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**CLEANING AND TENSION CONTROL SYSTEMS
FOR PAPER AND OTHER PRODUCTS****Frederic J. Bruno, Chicago, Ill., assignor to Oxy-Dry
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New York****Filed Dec. 27, 1956, Ser. No. 630,977****12 Claims. (Cl. 15—306)**

This invention relates to a cleaning and tension control system for paper and other sheet material products and more particularly concerns novel and improved apparatus for removing dirt, fiber particles and other foreign matter from sheet material products such as paper, die cut carton blanks and the like and for controlling the tension on such materials.

Numerous devices have been proposed for cleaning cartons to remove dust and other particles accumulating thereon during the course of manufacture. However, these prior proposals have not been found entirely satisfactory for a number of reasons, the more important including inefficiency of operation, relatively high cost of manufacture and relatively slow speeds of operation. As a result, the use of manual brushing and cleaning methods has been necessary in order to insure more effective cleaning, particularly in the manufacture of cartons for packaging foods and other similar products.

Accordingly one object of the invention resides in the provision of improved apparatus for cleaning sheet material products that is characterized by its simplicity, effectiveness and relatively low cost.

Another object of the invention resides in the provision of improved carton and paper cleaning apparatus which will effectively remove dust and other particles of matter from cartons, sheet material and the like and may be used in conjunction with other paper processing apparatus functioning at normal operating speeds. For instance, apparatus in accordance with the invention can be employed in the feed travel of a machine for waxing or glueing or may be in the form of a separate device with feeding and delivering means for die cut blanks or cartons.

Still another object of the invention resides in novel and improved apparatus utilizing both positive and negative air pressures cooperating to produce turbulent air flow on the surfaces being cleaned to more effectively clean such surfaces.

A still further object of the invention resides in a novel and improved apparatus for controlling the tension on continuous web and sheet materials which will at the same time function to clean the surfaces of the material.

The above and other objects and advantages of the invention will become more apparent from the following description and accompanying drawings forming part of this application.

In the drawings:

FIGURE 1 is a perspective view of one embodiment of the invention in partial section for cleaning die cut blanks of paper and other materials;

FIGURE 2 is an enlarged cross sectional view of FIGURE 1 taken along the line 2—2 thereof;

FIGURE 3 is a cross sectional view of FIGURE 2 taken along the line 3—3 thereof; and

FIGURE 4 is a cross sectional view of still another embodiment of the invention.

For the purposes of this application the invention will be described for use with paper and paper products, though it is to be understood that it is readily adaptable for use with other types of sheet material for both cleaning as well as tension-control. In the fabrication of die cut blanks of paper and like materials, fibrous particles of paper, dirt, dust and other foreign matter adhere to both surfaces of the blanks in such a manner that it can

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be effectively removed only by manual brushing and fanning procedures. This invention enables thorough cleaning of one or both surfaces of a sheet material at the relatively high speeds normally used in processing operations. In addition, a high degree of tension control of sheet materials is attainable with this invention and affords a stable, dependable procedure that will not damage or otherwise affect the material itself.

Referring to the drawings and more specifically to FIGURES 1, 2 and 3, which illustrate one embodiment of the invention for cleaning die cut blanks of paper board for boxes and other purposes, the apparatus generally denoted by the numeral 10 includes a pair of base plates 11 and 12 supported by a suitable frame not shown. These plates serve to guide the die cut blanks A through the cleaning devices generally denoted by the numerals 13 and 14. The guide plates may include side guides or flanges and the blanks are preferably moved through the apparatus by resilient feed rollers 15 and 16 carried by driven shafts 17 and 18, respectively.

It has been found that in the manufacture of paper and other products, dust, paper particles and the like adhere to the paper products with such tenacity that the products cannot be cleaned satisfactorily with known procedures using air pressure and vacuum. Moreover these prior procedures required relatively slow speeds of operation and therefore cannot be used in the feed travel of other processing apparatus.

Cleaning in accordance with the present invention is carried out by means of the improved air pressure and vacuum devices 13 and 14 embodying an arrangement of elements that can be manufactured at relatively low cost and that produce a highly turbulent air flow on the surfaces being cleaned to effectively remove and carry away dust and other foreign matter adhering to the surfaces. In addition, electronic means are preferably employed in advance of the cleaning devices to neutralize static charges on the surfaces being cleaned as well as the dust or fiber particles adhering thereto thereby facilitating the cleaning operation.

The electronic static neutralizing apparatus is in the form of a pair of elongated tubes 19 and 20 disposed above and below the blanks A being cleaned, the guide member 11 being provided with a transverse opening to expose the underside of the blank A to the tube 20. Each tube is preferably formed of an outer tubular member 21 of glass or other suitable material and an inner electrode 22 of metal or other conductive material. The electrode 22 is sealed in the tube 21 and the tube is filled with a gas that upon application of a high potential on the electrode 22 will generate ultra violet light. If desired, suitable fluorescent coatings may be used to achieve the same ends. The application of this high potential preferably in the form of an alternating current between the electrodes 22 and the frame of the apparatus neutralizes the static charges on the surface and the particles and facilitates removal of the particles by the cleaning unit.

