

Nov. 11, 1941.

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2,261,968

SHEET-FEEDING METHOD AND MACHINE

Filed April 1, 1940

3 Sheets-Sheet 1

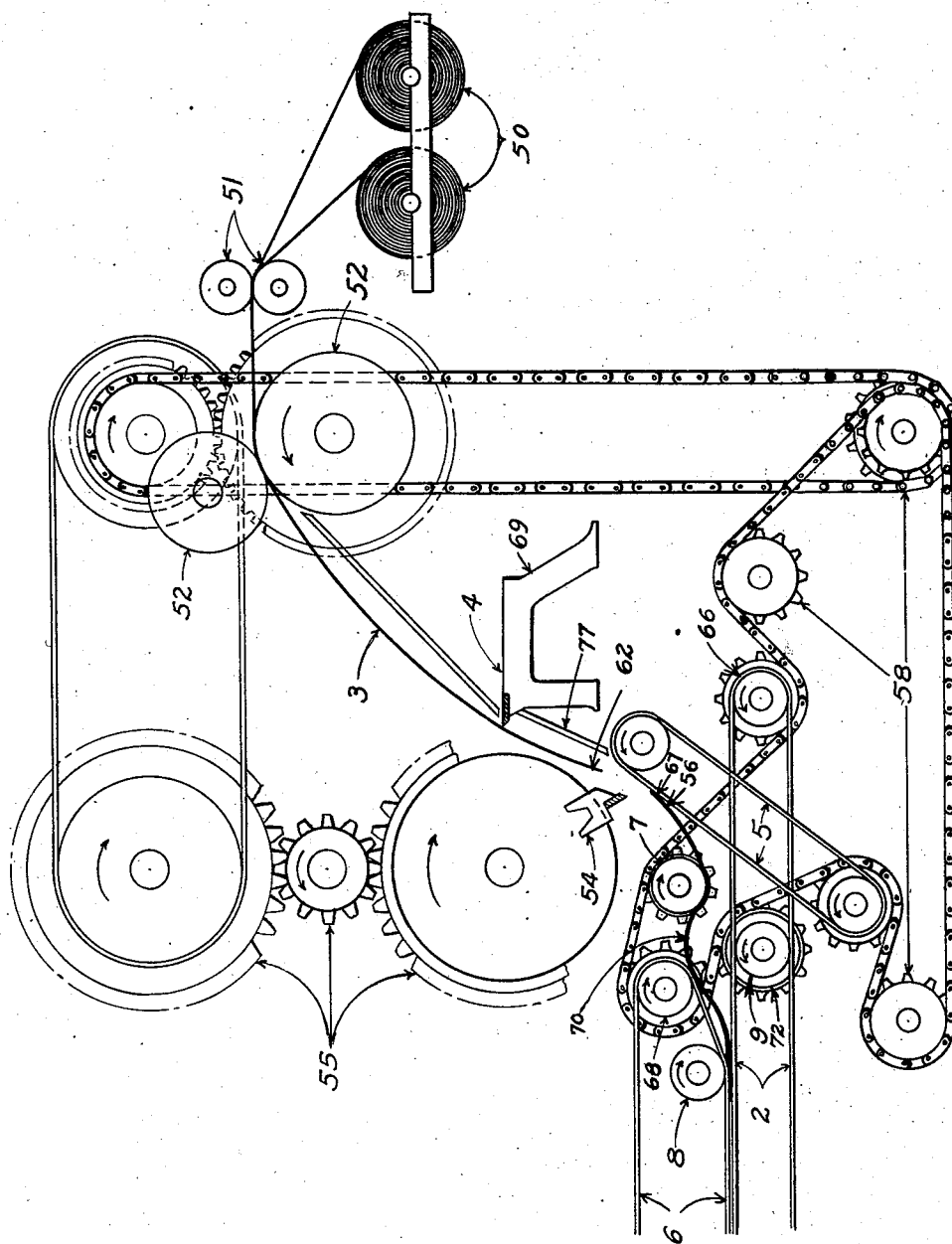


Fig. 1.

