Aug. 21, 1934. A. GERARD ET AL 1,970,742

METHOD OF MAKING FIBER PRODUCTS

Original Filed May 9, 1928 2 Sheets-Sheet 1

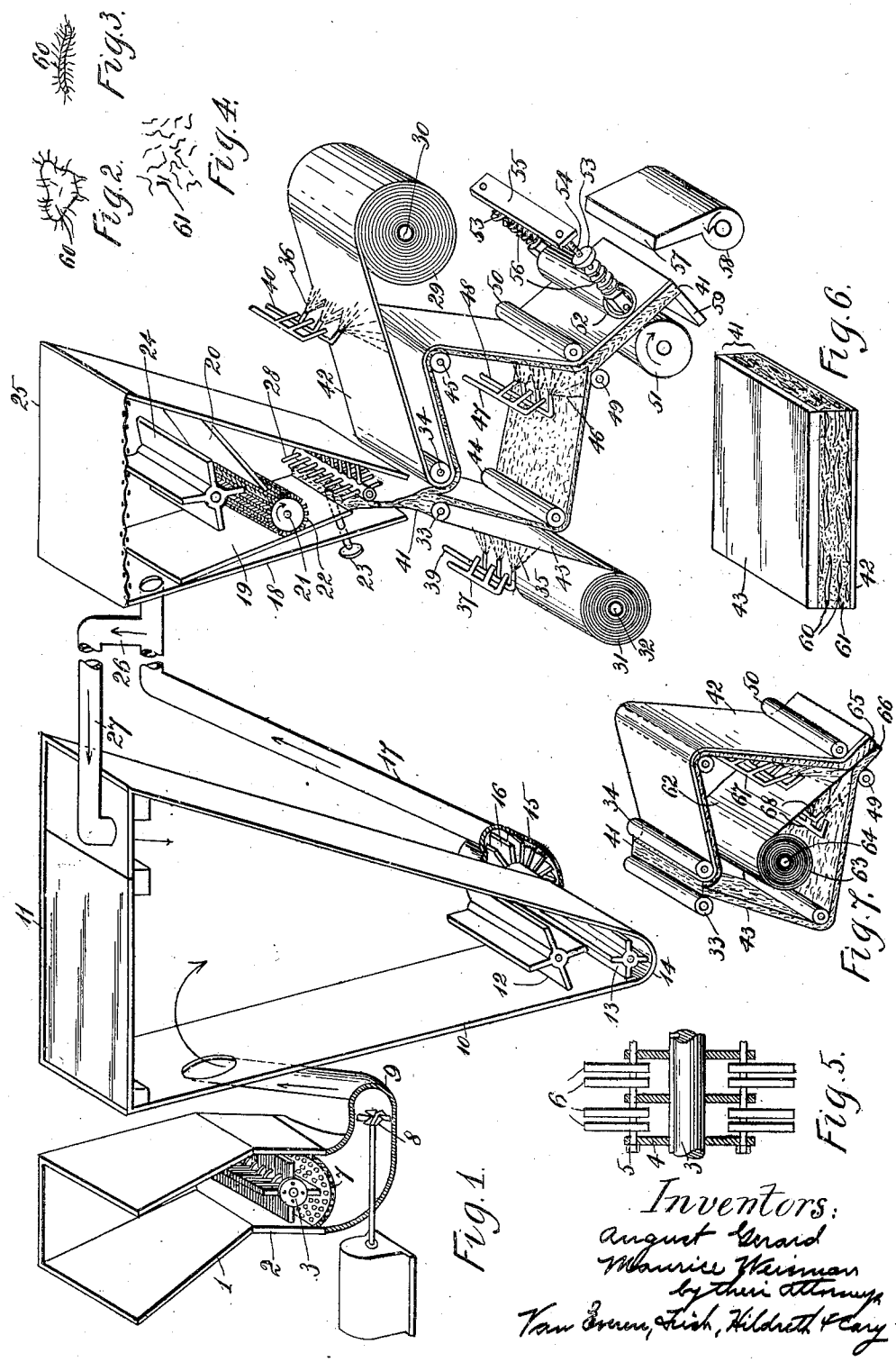


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

Inventors:
August Gerard
Maurice Waisman
by their Attorneys
Van Benum, Lush, Kildreth & Cary

