defect detector which develops signal information indicative of any web defects and supplies it to a control means which regulates the chopper frequency relative to the velocity of the web.

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The chopper is driven by a variable speed motor so that the length of the sheets may be varied when a defect signal is developed. Also, a counter counts the good sheets chopped and provides signal information to the control means so that a different length sheet is provided when a complete count is reached, such as 10, 75 or 100 sheets. The length coded defective sheets are removed only after the stream has been stacked whereby its motion is so slow that hand removal of bad sheets is feasible.

This is important because the speed of the moving web is so great that any effective removal of bad sheets is impracticable. The longer separation or count marker sheets are removed when the stacked sheets are packaged or boxed for shipment to the trade.

The subject matter which is regarded as my invention is particularly pointed out and distinctly claimed in the concluding portion of this specification. The invention, however, as to its organization and operation, together with further objects and advantages, will best be understood by reference to the following description taken in connection with the accompanying drawing, in which:

FIG. 1 indicates a schematic view of one embodiment of my invention; and

FIG. 2 is a block diagram of the control system indicated in FIG. 1.

Referring now to the drawing wherein like numbers indicate similar parts, I have shown a continuous web 10 of sheet forming material which is moved rapidly, as indicated by an arrow 11, past a defect detector 12 to a sheet chopper 14. Usually the detector 12 will be a scanning type. After the individual standard size sheets 16 are chopped from the web 10 by each chop cycle of the chopper 14, the sheets 16 pass from a high speed conveyor 17 to a slow speed conveyor 18 traveling at a slower speed such as 15% to 35% of the high speed conveyor 17. At this lower speed, indicated by an arrow 19, the sheets 16 are presented to and stacked in a vertical chute 20 having a back-up surface for stopping the sheets.

The detector 12 provides signal information A of any defect on the web 10 to a delay means 22 such as a delay circuit. The defect may be a hole, or a lump or a discoloration, etc. A delayed defect signal B corresponding to a delayed signal A is transmitted from the delay means 22 to a motor control circuit means 24 of a chopper motor 25. During the cycle before the chopper 14 severs the defective sheet 16' from the web 10, the delayed defect signal is effective to slow the motor 25. Thus, the defective sheet 16' is made longer than the good sheets 16.

In addition to the above control, the motor control circuit 24 provides signal pulse information to a counter 26 of each good sheet chopped. The counter is set to indicate marketable size packages such as 10, 50, 100 sheets or the like and on reaching such a count, provides another signal to the control means 24. In the event that there is no corresponding defect signal, the signal from the counter 26 causes the motor control circuit 24 to be delayed a greater amount than the defect containing sheet 16' whereby a count marker sheet is cut. Count marker sheets are indicated in FIG. 1 at 16'' (also called separator sheets).

It is contemplated that the web 10 will move at speeds of the order of 600 feet per minute whereby every second 5 sheets of 2 foot length will be transported from the high speed conveyor 17 to the low speed conveyor 18. The low speed conveyor will present the sheets to the back-up surface of the chute 20 at velocities of the order of 100 feet per minute. In the event that the sheets 16 are of considerable mass, a second even slower slow speed conveyor belt may be used to reduce the speed of the sheets to one that is acceptable to the chute 20. Thus, one of the problems of high speed chopping is avoided and

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that is the slowing of the sheets prior to attempting to stop them abruptly during stacking.

Once the sheets 16 are stacked, the stack is removed slowly from the region of the chopper. If the sheets are as much as .003" thick, and the web is chopped at 600 feet per minute, the stack will be removed at a rate of only about one foot per minute which provides ample opportunity to separate the first defective sheets and to package blocks of good sheets.