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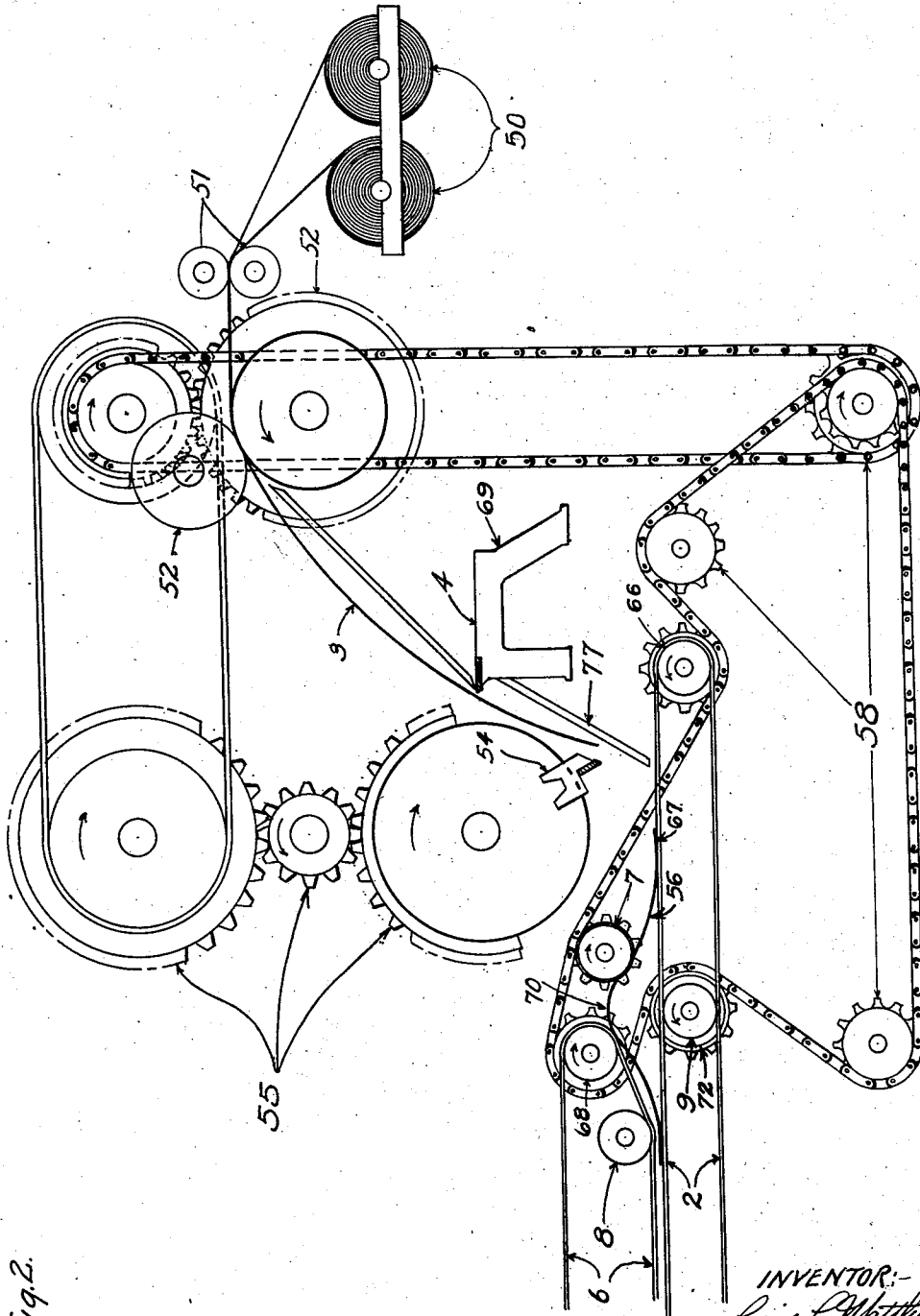


Fig. 2.

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3 Sheets-Sheet 3

Fig. 4.

