Sheet Delivery Control for Cut-Off Mechanisms

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In the continuous production of stiff sheet material, such as double faced corrugated board, it is necessary that during the continuous advance thereof, successive sections of preselected length be cut from the end of the web. These are either stacked for later use, or are delivered at once to another machine for operation thereon, as for instance, printing and slotting to make box blanks. It is customary to run the double facer which produces the web at a high rate of speed, to obtain the maximum production per day, and this speed often is 400 linear feet per minute, or even higher. Therefore the stiff sections or sheets, as they are cut from the advancing web, are traveling at the same speed. As soon as these sections are cut off it is customary to momentarily increase their speed of travel to space them from, and get them out of the path of, the high speed traveling web. In order to properly stack the sheets, or to position them properly on a cross-conveyor, it is important that each sheet be slowed down at the same rate, and within the same range of travel.

Serious difficulties are encountered in slowing down and stopping the sheets within a comparatively short distance. Such distance may not greatly exceed the length of the sheet itself, if the sheets are to be stacked at the delivery end of the double facer, or if they are to be deposited on a closely juxtaposed conveyor traveling at right angles to the direction of travel of the web. If the speed of the sheet be momentarily increased to get it out of the way of the advancing end of the web, this increases the difficulty in stopping the sheet in a predetermined position after traveling a further distance approximating its own length.

Various devices have been proposed for slowing down the sheet speed, among which are slowly rotating rollers which move relatively toward and from each other to first permit a portion of the sheet to pass rapidly thereby and then to grip the sheet near the rear or tail end and slow it down to the rotational speed of the rollers. Apparatus of this type is objectionable in many respects. The sheet may slip somewhat and to varying degrees, during the sheet gripping and retarding action. The structural strength of the double faced corrugated sheet may be reduced if the sheet is gripped too tightly. The degree of gripping and retarding will vary with even slight variations in the thickness of the sheet. The movable part or parts are heavy and offer considerable resistance to rapid and intermittent movements during the gripping and releasing action.

The main objects of the present invention are to provide an improved sheet retarding mechanism, which requires the minimum of moving parts; which has such parts of light weight and low inertia to movement; which may grip the sheet as tightly or lightly as desired to vary the rate of speed reduction and without liability of crushing the sheet or reducing its structural strength; which may be readily applied to existing machines with the minimum of structural changes; which will operate in the same manner and to the same extent on sheets of varying thicknesses; and which may be readily adjusted to give varying degrees of retarding action in accordance with local conditions or the desire of the operator.

In carrying out my invention I employ suction nozzles adjacent to the path of travel of the sheets, and cause the desired suction to be applied directly to the surface of the stiff sheet, and at any desired point along the sheet, and to such an extent or for such time interval as will slow down the sheet to the desired slow speed and in the desired time interval.

The control of the suction applied to the sheet may be effected in various ways. An intermittently operating valve may turn on and off the suction during the travel of the sheet, so that the sheet may freely slide for one interval of time and then be retarded by the application of suction. The nozzles may have air sucked in continuously, and the nozzles intermittently moved into and out of engagement with the sheet. The suction may be continuously applied and the sheet moved over the nozzles by sheet advancing means and the sheet slowed down by the suction after it leaves said rollers, or the same results may be obtained in various other ways. The application of the suction is preferably in timed relationship to the operation of the cut-off mechanism so that it will act the same on each successive stiff sheet. The control of the suction may be electrical or mechanical, and operated by the cut-off or other suitable means. Any such means may be adjustable in accordance with the length of the sheet.

By properly regulating the suction or degree of vacuum, the amount of retardation may be controlled at the will of the operator or in accordance with local conditions; for instance, by applying a high vacuum giving a 28" pull, the sheet may be almost instantly stopped, and by using a lesser vacuum the sheet will not be stopped, but
will slow down and still slide over the nozzle by its own momentum or by the pull of a conveyor belt, and at a rate depending on the degree of vacuum applied. The degree of vacuum may be controlled in various ways, as by a valve in the suction line, or by varying the speed of the suction pump, or by moving the nozzle toward or from the path of the sheet.

In the accompanying drawings I have illustrated only a few of the possible embodiments of my invention. In the drawings:

Fig. 1 is a perspective view of a portion of a machine provided with stationary suction nozzles.

Fig. 2 is a detail of a solenoid operated valve for the air line.