The stack moves down to the region of a very slow speed (two feet per minute if 12" sheets are cut) belt or conveyor means 30. A compressible end plate 31 is illustrated for maintaining the sheets 16 in a vertical position whereby the longer defective sheets 16' are easily detectable either by operating personnel or by a mechanized removal system. Also, the separator sheets 16" may be removed and replaced by separator boards if such are to be used in the package system. If no separator boards are to be used, once the defective sheets 16' are removed, the entire stack between the counter sheet 16" is placed in a box or wrapper in preparation for the next step of the packaging operation.

It will be apparent from the above discussion that only defective sheets need to be removed as compared to removing good sheets as well as defective sheets by a high speed deflector. These sheets may be removed without appreciably slowing the speed of the chopping operation and without potential damage because of prior art high speed deflectors and the like.

Of course, it must be understood that the blades of the chopper 14 must be synchronized with web 10 velocity during the periods when they are cutting the web. Thus, when the length of a sheet must be varied as in the case of sheets 16' or 16", the frequency variation of the chopper motor 25 is accomplished by speed variation during that portion of its rotation cycle when the chopper 14 is removed from the path of the web 10.

One type of motor 25 that will work well to run the chopper 14 is an impulse or stepping type motor that requires, by way of example, 200 pulses to make a complete revolution of 200 steps. To make 5 two foot long sheets per second (for a web traveling 600 feet per minute) such a motor must receive 1000 pulses per second. Assuming that the chopping function is in progress during pulse No. 1, pulses 0-20 and 180-200 are presented at a rate that will cause the blade to be synchronized with the speed of the web 10. Of course, gear ratio controls may be used between the motor 25 and the chopper blades. For the present discussion, it may be assumed that one chop per 200 pulses is required.

In FIG. 2, I have shown in a simplified form one arrangement for slowing the motor to lengthen the cut sheets as indicated at 16' and 16". A pulse train generator 35 supplies pulses at a rate of 1000 pulses per second. Thus, the pulse train passes from the generator 35 through a sheet length control circuit 36, a modulator circuit 37, and a power amplifier 38 without any change in the rate. If the length of a sheet is to be reduced, the length control circuit 36 adds pulses to the pulse train during the period 20-180. If the length of the sheet is to be increased a few of the pulses 20-180 are deleted. In each case, a pulse train of 200 pulses passes through the power amplifier 38 to drive the motor 25 one complete chop cycle revolution. However, for the present discussion, the length control circuit 36 is fixed to produce a given length sheet 16.

Turning now to the defect signal relay, one of the more common delay means 22 is a pin wheel 40 (FIG. 2). The pin wheel has a plurality of pins 41, one of which is depressed by a relay 43 when one (or several) defects are detected in a portion of the web 10 corresponding to a portion of the web 10 which will be chopped into a sheet 16'. A cam follower 45 is spaced peripherally along the pin wheel 40 to a distance corresponding to the effective distance between the detector 12 and the chopper 14.

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The direction of rotation of the pin wheel 40 is indicated by an arrow 46. The speed of rotation is established in accordance with the sheet size and the web speed so that each sheet 16 has a corresponding pin 41. A depressed pin, as sensed by the follower 45, causes operation of a switch 47 whereby the signal B is coupled into the modulator 37. Under the speed and rate assumptions of the above disclosure, this causes the modulator 37 to cancel out 5 pulses between pulse No. 20 and 180, so that the defective sheet 16' is one-half inch larger than the good sheets 16.

The output of the modulator circuit 37 also flows to the counter 26. This coupling is shown as through a portion of the power amplifier 38. The counter 26 is wired to ignore defective sheet signals. This can be easily accomplished by selecting the count signal such as pulse No. 25 to be one of those that is deleted by the defect signal B. Thus, the defective sheet will not be counted.

While I have shown a particular embodiment of this invention, modifications thereof will occur to those skilled in this art. I intend therefore to have the appended claims cover such embodiments as properly fall within the scope of the present invention.