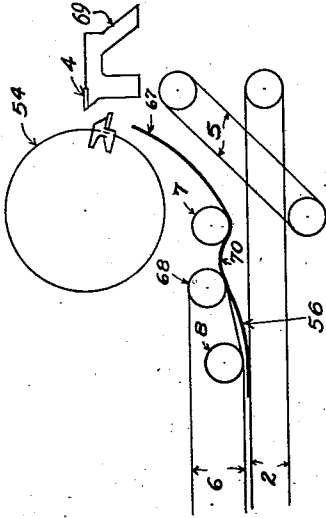


Fig. 6.

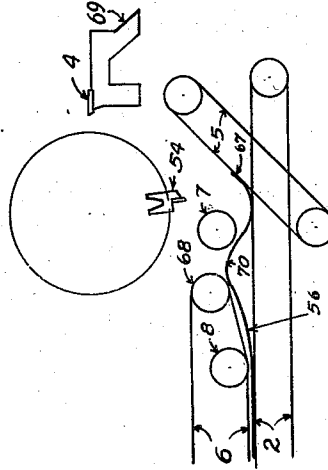


Fig. 3.

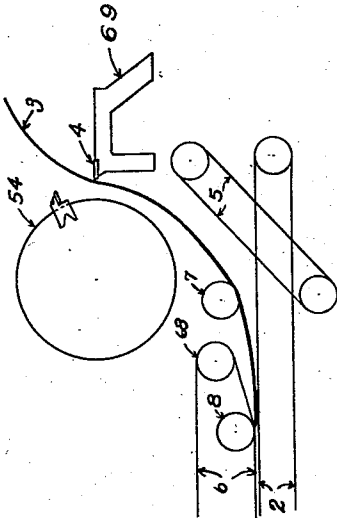
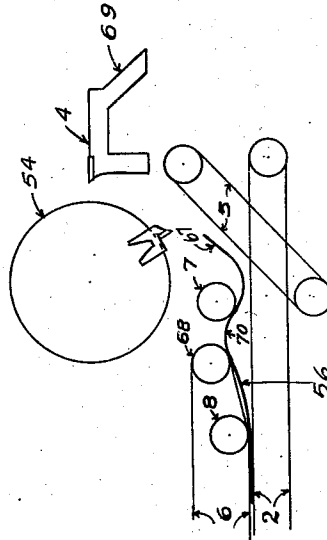


Fig. 5.



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UNITED STATES PATENT OFFICE

2,261,968

SHEET-FEEDING METHOD AND MACHINE

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Application April 1, 1940, Serial No. 327,107

29 Claims. (Cl. 164—68)

The present invention relates to methods and machines for feeding sheet material, such as paper and the like. The invention is particularly related to methods and machines involving high speeds, like those used at paper mills for cutting webs from a roll or rolls into sheets, and feeding the sheets, by means of more or less horizontal conveyor tapes, into a lay-boy or other magazine, and more particularly still to machines of this character in which the cutting knife is rotary. The sheets are fed by high-speed tapes to low-speed tapes by which they become overlapped, and it is in this overlapped condition that they arrive in the lay-boy.

When the sheets cut from the web are shorter than the length of the peripheral path of travel of the rotary-knife blade, this blade must obviously travel faster than the web stock, in order that it may return to the stock in sufficient season to make the next cut of a sheet of the same-size length. Because of the greater cutter speed, there is a tendency for the cutter, during its next revolution, to overtake the sheet cut during the previous revolution, causing the tail of the sheet to become hooked or "whipped" in front of the fast-traveling knife. The consequent buckling of the tail of the sheet results not only in damaging the sheet, by causing cracking or tearing, at the sharp part of the bend in the tail of the sheet, but also in interposing the tail as an obstruction to the travel of the head of the next-following sheet, thereby interfering with the smooth free travel of the latter, and causing the sheets to become jumbled into a waste mass.

Proposals heretofore made for overcoming this difficulty have not proved to be entirely satisfactory. One such is disclosed in Letters Patent 1,882,403, to Charles B. Maxson, issued October 11, 1932, but as the shields therein described can not fully protect the knife, there still remains a small unprotected knife lip that occasionally acts as a hook to catch and whip the tail of an occasional sheet.