Fig. 3 is a vertical section through a few of the air nozzles and the associated parts.

Fig. 4 is a vertical section at right angles to the plane of Fig. 3.

Fig. 5 is a plan view of a portion of an alternative construction having movable nozzles.

Fig. 6 is a side elevation of the parts shown in Fig. 5, and

Fig. 7 is a somewhat diagrammatic showing of an alternative means for controlling the application of suction.

In Fig. 1 I have illustrated my invention as applied to a standard form of machine in which a double faced corrugated web is continuously produced in a double facer and delivered at high speed through a cut-off mechanism, illustrated as a pair of parallel rotateable cutters 10 and 14. The sheets or sections cut from the web are deposited on a plurality of narrow parallel conveyor belts 12. The cut-off mechanism has a drive shaft 13 which is driven from the main drive of the double facer in any conventional manner so that the double facer and cutter will operate in proper timed relationship.

It will be understood that the cut-off mechanism is provided with means for varying the time cycle of the cutters to cut off sheets of the desired length, and that the rotation speed of the cutters is varied during each complete rotation so that the cutter blades will travel at the speed of the sheet at the instant of cutting, but may decelerate and then accelerate between successive cutting actions to permit greater or lesser length of web to pass therebetween, and to produce sections or sheets of the desired length. Reference may be had to the Behrens Patents 2,282,913 and 2,525,710 and to the Behrens application Serial No. 550,835, now Patent No. 2,394,589 issued February 12, 1946, for disclosure of suitable means for controlling the frequency of the cutting action on a web traveling at a constant speed. It will be understood that such mechanism may be incorporated between the shaft 13 and the cutters, and that the sheet is advanced by suitable feed mechanism which in most cases is the machine which makes the stiff sheet material. This mechanism is conventionally illustrated as a pair of rollers 16a and 16b which are driven from the same source of power as the cutters 10 and 11 and with the same peripheral speed as that of the cutters at the instant of cutting. Other means may be provided for accomplishing the same result.

The belts 12 are mounted on pulleys 14 on parallel shafts 15 and 16, and the belts are so positioned as to receive and advance the sections or sheets as they are cut from the web. Ordinarily the belts are driven at a higher speed than that of the web so that each stiff section or sheet after it is cut from the web, is speeded up to space from the end of the web. I have shown the shaft 15 driven by sprockets 17 and 18 and chain 19 from the drive shaft 13, so that the speed of travel of the belt 12 will be kept slightly higher than the speed of the other rollers 16a and 16b and the web. The shaft 15 may be freely rotatable by the conveyor belts.

It will be understood that the cutters 10 and 14 are geared together and that the drive shaft 13 is connected to said cutters by means for alternately accelerating and decelerating the cutters, for instance as shown in the Behrens patents above referred to. It will also be understood that the drive shaft 13 is connected to the machine that continuously forms and advances the web. Such portions of the machine constitute no novel feature of the present invention, and may be of the type commonly employed in commercial machines.

Disposed above the conveyor belts and adjacent to their delivery ends is an idler roller 20 mounted on pivoted arms 21 so that it may rest on the sheet being advanced by the belts and hold it down on the belts so that the sheet will, under normal conditions, be advanced by the belts and at the speed of the latter.

All of the parts so far specifically referred to may be of any conventional type, and do not form any novel portion of the present invention.

In the embodiment of my invention shown in Figs. 1 to 4 there is provided a suction means. This is shown as a vacuum pump 23 which may be mounted in any desired position and driven in any suitable manner, as for instance by an electric motor. The suction might be produced by any other well known equivalent means. The intake of the suction producer is through a pipe 26 which may be connected by a pipe 27 to a pipe 28 disposed between the upper and lower runs of the belts 12, and preferably adjacent to the shaft 13 at the delivery end of the conveyor belts. The pipe 28 may be supported in any suitable manner as by brackets mounted on the side frames carrying the shaft 16, and is provided with a series of intake nozzles 29 at spaced points along the length thereof, and positioned between the belts 12. The nozzles extend upwardly from the pipe 26 and terminate in an attenuating or diverging plane of the upper surface of the upper run of the belts.

