This invention relates generally to paper finishing machines and more particularly to machines which unwind a continuous web of paper from a supply roll and periodically sever the continuous web across its transverse dimension for the purpose of producing uniform size sheets which are assembled in a pile for further processing.

Many factors are involved in the high speed operation of paper cutting machines which determine the ultimate degree of performance for the machine. In any such operation at high speed, it is necessary for positive control to be applied to the web and the cut sheets at all times without producing any blemishes on the surface of the paper. The degree to which accurate control can be maintained determines the accuracy of the size of the cut sheets and hence the roll and the consequent tripping operations with consequent reduction in waste of material as well as improving the characteristics of the piling operation so that a more uniform pile is achieved which is advantageous for subsequent operations. For high quality paper, it is also necessary that the dust produced by the cutting operation be satisfactorily disposed of in order to prevent the tripping of the sheets and thereby assure a positive grip on the paper; a more accurate cut and more precise delivery of the sheet to the subsequent tape transport system. At the same time, the sheet is not gripped so rigidly that a needed amount of slip can occur thereby obliterating the need for exact synchronization between the sheet transport members of the machine. These features result in a more accurate cut and less loss of material due to a small amount of trimming being required of the piled sheets and a better piling operation is achieved which facilitates subsequent operations as well as high speed operation of the paper cutting machine.

The suction roll employed in the invention has a transverse width adjustment which permits the paper to completely cover the suction passages in the roll thereby giving good gripping action on the sheet without slippage to enhance control of the sheet. Leakage air flow past the arches between the roll and the suction box provides for dust removal. The suction force also holds the sheet off the cutter drum to eliminate the possibility of slippage between the drum and the sheet which slippage could cause defect marks on the surface of high quality paper.

Alternatively, the width of the suction area on the drum can be adjusted to be wider than the paper passing thereover to provide a substantial amount of air flow into the suction roll whenever such additional flow is required for cleaning the dust from the paper.

Immediately down stream from the suction portion of the roll, means are provided to apply positive pressure for producing air flow outward from the perforate surface of the roll thereby to release the sheet once it is past the suction sector of the roll.

The foregoing and additional objects and features of the invention will become apparent from the following detailed description taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a profile view of a portion of a paper cutting machine incorporating a honeycomb suction roll;
FIG. 2 is a view in cross section of the honeycomb suction roll;
FIG. 3 is a sectional view along the line 3-3 of FIG. 2;
FIG. 4 is a fragmentary view of the honeycomb surface of the roll;
FIG. 5 is a sectional view of another form of suction box; and
FIG. 6 is a sectional view of a modification having an upper suction box for cleaning the top of the sheet.

Referring now to FIGS. 1, 2 and 3, the general arrangement of a suction roll will be described, only portions of such details being apparent in the small scale view of FIG. 1. The honeycomb cylinder 16 is supported on a central tubular hub 21 which is suspended at its ends by support flanges 22. The flange 23 at one end seals the tubular member 21 and at the other end provides a communicating passageway 25, 27 for the attachment of a suction line.

Mounted on the outside of the tubular hub 21 near the opposite end thereof are side supports 24 in which are journaled two lead screws 25. The lead screws 25 are adapted to be turned by any suitable means, such as a hex head 26 formed at one end thereof for engagement by a suitable tool.

The lead screws 25 have a square cut helix 27 formed in the surface thereof for driving, respectively, two sector end plates 28. Each end plate 28 has mounted therein a tubular sleeve 29 through which a lug 31 projects into the helix 27 for the driving assembly. The upper end of the plate 28 has a flange extension 32 upon which a circular segment of honeycomb material 33 is mounted. The honeycomb segment 33 extends to a point which provides a clearance of approximately 3/16 of an inch from the interior surface 34 of the cylindrical honeycomb shell 16. The radial edges of the end plates 28 are formed to provide a sliding fit with the inner surfaces of walls 35 hereinafter described.