An object of the invention is to provide a novel method and machine that shall be substantially free of this difficulty. Other objects will be explained hereinafter, and will be particularly pointed out in the appended claims.

The invention will now be more fully described in connection with the accompanying drawings, in which Fig. 1 illustrates a preferred embodiment thereof; Fig. 2 is a modification; and Figs. 3 to 6 are explanatory diagrams.

A web 3 is illustrated as led from a roll or rolls 50 of paper between feed rolls 51 and 52 and over a stationary bed knife or cutter 4, mounted upon a cutter unit 69. The term "web," "paper," "sheet," or its equivalent, will be employed to denote either a single layer or a plurality of superposed layers of the paper or other material. A

rotary cutter 54, operated by mechanism 55, co-operates with the cutter 4 to cut the traveling web into sheets 56. The invention is equally applicable to use with previously cut sheets. Owing to the feeding action of the rolls 51 and 52, aided by gravity, the sheets 56 travel, at a downward incline, toward high-speed conveyor tapes or belts 2, that are mounted on a roll 66. The belts or tapes 2 are disposed approximately horizontal, substantially parallel to the bed knife 4, at a level below the level at which the web is fed between the rolls 51 and 52. The belts 2 co-operate with conveyor belts or tapes 6 that are mounted under a roll 8 and around a roll 68, to feed the sheets further, ultimately into a lay-boy (not shown). The tapes 2 and 6 are actuated by mechanism 58 desirably at a speed approximately ten per cent faster than the speed of the web 3, as determined by the feed rolls 51 and 52. The mechanism 58 may be in the form of a link chain engaging sprocket wheels upon the shafts that it turns. The roll 8 is shown positioned to the left of the rolls 66 and 68, and the roll 68 is shown raised slightly above the tapes 2 to provide a space in which the tapes 2 and 6 may bite the heads 62 of the oncoming sheets.

As described in a copending application, Serial No. 326,975, filed March 30, 1940, the machine may be provided also, as illustrated in Fig. 1, with a line of sloping or inclinedly disposed tapes 5, positioned between the bed knife 4 and the tapes 2, in the path of feeding movement of the sheets 56. The tapes 5 gradually straighten out the head end 62 of each sheet, if it should happen to be curled, thereby facilitating proper feeding of the sheets 56. As also explained in the said application, the tapes 5 may be actuated by the mechanism 58 at approximately the same speed as the speed of the tapes 2. As illustrated in Fig. 2, however, the invention is operable without the tapes 5, using merely the ordinary stationary inclined guide board 77 disposed between the cutter 4 and the tapes 2, if the sheets 56 are fed smoothly to the tapes 2 without their aid.

The rotary cutter 54 is operated by mechanism 55 at a peripheral speed greater than the speed of travel of the web, in order that the sheets cut from the web may be shorter than the length of the peripheral path of travel of the rotary cutter 54. Owing to this greater speed of travel of the knife 54, it has a tendency to engage the tail end 67 of a newly-cut sheet, and force it into a loop before it reaches the roll 68 of the tapes 6, with undesirable consequences, as before described.

According to a feature of the invention, therefore, a roll 7 mounted just back of and close to the roll 68, between the cutters 4, 54 and the tapes 2, above and to the left of the tapes 5 (if the tapes 5 are employed), is rotated at high

speed by the mechanism 58, its lower periphery in the direction of travel of the sheet, as indicated by the arrow, to cause it to engage or take up the tail 67 of each sheet. Because the diameter of sprocket on the roll 7 is smaller than that of the roll 68, however, it is rotated somewhat more rapidly than the roll 68. The roll 7, therefore, pulls the tail of each sheet temporarily with greater speed than the speed with which the tapes 2 and 6 pull the head and the body of the sheet to feed the sheet forward toward the layboy (not shown).