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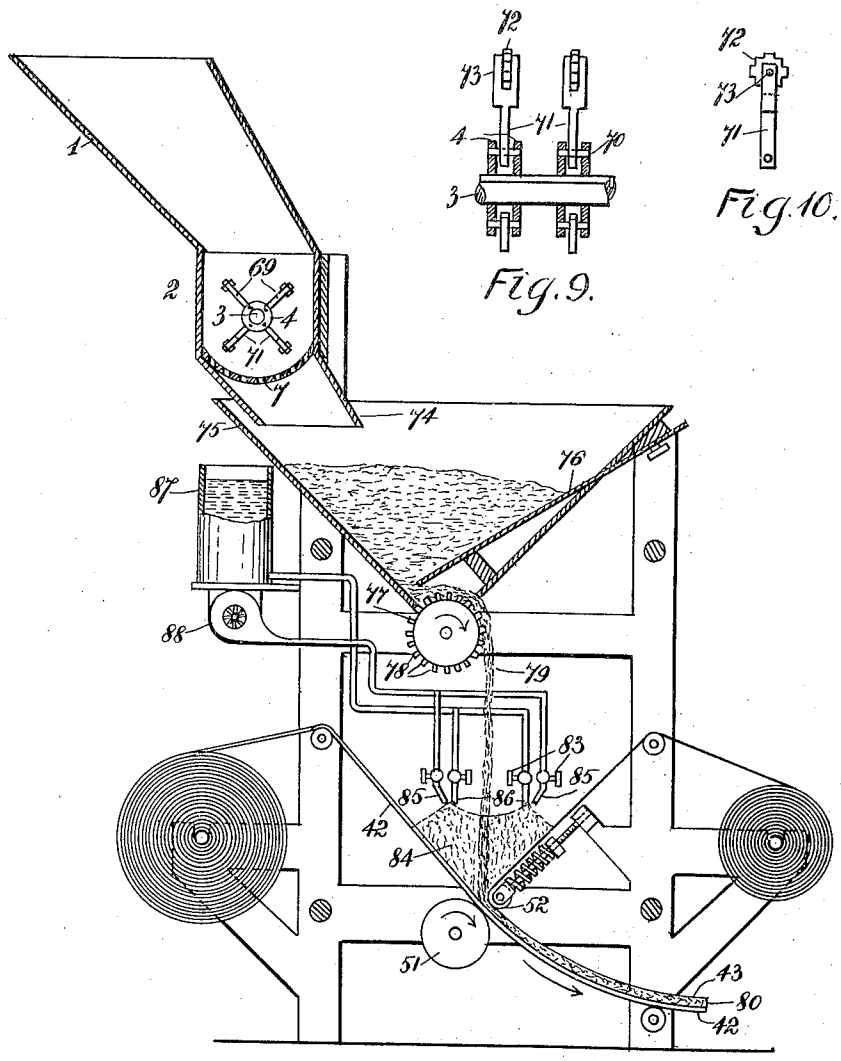



Fig. 8.




Fig. 9.




Fig. 10.

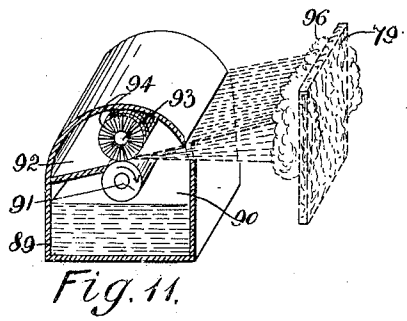



Fig. 11.