To prevent the end of the advancing stiff sheet from abutting against the nozzles, and for guiding the sheet over the nozzles, there is preferably provided adjacent to each nozzle a convex guard 30 which may be provided with a clamp 31 for rigidly supporting it in the desired position on the pipe 26. This pipe may be provided with a large number of holes in the upper side, so that a greater number of nozzles may be employed, and in the proper position in respect to the belts, and to permit of the use of a greater or lesser number of belts of different spacing and width. As shown there are three of the nozzles 29 between each two adjacent belts, and the holes beneath the sheet are closed by plugs 32. Each guard 30 is of a width substantially equal to the distance between adjacent belts, and as shown, each guard serves for three nozzles.

The application of suction to the nozzles is so controlled that there is little or no retardation of the sheet during the major portion of its travel over the nozzles, but suction of the desired degree is applied through the nozzles to the sheet when the rear or tail end portion of the sheet is passing over them. This control, whereby the suction
is applied intermittently and to the sheets in succession, may be effected in various ways. As shown in Figs. 1 and 2, the pipes 26 and 27 are connected by a valve chamber 33 having a valve 34 for closing or opening the connections between the pipes. This valve as shown is normally closed, so that there will be no suction at the nozzles. It is connected to a solenoid 35 so that when the solenoid is energized the valve 34 is pulled from the seat and the full suction created by the vacuum pump 25 is applied to the nozzles.

The operation of the solenoid is in timed relationship to the cut-off mechanism so that after a sheet has been cut from the web and has traveled to such a point that its rear or tail end portion is passing over the nozzles, the suction is applied to pull the sheet against the end of the nozzles to an extent varying with the degree of suction pressure and to a degree which will stop the sheet or will reduce the speed to the desired extent. Any suitable timing mechanism may be employed. As shown, the cutter 10 is provided with a cam 36 for intermittently operating a circuit closer 37 which is connected by a cable 38 to a source of electrical energy (not shown) and to the solenoid. The cam 36 is preferably adjustable circumferentially of the cutter so that the suction will be applied at the proper time to each sheet, regardless of its length, and when the tail end portion of the sheet is in the proper position in respect to the suction nozzles.

Various other control means may be employed. For instance, in Fig. 7, the cutter 10 and cam 36 are shown as operating a valve 40 which will let air enter a pipe 41 connected to the pipe 21 leading to the intake side of the vacuum pump 25. Thus when the valve is open the vacuum pump will draw in air through the pipe 41 and create very little if any suction on the nozzles 28, but when the cam 36 closes the valve the pump 25 will create the desired suction at said nozzles.

In the embodiments above described the nozzles are in fixed position in respect to travel of the sheets and the control is effected by making and breaking the suction applied at the nozzles. As one of many possible alternatives, the air may be drawn in continuously through the nozzles and the nozzles moved toward and from the path of travel of the sheets. In the form shown in Figs. 5 and 6, the pipe 26, instead of being in fixed position, is mounted on a pair of arms 43 pivoted on brackets 44 so that the nozzles may be raised or lowered in respect to the plane of the sheet. The arms are shown as connected to a solenoid 45, so that when the sheet is in the proper position in its path of travel the solenoid is actuated to lift the nozzles into engagement with the sheet and permit the application of suction to the sheet to stop or retard it to the desired extent. If desired the idler roller 28 shown in Fig. 1 may be mounted on the arms 43, as shown in Figs. 5 and 6 so that this roller will normally hold the sheets on the belt so that they will travel at the belt speed, but will be slightly lifted above the sheets when the nozzles are raised into engagement with the under surface of the sheet.

Various other types and designs of apparatus parts may be employed in carrying out my invention. For instance, the stationary nozzle of Figs. 3 and 4 may be used without an intermittently operated valve control. With the idler properly spaced from the nuzzle, the latter may apply a suction insufficient to slow down the sheet while it is held on the conveyor belts by the idler, but at the instant the sheet leaves the idler the suction will retard the sheet and cause the belts to slip therewith.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A machine for cutting a web of stiff material into sheets during its high speed advancement, having means for so feeding the web and means for momentarily increasing and then decreasing the speed of each sheet as cut, said means comprising a vacuum nozzle with its inlet adjacent to the path of travel of one surface of the cut off sheet, and means acting in timed relationship with the travel of said sheets for intermittently causing suction at said nozzle to act on and retard the speed of each successive sheet.