I claim:

1. A high speed cutting and classifying apparatus comprising:

an inspection device for detecting defects in a moving web and developing signal information for each detected defect;

cyclic web chopping means for severing a predetermined length sheet from the moving web during each chop cycle;

signal information delay means coupled to receive said defect signal information and delay it;

a motor coupled to drive said chopping means at a rate corresponding to the predetermined length; and

motor control means receptive of said delayed defect signal information and responsive thereto to change the speed of said motor during the chop cycle which will sever the defective sheet whereby said defective sheet is of a length different from the predetermined length.

2. A cutting and classifying apparatus as in claim 1, including:

a counter circuit coupled to said motor control means and receptive of count signal information indicative of each cycle resulting in a chop of a sheet of the predetermined length for accumulating count signal information and providing a count signal to said motor control means whereby the motor speed is varied to provide a count sheet separator of a length different from said predetermined length.

3. A cutting and classifying apparatus as in claim 2, including:

means for stacking the cut sheets whereby different length sheets are easily determinable with the defective sheets being thus removable and the count sheets being useable to indicate the number of good sheets for a specific size package.

4. A cutting and classifying apparatus as in claim 2 wherein:

said motor control means causes said defective sheet to be longer than a standard sheet and said count sheet to be longer than a standard sheet by an amount different from that of said defective sheet.

5. A cutting and classifying apparatus as in claim 1, including:

means for conveying the moving web at a specific velocity with said chopping means being synchronized to move with the web at said specific velocity during the chopping operation, and said motor control means being operable to change the speed of said motor only during periods of the chop cycle other than said chopping operation.

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6. A cutting and classifying apparatus as in claim 5 wherein, said motor rotates a single revolution upon the receipt of a specified number of impulses whereby deleting impulses during the period when the motor is driving said chopping means at a position remote from the moving web will not effect the cutting synchronism therebetween, but will cause the length of the cut sheet to be increased.

7. A high speed sheet cutting and classifying method, comprising the steps of:

moving a web material to be cut into sheets past a defect detector and a sheet chopper to a stacking means;

inspecting the moving web material at the detector to develop signal information indicative of defects therein;

chopping nondefective portions of the web material into uniform length sheets;

utilizing the defect signal information to regulate the chopping step for changing the length of a sheet containing a defect; and

stacking the cut sheets with one set of ends aligned whereby any defective sheet is easily discernible in the stacked sheets.

8. A method as in claim 7 wherein said chopping step is synchronized with said moving step at least during the chopping operation; and

the defect signal information is utilized to delay said chopping step to obtain elongated defective sheets with the utilization occurring at periods when the sheet chopper is remote from the web material.

9. A method as in claim 7, including the steps of: counting the nondefective sheets and developing count signal information;

utilizing the count signal information to vary the sheet chopper speed to obtain a count marker sheet of a length different from the nondefective sheets and the defective sheets; and

synchronizing the defect signal information and the count signal information so that the defective sheets are not counted in said counting step.

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10. A method as in claim 9 wherein said chopping step is delayed by both said count signal information and said defect signal information to obtain easy identification in the stacked sheets of both elongated defect sheets and differently elongated count marker sheets.

11. A method of cutting a moving web into discrete sheets and classifying same, which comprises:

scanning the moving web to identify portions of the web containing defects;

chopping nondefective portions of the web into uniform length sheets and defective portions into sheets of a length different from said uniform length; and

stacking the sheets so as to render the different length sheets discernible from the sheets of uniform length.

12. A method as in claim 11 including the steps of:

moving the web at a high speed during the scanning step; and

moving the stack formed by said stacking step at a much lower speed whereby defective sheets may be removed at a low speed.

13. A method of cutting a moving web into discrete sheets, comprising the steps of:

chopping nondefective portions of a moving web into uniform length sheets;

developing signal information indicative of the number of uniform sheets cut;

utilizing said signal information to identify portions of the web corresponding to count marker sheets;

cutting said count marker sheet portions into sheets of a length different from said uniform length; and

stacking the sheets so as to render the different length sheets discernible from the sheets of uniform length.

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40 WILLIAM S. LAWSON, *Primary Examiner*.