By temporarily thus pulling the tail end 67 of each sheet forward in substantially the direction of feed of the sheet, the roll 7 unhooks the said tail end 67 from in front of the fast-traveling rotary knife 54, thus actuating it out of the path of travel of the rotary cutter 54. As illustrated in Fig. 1, the paper sheet comes down over the sloping tapes 5, and along the horizontal tapes 2, to the roll 8. Somewhat similar action takes place in the machine of Fig. 2, in the absence of the tapes 5. The main body of the sheet then has a tendency to travel at the speed of the tapes 2 and 6, which, as before stated, may be about ten per cent faster than the web is drawing into the cutter. If the paper becomes "hooked" on the faster-moving rotary knife 54, the roll 7, running at fast speed, and deliberately forming a loop 70 between the fast-running roll 7 and the slower-running roll 68, will unhook it.

The operation will be understood more clearly by reference to Figs. 3 to 6. The tapes 2 and 6, running at a speed ten per cent faster than the web 3, pull upon the head of the web even before the web is cut, causing the body of the web to pull up against the roll 7, as illustrated in Fig. 3. At the instant of severing the web, the paper is still in contact with the roll 7 which, because of its higher speed than the speed of travel of the body of the sheet engaged on both sides of the tapes 2 and 6, starts a slight loop 70 between the rolls 68 and 7, as illustrated in Figs. 1 and 4. In Figs. 1 and 4, the sheet is shown still hugging the roll 7, before it begins to fall away therefrom. Fig. 4, however, represents a stage of operation prior to that illustrated in Fig. 1. Following upon the operation illustrated in Fig. 4, the end 67 of the sheet 56 strikes the tapes 5, as illustrated in Fig. 1; and, in the absence of the tapes 5, the end 67 of the sheet 56 engages the tapes 2, as illustrated in Fig. 2.

Even the slight loop 70 formed at the instant of severing the web 7 serves to remove the tail end 67 of the sheet slightly from in front of the traveling knife 54; the tail end has moved momentarily faster than the knife 54, and becomes thereby unhooked therefrom. It is also to be observed that the weight and the natural tendency of the loop 70 to straighten out will keep part of the loop in contact with the roll 7, as illustrated in Figs. 2 and 5, and thus take it away from the rotary knife. The further operation, however, is as illustrated, first, in Figs. 1 and 4, and later in Fig. 5. In Fig. 5, the tail end 67 of the sheet 56 is shown beginning the fall away from the roll 7. It is not necessary that the loop 70 become very large; all that is essential is that it become large enough for the tail end 67 of the sheet 56 to become unhooked from the knife 54, whereupon it ultimately falls away completely from the roll 7, as illustrated in Fig. 6. Further hooking action thereafter is discontinued; it is no longer needed.

Many kinds of paper will form this loop 70 of their own accord under the influence of the fast-running roll 7. On some heavy weights of paper, or other material, however, it is desirable to mount a further roll 9 in the position indicated in Figs. 1 and 2, below the roll 7. This roll 9 may be covered with rings 12 that may be constituted of a phenol-condensation product, like Bakelite, or a similar material, that extend up into the spaces between the horizontal tapes 2. A crosswise corrugation of "wave" is thus introduced into the paper, particularly when the stock is heavy, so that even a slight touch by the extra-high-speed roll 7 will form the before-described loop 70 to overcome hooking in front of the knife.

The roll 9 may or may not be used, as conditions demand, in conjunction with the roll 7. In both cases, a place is deliberately provided in which the paper becomes looped into the controlled, non-injurious form 70, instead of being whipped behind the knife 54, as in the prior art.

Modifications will occur to persons skilled in the art, and all such are considered to fall within the spirit and scope of the invention, as defined in the appended claims.

What is claimed is:

1. A method of feeding sheet material that comprises feeding a sheet, and feeding the tail of the sheet in the direction of travel of the sheet more rapidly than the speed of feed of the body of the sheet to cause the tail of the sheet to travel more rapidly than the head of the sheet.

2. A method of feeding sheet material that comprises pulling upon the head of a sheet to feed the sheet, and pulling upon the tail of the sheet with greater speed than the speed of pull upon the head of the sheet to cause the tail of the sheet to travel more rapidly than the head of the sheet.