The upper and lower cleaning units 13 and 14 are identical and therefore only the upper unit 13 will be described. It comprises essentially an elongated outer housing 23 having four elongated chambers 24, 25, 26 and 27. Air pressure is applied to the chamber 24 through a hose 28 coupled with an inlet conduit 29. The air entering chamber 24 passes into the chamber 25 through a relatively narrow elongated opening 30. The compressed air is discharged from the chamber 25 through a plurality of fine ports 31 formed by the externally threaded elongated member 32 carried by the housing wall 33 and bearing against the edge of the lower wall 34 of the chamber 25. The threads are preferably standard SAE threads and form a plurality of high

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velocity ports which produce considerable turbulence of the air or other gas emanating therefrom and direct the streams emanating from the ports obliquely on the surface being cleaned. In addition, since at least the bottom half of the rod or member 32 has threads or grooves, they not only produce inclined jets but also enable the gas or air to flow readily over the material surface and effectively clean the material.

In operation, the blanks A pass immediately beneath the ports 31 as shown in FIGURES 1 and 2 so that the dust and other particles of matter are forcibly loosened from the surface of the blank. The loosened particles are then removed from the blanks by a vacuum system including the chambers 27 and 26. These chambers are connected by an elongated opening 35 and vacuum is applied to the chamber 26 by a vacuum hose 36 connected with the outlet 37. The vacuum port 38 is formed by spacing the lower wall 39 of the chamber 27 from the threaded member 32.

With the foregoing arrangement, the blanks being cleaned are guided past the air pressure and vacuum orifices by the bottom housing walls 34 and 39. By maintaining a relatively small clearance between the cleaning units 13 and 14, the highly turbulent air from the orifices 31 strikes the surfaces of the blanks and together with the dust and other foreign matter, is carried out through the vacuum system. In cases where the cleaning units 13 and 14 are substantially wider than the blanks being cleaned, it may be desirable to utilize adjustable side guides 40 as shown in FIGURES 1 and 3 to insure effective cleaning of the edges of the blanks as well as the central portions thereof.

While the invention was described above in connection with the cleaning of die cut blanks and probably represents one of the more difficult problems of the industry, it is to be understood that it also may be used for cleaning continuous strips of sheet materials of paper, plastic, cloth and the like. Moreover, in addition to the use of the invention for cleaning surfaces of materials, it may also be utilized for tension control of webs. This feature may be observed more clearly in FIGURE 2.

Tension control is attained by adjusting the air pressure and vacuum to obtain the desired friction between the web A and the guiding surfaces 39 of units 13 and 14. By lowering the air pressure and increasing the vacuum the web will be subjected to increased friction when passing between the units 13 and 14. Decreased friction is obtained by decreasing the vacuum or increasing the air pressure or both. Tests have indicated that this tension control system is highly stable and dependable and may be precisely adjusted over wide ranges of tension. If desired, multiple sets of units may be utilized for increased tension or a somewhat modified structure may be used as shown in FIGURE 4.

In FIGURE 4, upper and lower cooperating units 50 and 51 of identical structure are utilized for controlling the tension on the web 52. Each unit comprises an elongated housing 53 of substantially rectangular section and divided into two chambers 54 and 55 by a central well 56. Each unit 50 and 51 is provided with two sets of semi-cylindrical ridges 57, 58 and 59, 60 which function to guide the web 52 between the units. In order to control the tension on the web 52, the heads 50 and 51 are each provided with elongated opening 57' and 59', and communicating with the chambers 54 and 55, respectively. By applying air pressure to chamber 54 through the base 61 connected to inlet 62, the web will be deflected away from the ridges 57, 58 of each unit and cause it to bear more firmly against the sets of ridges 59, 60. As in the case of the embodiment of the invention shown in FIGURES 1 to 3, vacuum is applied to the chambers 55 through vacuum hoses 63 and outlet ports 64 and the vacuum in cooperation with the compressed air controls the tension applied to the web

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52. While the heads 50 and 51 may be positioned in any suitable manner on opposite sides of the web 52, it is preferable to position them to deflect the web in its passage between the heads and thus cause the web to slidably engage each of the ridges 57 through 60.

While only certain embodiments of the invention have been shown and described, it is apparent that modifications, alterations and changes may be made without departing from the true scope and spirit thereof as expressed in the claims.

What is claimed is:

1. Sheet material cleaning and control apparatus comprising means for loosely supporting said material, means having an outer surface with a convex curvature in close proximity to said sheet material for directing a plurality of streams of compressed gas obliquely onto said material, the last said means producing a turbulent gas flow impinging on said material, vacuum means in closely spaced relationship to said stream producing means and substantially coextensive therewith, said streams and vacuum means influencing the position of the material relative thereto as the material is moved past said streams and vacuum means and means maintaining said material in spaced relationship to said stream-producing means and vacuum means.