The honeycomb shell 16 is formed into a cylinder and secured to a circular rim 35. The cylinder 16, with its end rims 35, is rotatably supported by means of bearings 36 on the flange 24 and hence the honeycomb cylinder 16 is rotatably mounted with respect to the tubular hub 21.
Referring now more particularly to FIG. 2, further details of the honeycomb suction roll will be described. The tubular hub 21 has one or more apertures 37 located in the upper portion thereof and approximately midway between the ends of the tube 21. This passageway provides communication between the interior of the tube 21 and a larger volume bounded by side walls 38 which support flanges 39 and honeycomb air seals 41 running approximately the full length of the honeycomb roll cylinder 16. The honeycomb seals 41 extend to within a few hundredths of an inch of the interior surface 34 of the honeycomb. The angle included between the radial walls 38 may vary and preferably is between 45 and 60 degrees. The walls may be made of any suitable sheet material and re-inforced by spaced gussets 42 secured to the outside of the walls 38 and the outer surface of the tube 21. The walls 38 thus provide an extension of the suction box defined by the interior of the tubular hub 21 and limit the effective suction area to that portion of the honeycomb cylinder 16 which is between the walls 38 and between the adjusted positions of the end plates 28. To facilitate the separation of sheets from the cylindrical surface 16 an air blast is provided just down stream from the effective suction area on the cylinder 16. For this purpose, a cylindrical header 43 runs the entire length of the roll and has spaced along the upper surface thereof a plurality of holes 44 through which jets of high velocity air can issue when the header 43 is connected to a high pressure air supply. The high velocity air jets pass through the honeycomb surface of the cylinder 16 and are thus effective to separate paper sheets from the honeycomb surface.

Referring now to FIG. 4, a plan view of a typical honeycomb structure is shown. In the formation of the honeycomb cylinder 16 material such as stainless steel of approximately .005 inch in thickness is used to fabricate the honeycomb. With honeycomb cells approximately 1/4 inch on centers, a surface which has openings in excess of 90 percent of its area is obtained. At the same time such a surface has a mechanical strength which is far in excess of that which would be obtained from a mere perforated sheet of the same weight and substantially better than could be obtained with a perforated sheet having the same high percentage of suction area relative to the remaining structural web. The cylinder 16 is formed on a mandrel to obtain a substantially accurate interior cylindrical surface 34 and the outer surface 16 is grooved so that the honeycomb is still on the mandrel. The honeycomb sealing segments 33 and strips 41 are also ground to conform to the inner cylindrical surface 34 to permit a close spacing between the stationary and rotating elements. With a spacing of approximately 1/8 of an inch between the stationary and rotating portions of the honeycomb, a good air seal is obtained due to the turbulence induced in air flow through the clearance between the elements by the successive cells of the honeycomb in the sealing elements.

Referring now to FIG. 5 an alternative construction of the honeycomb suction roll is shown in which both positive and negative pressure are employed. For this purpose three radial walls 51, 52 and 53 are secured to the outer surface of the tubular hub 54. Each of the radial walls 51–53 has honeycomb sealing strips 56 fastened to the plurality of holes 45 previously described in connection with FIG. 2. The wall 52 may have a somewhat wider strip 55 than the other walls require since differential positive and negative pressure across the wall 52 is higher than the pressure differential to atmosphere which is effective across the walls 51 and 53. This differential pressure is supplied from the tubular hub 54 which has a central dividing wall 56 and separate apertures 57 and 58 into the respective sector chambers defined between walls 51 and 52 and between walls 52 and 53. The opposite halves of the tubular hub 54 are supplied respectively with positive and negative pressure such that one of the sectors operates as a suction box similar to that described between the walls 38 of FIG. 2. The other chamber, however, receives positive pressure from the portion of the tubular hub 54 to which it is in communication and this positive pressure supplies a leading edge suction air flow through the honeycomb cylinder 16. This outward large volume flow may be used to replace the high velocity jet flow supplied by the header 43 in FIG. 2 and may be useful in connection with heavy papers or when cutting multiple sheets, for example.