3. A method of cutting sheet material from a web and feeding the sheets so cut that comprises feeding the web to a rotary cutter to cause the cutter to cut the web into sheets, feeding the sheets so cut, and pulling the tail ends of the sheets forward in the direction of feed of the sheets to actuate the tail ends of the sheets out of the path of travel of the rotary cutter to prevent the rotary cutter engaging the said tail ends.

4. A method of cutting sheet material from a web and feeding the sheets so cut that comprises feeding the web to a rotary cutter to cause the cutter to cut the web into sheets, feeding the sheets so cut, and pulling the tail ends of the sheets forward in the direction of feed of the sheets without increasing the speed of travel of the bodies of the sheets to form the tail ends of the sheets into loops, thereby to actuate the tail ends of the sheets out of the path of travel of the rotary cutter to prevent the rotary cutter engaging the said tail ends.

5. A method of cutting sheet material from a web and feeding the sheets so cut that comprises feeding the web to a rotary cutter to cause the cutter to cut the web into sheets, engaging the head of each sheet so cut and pulling the engaged head of the sheet to feed the sheet away from the cutter, and pulling the tail end of each sheet forward in the direction of feed of the sheets to actuate the tail ends of the sheets out of the path of travel of the rotary cutter to prevent the rotary cutter engaging the tail ends.

6. In a machine comprising a stationary cutter

and a cooperating rotary cutter for cutting a traveling web into sheets, in which the rotary cutter is actuated at a peripheral speed greater than the speed of travel of the web in order to produce sheets from the web having a smaller length than the length of the peripheral path of travel of the rotary cutter, a method of the character described that comprises feeding the sheets, and pulling the tail ends of the sheets forward in the direction of feed of the sheets to actuate the tail ends of the sheets out of the path of travel of the rotary cutter to prevent the rotary cutter engaging the said tail ends.

7. In a machine comprising a stationary cutter and a cooperating rotary cutter for cutting a traveling web into sheets, in which the rotary cutter is actuated at a peripheral speed greater than the speed of travel of the web in order to produce sheets from the web having a smaller length than the length of the peripheral path of travel of the rotary cutter, a method of the character described that comprises feeding the sheets, and pulling the tail ends of the sheets forward in the direction of feed of the sheets without increasing the speed of travel of the bodies of the sheets to form the tail ends of the sheets into loops, thereby to actuate the tail ends of the sheets out of the path of travel of the rotary cutter to prevent the rotary cutter engaging the said tail ends.

8. A machine of the character described having, in combination, means for feeding a web, a cutter for cutting the web into sheets, means for feeding the sheets after they are cut, and means for pulling upon the tail ends of the sheets to cause them to travel more rapidly than the bodies of the sheets.

9. A machine of the character described having, in combination, a stationary cutter and a cooperating rotary cutter for cutting a traveling web into sheets, means for actuating the rotary cutter at a peripheral speed greater than the speed of travel of the web to cause the sheets cut from the web to have a length smaller than the length of the peripheral path of travel of the rotary cutter, and means for pulling upon the tail ends of the sheets to actuate them out of the path of travel of the rotary cutter.

10. A machine of the character described having, in combination, a stationary cutter and a cooperating rotary cutter for cutting a traveling web into sheets, means for actuating the rotary cutter at a peripheral speed greater than the speed of travel of the web to cause the sheets cut from the web to have a length smaller than the length of the peripheral path of travel of the rotary cutter, a conveyor for engaging the head of each sheet and feeding the sheet away from the cutters, and means for pulling upon the tail ends of the sheets to actuate them out of the path of travel of the rotary cutter.

11. A machine of the character described having, in combination, a stationary cutter and a cooperating rotary cutter for cutting a traveling web into sheets, means for actuating the rotary cutter at a peripheral speed greater than the speed of travel of the web to cause the sheets cut from the web to have a length smaller than the length of the peripheral path of travel of the rotary cutter, a conveyor for engaging the head of each sheet and feeding the sheet away from the cutters, a roll positioned between the cutters and the conveyor, and means for operating the roll at relatively high speed to actuate the tail

ends of the sheets out of the path of travel of the rotary cutter.