2. In combination with a cut-off mechanism for acting on a rapidly advancing web of stiff sheet material, means for so feeding the web and means for momentarily increasing and then decreasing the speed of each sheet as cut, said means comprising a vacuum nozzle spaced from said cut-off mechanism and having an inlet adjacent to the path of travel of the cut off sections, and means controlled in timed relationship with the operation of the cut-off mechanism for momentarily applying suction to one surface of each successive section during its travel from said cut-off mechanism, for retarding the speed of travel thereof.

3. In combination with a cut-off mechanism for acting on a web of stiff sheet material advancing at high speed and cutting said web into successive sections, means for so feeding the web and means for momentarily increasing and then decreasing the speed of each sheet as cut, said means comprising a vacuum nozzle spaced from said cut-off mechanism and over which the cut off sections travel, and means for causing suction at the nozzle to act upon the rear portion of each successive sheet to retard the speed of travel thereof.

4. In combination with a cut-off mechanism for cutting into successive sections a web or stiff sheet material traveling at high speed, means for so feeding the web and means for momentarily increasing and then decreasing the speed of each sheet as cut, said means comprising a vacuum nozzle having an inlet substantially in the plane of the under surface of the cut off sections traveling at high speed, and means controlled in timed relationship with the cut-off mechanism for applying suction at said inlet intermittently and only while the rear portion of each section is passing over said inlet and thereby retarding the speed of travel of the sections in succession.

5. In combination with a cut-off mechanism for cutting into successive sections a web of stiff sheet material traveling at a high speed, a plurality of conveyor belts spaced apart laterally for receiving the cut off sections, means for driving said conveyor belts at a higher speed than that of the web to space each section, and means for stopping the end of the web after it is cut therefrom, and means disposed between said belts and adjacent to the delivery end thereof for applying suction pressure to the sections and retarding their speed below that of said conveyor belts.

6. In combination with a cut-off mechanism for cutting into successive sections a web of stiff sheet material traveling at high speed, a plurality of conveyor belts spaced apart laterally for receiving the stiff cut off sections, means for
driving said conveyor belts at a higher speed than that of the web to space each section from the end of the web after it is cut therefrom, a plurality of nozzles disposed between said belts adjacent to the delivery end thereof, and means for applying suction to said nozzles to act on and retard said sections only while the rear or tail end portion of each section is passing over said nozzles.

In combination with a cut-off mechanism for cutting into successive sections a web of stiff sheet material traveling at high speed, a plurality of conveyor belts spaced apart laterally for receiving the stiff cut-off sections, means for driving said conveyor belts at a higher speed than that of the web to space each section from the end of the web after it is cut therefrom, a plurality of nozzles disposed between said belts adjacent to the delivery end thereof, and means for applying suction to said nozzles to act on and retard said sections only while the rear or tail end portion of each section is passing over said nozzles.

In combination with a cut-off mechanism for cutting into successive sections a web of stiff sheet material traveling at high speed, a plurality of conveyor belts spaced apart laterally for receiving the stiff cut-off sections, means for driving said conveyor belts at a higher speed than that of the web to space each section from the end of the web after it is cut therefrom, a plurality of nozzles disposed between said belts adjacent to the delivery end thereof, means for applying suction to said nozzles to act on and retard said sections only while the rear or tail portion of each section is passing over said nozzles, said nozzles having curved guards for guiding the sections thereover.

In combination with a cut-off mechanism for cutting into successive sections a web of stiff sheet material traveling at high speed, a plurality of conveyor belts spaced apart laterally for receiving the stiff cut-off sections, means for driving said conveyor belts at a higher speed than that of the web to space each section from the end of the web after it is cut therefrom, a transverse pipe between the upper and lower runs of said belts, and upstanding nozzles disposed along said pipe and having their upper ends substantially in the plane of said surface of the upper runs of said belts.

In combination with a cut-off mechanism for cutting into successive sections a web of stiff sheet material traveling at high speed, a plurality of conveyor belts spaced apart laterally for receiving the stiff cut-off sections, means for driving said conveyor belts at a higher speed than that of the web to space each section from the end of the web after it is cut therefrom, a transverse pipe between the upper and lower runs of said belts, upstanding nozzles disposed along said pipe and having their upper ends substantially in the plane of said surface of the upper runs of said belts, and means for applying suction to said nozzles to act on and retard said sections only while the rear or tail portion of each section is passing over said nozzles.

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No references cited.