In FIG. 6 an embodiment of the invention similar to that previously described is shown with the addition of a stationary suction box 61. The box 61 is positioned above the effective suction area on the cylinder 16 and has a perforate curved bottom surface 62. The sheets 12 pass between the surface 62 and the cylinder 16 with the sheet held in contact with the cylinder 16 by a greater suction force than applied to the sheet from the box 61. The top surface of the sheet is thus cleaned by the air flow over the upper surface of the sheet into the perforate surface 62. In order to obtain adequate suction with reasonable volume flow, an imperforate central section 63 for the bottom wall of the box 61 may be employed. Contacting or laminar air seals 64 may also be employed at the edges of the box 61. In the device herein disclosed, the honeycomb cylinder 16 may be driven by any suitable means to rotate at a speed of the paper sheets being cut. By means of rotating the lead screws 25, the two end plate sectors 28 can be positioned to correspond to the edge of the paper passing through the machine and since the end plates 28 can be independently positioned, the effective suction area of the roll can be accommodated to paper passing through the machine off center relative to the transverse dimension of the roll. When it is desired to apply the maximum control force to the paper sheets, the suction area is increased to a limited extent by reversing the direction in which the flanges 39 and the sealing strips 41 supported thereby extend. This is shown in FIG. 1 where the flanges 41 extend toward each other while in FIG. 2 they are shown extending in the opposite directions.

While particular embodiments of the invention have been disclosed, it will be apparent that modifications may be made in the structure without departing from the invention which is to be limited only by the scope of the appended claims.

I claim:

1. A sheet cutting, cleaning and transporting system comprising means for cutting a continuously running web transversely to form sheets having leading and trailing edges, a vacuum roll adjacent the cutting means to receive the leading edge of cut sheets, transporting means for transporting the cut sheets away from said roll having an input flow path on the side of said vacuum roll opposite said cutting means for receiving the leading edge of said sheets after said leading edge passes over said vacuum roll, said vacuum roll having control cut sheets while delivering them to said transported means, suction means within said vacuum roll for producing inward suction across the portion of said roll over which the cut sheets pass, said vacuum roll having a perforate surface entirely across the transverse dimension of said sheets to produce suction air flow across said leading and trailing edges of said sheets for removing
5 dust therefrom, and means for disengaging said leading edge from said vacuum roll for engagement with said transporting means.

2. Apparatus according to claim 1 and including means for adjusting the effective suction width of said vacuum roll to produce suction airflow across the edges of said sheets for removing dust therefrom.

3. Apparatus according to claim 1 in which the means for disengaging said leading edge includes air pressure means located inside said vacuum roll extending substantially the full width of said roll for directing an air jet upwardly through said roll to lift said sheets off said roll and onto said transporting means.

4. Apparatus for cutting a continuous web into sheets, for transporting the same, and for simultaneously cleaning the leading and trailing edges of said cut sheets, comprising: means for cutting said web transversely at successively spaced intervals to form sheets having freshly cut leading and trailing edges; means in direct sequence with said sheets following said cutter for cleaning the leading and trailing edges of said respective sheets while guiding the path and controlling the throughput speed thereof including a roll having a substantially completely perforated surface adapted to expose substantially the entire length of said leading and trailing edges to air flow into and out of said roll, means for rotating said roll at a predetermined peripheral speed, means for feeding sheets to said roll, means for temporarily holding said sheets in contact with said roll, and means associated with said roll for directing forced air flow through the surface of said roll across the leading and trailing edges of said sheets; and means for releasing said sheets from said roll and guiding the same to a delivery point including means for directing air under pressure outwardly through the surface of said roll at a point following the point at which said paper is held in contact with said roll.

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