12. A machine of the character described having, in combination, a stationary cutter and a cooperating rotary cutter for cutting a traveling web into sheets, means for actuating the rotary cutter at a peripheral speed greater than the speed of travel of the web to cause the sheets cut from the web to have a length smaller than the length of the peripheral path of travel of the rotary cutter, means for engaging the head of each sheet and thereupon feeding the sheet away from the cutters, means inclinedly disposed between the cutters and the feeding means for engaging the head of each sheet prior to its engagement by the feeding means, means for actuating the inclinedly disposed means in the direction of incline toward the feeding means at approximately the same speed as the speed of operation of the feeding means, a roll positioned between the cutters and the second-named means, and means for operating the roll at relatively high speed to actuate the tail ends of the sheets out of the path of travel of the rotary cutter.

13. A machine of the character described having, in combination, a stationary cutter and a cooperating rotary cutter for cutting a traveling web into sheets, means for actuating the rotary cutter at a peripheral speed greater than the speed of travel of the web to cause the sheets cut from the web to have a length smaller than the length of the peripheral path of travel of the rotary cutter, means for feeding the sheets, and means for pulling the tail ends of the sheets forward in the direction of feed of the sheets at a speed greater than the speed of feed of the bodies of the sheets to actuate the tail ends of the sheets out of the path of travel of the rotary cutter.

14. A machine of the character described having, in combination, a stationary cutter and a cooperating rotary cutter for cutting a traveling web into sheets, means for actuating the rotary cutter at a peripheral speed greater than the speed of travel of the web to cause the sheets cut from the web to have a length smaller than the length of the peripheral path of travel of the rotary cutter, a roll for waving the tail ends of the sheets, and a roll for engaging the waved tail ends to actuate them out of the path of travel of the rotary cutter.

15. A machine of the character described having, in combination, a stationary cutter and a cooperating rotary cutter for cutting a traveling web into sheets, means for actuating the rotary cutter at a peripheral speed greater than the speed of travel of the web to cause the sheets cut from the web to have a length smaller than the length of the peripheral path of travel of the rotary cutter, a tape conveyor for engaging the head of each sheet and feeding the sheets away from the cutters, a plurality of projections disposed in the spaces between the tapes of the conveyor for engaging the tail ends of the sheets to wave them, and means for actuating the waved tail ends out of the path of travel of the rotary cutter.

16. A machine of the character described having, in combination, a stationary cutter and a cooperating rotary cutter for cutting a traveling web into sheets, means for actuating the rotary cutter at a peripheral speed greater than the speed of travel of the web to cause the sheets cut from the web to have a length smaller than the length of the peripheral path of travel of the rotary cutter, a tape conveyor for engaging the

head of each sheet and feeding the sheets away from the cutters, a roll having a plurality of projections disposed in the spaces between the tapes of the conveyor for engaging the tail ends of the sheets to wave them, a roll positioned between the cutters and the conveyor, and means for operating the last-named roll at relatively high speed to actuate the waved tail ends of the sheets out of the path of travel of the rotary cutter.

17. A machine of the character described having, in combination, a stationary cutter and a cooperating rotary cutter for cutting a traveling web into sheets, means for actuating the rotary cutter at a peripheral speed greater than the speed of travel of the web to cause the sheets cut from the web to have a length smaller than the length of the peripheral path of travel of the rotary cutter, a conveyor for engaging the head of each sheet and feeding the sheets away from the cutters, a cooperating conveyor engaging the first-named conveyor to one side of the cutters, a roll positioned between the cutters and the first-named conveyor above the first-named conveyor and relatively close to the second-named conveyor, means inclinedly disposed between the cutters and the conveyors for engaging the head of each sheet prior to its engagement by the conveyors, and means for actuating the inclinedly disposed means in the direction of incline toward the feeding means at approximately the same speed as the speed of operation of the feeding means and for operating the roll at relatively high speed to actuate the tail ends of the sheets out of the path of travel of the rotary cutter.