2. Sheet material cleaning and control apparatus according to claim 1 wherein said stream producing means includes a flat member disposed in substantially parallel relationship to the plane of movement of said material and a substantially circular threaded rod with the outer edges of the threads in contacting relationship with one edge of said member to form a plurality of individual, inclined stream producing jets.

3. Sheet material cleaning and control apparatus according to claim 2 wherein the first said means further includes second stream producing and associated vacuum means disposed in closely spaced parallel relationship to the first said stream producing and vacuum means and on the opposite side of said material with the second stream producing and vacuum means being reversed relative to the first stream producing and vacuum means.

4. A gas pressure and vacuum head comprising an elongated chamber having an elongated opening in at least one wall thereof, an elongated member having a convexly curved threaded surface at least partially closing said opening with the outer edge of said threads bearing against one edge of said opening to form a plurality of discrete inclined orifices, means sealing said member to the other edge of said opening, a second elongated chamber having a slot therein substantially coextensive with the first said opening and in closely spaced parallel relationship thereto, and means for introducing gas under pressure into the first said chamber and for maintaining the pressure in the second chamber below atmospheric pressure.

5. A gas pressure and vacuum head comprising an elongated chamber having at least one substantially flat wall and an elongated slot in said wall, a chamber partitioning member dividing said chamber into two compartments with one edge of said partitioning member in spaced relationship to the plane of said slot, an elongated member having at least a portion of its outer surface convexly curved throughout its length and threads formed in said convexly curved surface, said elongated member being carried by said one edge of said partitioning member with the outer edges of said threads bearing against one edge of said slot and spaced from the other edge of said slot, means for introducing gas under pressure into one of said compartments for discharge through the orifices formed between the threaded member and said one edge of the slot and means for maintaining a negative gas pressure in the other compartment.

6. A gas pressure and vacuum head according to claim 5 wherein each compartment is longitudinally subdivided into two parts connected by an elongated opening.

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7. Apparatus for cleaning sheet-like material comprising means for transporting said material, means for neutralizing electrostatic charges on at least one surface of the material as it is transported, and a surface cleaning head in closely spaced relationship to said material, said head comprising an elongated chamber having at least one substantially flat wall including an elongated slot in said wall, a chamber partitioning member dividing said chamber into two compartments with one edge of said partitioning member in spaced relationship to the plane of said slot, an elongated member having at least a portion of its outer surface convexly curved throughout its length and threads formed in said convexly curved surface, said elongated member being carried by said one edge of said partitioning member with the curved surface portion extending outwardly and the outer edges of said threads bearing against one edge of said slot and spaced from the other edge of said slot, means for introducing gas under pressure into one of said compartments for discharge through the inclined orifices formed between the threaded member and said one edge of the slot and means for maintaining a negative gas pressure in the other compartment, said orifices each producing a highly turbulent flow of gas therethrough impinging on said surface and said negative pressure compartment withdrawing said gas together with the particles on said surface loosened by the action of said neutralizing means and said turbulent gas flow.

8. Apparatus according to claim 7 wherein second neutralizing means and a second cleaning head are disposed adjacent the other surface of said material and said heads are spaced one from the other to receive the material being cleaned therebetween.

9. Tension controlling and cleaning apparatus for sheet material comprising a pair of opposing units spaced one from the other to receive the sheet material therebetween, each of said units including an air pressure chamber having an elongated slot therein, an elongated member having at least a portion of its outer surface convexly curved throughout its length and annular threadlike grooves formed in said convexly curved surface, said elongated member closing said slot with said thread-like grooves engaging one elongated edge of said slot to form a plurality of inclined pressure ports, and a vacuum port in closely adjoining parallel relationship to said air pressure ports, said air pressure and vacuum ports on the adjoining faces of each unit controlling the friction between said material and said unit and removing dirt and other foreign particles carried by the material.

10. Apparatus according to claim 9 wherein said pres-

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sure ports on each unit directly oppose the vacuum ports on the other unit.

11. Apparatus according to claim 9 including ultraviolet light generating means positioned in close proximity to the sheet material being cleaned for neutralizing the static charges on the sheet material preparatory to the cleaning operation.

12. Apparatus for cleaning sheet-like material comprising means for transporting said material, ultraviolet light generator means positioned in close proximity to one of the surfaces being cleaned, slot means in said transporting means cooperating with a second ultraviolet generator means positioned in close proximity to the other surface to be cleaned, tension controlling and cleaning means adjacent said ultraviolet light generator means having an outer surface with a convex curvature in close proximity to said sheet material and including means for directing a plurality of streams of compressed gas obliquely onto said material, the last said means producing a turbulent gas flow impinging on said material, vacuum means in closely spaced relationship to said stream producing means and substantially coextensive therewith, said streams and vacuum means influencing the position of the material relative thereto as the material is moved past said streams and vacuum means.

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