18. A machine of the character described having, in combination, means for feeding a sheet, and means for feeding the tail of the sheet in the direction of travel of the sheet more rapidly than the speed of feed of the body of the sheet to cause the tail of the sheet to travel more rapidly than the head of the sheet.

19. A machine of the character described having, in combination, means for pulling upon the head of a sheet to feed the sheet, and means for pulling upon the tail of the sheet with greater speed than the speed of pull upon the head of the sheet to cause the tail of the sheet to travel more rapidly than the head of the sheet.

20. A machine of the character described having, in combination, a rotary cutter, means for feeding a web to the cutter to cause the cutter to cut the web into sheets, means for feeding the sheets so cut, and means for pulling the tail ends of the sheets forward in the direction of feed of the sheets to actuate the tail ends of the sheets out of the path of travel of the rotary cutter to prevent the rotary cutter engaging the said tail ends.

21. A machine of the character described having, in combination, a rotary cutter, means for feeding a web to the cutter to cause the cutter to cut the web into sheets, means for feeding the sheets so cut, and means for pulling the tail ends of the sheets forward in the direction of feed of the sheets without increasing the speed of travel of the bodies of the sheets to form the tail ends of the sheets into loops, thereby to actuate the tail ends of the sheets out of the path of travel of the rotary cutter to prevent the rotary cutter engaging the said tail ends.

22. A machine of the character described having, in combination, a rotary cutter, means for feeding a web to the cutter to cause the cutter to cut the web into sheets, means for engaging

the head of each sheet so cut and for pulling the engaged head of the sheet to feed the sheet away from the cutter, and means for pulling the tail end of each sheet forward in the direction of feed of the sheets to actuate the tail ends of the sheets out of the path of travel of the rotary cutter to prevent the rotary cutter engaging the tail ends.

23. A machine of the character described having, in combination, a stationary cutter and a cooperating rotary cutter for cutting a traveling web into sheets, means for actuating the rotary cutter at a peripheral speed greater than the speed of travel of the web in order to produce sheets from the web having a smaller length than the length of the peripheral path of travel of the rotary cutter, means for feeding the sheets, and means for pulling the tail ends of the sheets forward in the direction of feed of the sheets without increasing the speed of travel of the bodies of the sheets to form the tail ends of the sheets into loops, thereby to actuate the tail ends of the sheets out of the path of travel of the rotary cutter to prevent the rotary cutter engaging the said tail ends.

24. A machine of the character described having, in combination, a roll, means for feeding sheets past the roll, and means for operating the roll at relatively high speed to cause the tail ends of the sheets to travel more rapidly than the bodies of the sheets.

25. A machine of the character described having, in combination, a cutter for cutting a traveling web into sheets, means for feeding the sheets away from the cutter, a roll positioned between the cutter and the feeding means, and means for operating the roll at relatively high speed to cause the tail ends of the sheets to travel more rapidly than the bodies of the sheets.

26. A machine of the character described having, in combination, means for feeding sheets, means for waving the tail ends of the sheets, and means for engaging the waved tail ends to cause them to travel more rapidly than the bodies of the sheets.

27. A machine of the character described having, in combination, a cutter for cutting a traveling web into sheets, means for feeding the sheets away from the cutter, a roll for waving the tail ends of the sheets, and means for engaging the waved tail ends to cause them to travel more rapidly than the bodies of the sheets.

28. A machine of the character described having, in combination, a cutter for cutting a traveling web into sheets, means for feeding the sheets away from the cutter, a plurality of projections for engaging the tail ends of the sheets to wave them, and means for engaging the waved tail ends to cause them to travel more rapidly than the bodies of the sheets.

29. A machine of the character described having, in combination, means for feeding units of sheet material, means for engaging the head of each unit fed by the feeding means and thereupon feeding the said unit further, means inclinedly disposed between the two first-named means for engaging the head of each unit prior to its engagement by the second-named means, means for actuating the inclinedly disposed means in the direction of incline toward the second-named means, and means for pulling upon the tail ends of the sheets to cause them to travel more rapidly than the bodies of the sheets.

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