Inventors:
August Gerard
Maurice Waisman
by their attorneys
Van Everen, Fish, Kilbourn & Cary

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# UNITED STATES PATENT OFFICE

1,970,742

## METHOD OF MAKING FIBER PRODUCTS

August Gerard, Reading, and Maurice Weisman, Brighton, Mass., assignors, by direct and mesne assignments, to Cotton-Wood Products, Inc., Reading, Mass., a corporation of Massachusetts

Original application May 9, 1928, Serial No. 276,303. Divided and this application March 23, 1931, Serial No. 524,514

5 Claims. (Cl. 154—33)

This invention relates to fiber products having cushioning or insulating characteristics, and to methods and machines for making such products. This application is a division of our copending application Serial No. 276,303, filed May 9, 1928.

One object of the invention is to produce cushioned pads for use in the covers of candy boxes and the like.

Heretofore, efforts have been made to manufacture cushion pads, and the like, from wood pulp fiber in a simple and inexpensive manner, but difficulties have been experienced in making an adequate, coherent and rugged pad, owing to the short lengths of the fibers and the difficulties of joining the fibers together in such a manner as to produce the desired resiliency.

An object of the present invention is to overcome these difficulties and to provide an efficient, durable and easily constructed cushioned pad or insulating product of much lower cost than that of the usual cushioned products now available.

Another object is to make out of waste paper or similar fibrous material, cushioning or insulating products adapted for use as cushioned pads, thermal insulation, acoustical insulation, packing, sheathing paper and related uses.

In accordance with one aspect of the present invention, old newspapers or other waste papers, or similar materials hereinafter referred to as paper, are beaten while dry, into relatively small particles consisting of separate fibers of substantially completely disintegrated paper and of small flakes of incompletely disintegrated paper having a greater maximum length than that of said fibers. These particles are produced in such proportions that when thoroughly intermingled, the fibers form a soft wadding between the flakes, and the resulting combination consists of flakes dispersed throughout the soft wadding in interlocking relationship therewith.

A laminated product having cushioning and insulating characteristics may be made by depositing a cementitious material on one surface of a piece of sheet fabric, depositing the above referred to flakes and fibers as a cushioning layer on the resulting cementitious surface, and pressing the particles so deposited into cementing relationship with the fabric.

In one species of the invention, the cushioning particles are deposited as a stream between two confluent sheets of fabric having cementitious material on their inner surfaces, thereby producing a cushion layer between the two fabric layers. The resulting laminations are then split medially of the intermediate cushioning layer to produce two separate laminated sheets, each having a fabric layer and a cushioning layer cemented thereto. The cleavage surfaces, exposed by the fissure in the cushioning layer, are given a deposit of minute droplets of cementitious material and are then restored into face to face contact and cemented together.

These and other objects and features of the invention will be understood more clearly from the following detailed description in connection with the appended drawings, in which Fig. 1 is a schematic perspective view of one form of apparatus adapted for making the product of the present invention, the front sides of portions of the apparatus being removed to expose to view the interior thereof, and portions being shown in cross-section; Fig. 2 is an enlarged plan view of a typical fibrous flake produced by disintegration of dry paper; Fig. 3 is an enlarged cross-sectional view of the flake of Fig. 2; Fig. 4 is an enlarged view showing a plurality of separate fibers of substantially completely disintegrated paper; Fig. 5 shows on a larger scale an axial section of a portion of the disintegrator rotor of Fig. 1; Fig. 6 is an enlarged perspective view of a finished cushioned pad or insulating product; Fig. 7 is a perspective view showing a modification of a portion of Fig. 1 adapted to provide a fabric layer between two cushioning or insulating layers; Fig. 8 is an elevation of a different type of machine from that of Fig. 1, portions of the machine being shown in section, and the front frame of the machine being removed in order more clearly to expose to view the details of the machine; Fig. 9 shows on a larger scale an axial section of the disintegrator rotor of Fig. 8; Fig. 10 is a side view of one of the hammers shown in Fig. 9; and Fig. 11 is a perspective view of a modification of apparatus for producing droplets of cementitious material.

Referring to Fig. 1, paper such as waste paper and particularly old newspapers or other fabric of similar character, is deposited while substantially dry into the receiving hopper 1, from which the paper feeds to the disintegrator 2 of the beater type, having the rotor shaft 3 upon which are mounted the radial disks 4 keyed fast to the shaft. Bolts 5 mounted in equally spaced relation near the periphery of disks 4 support the metal hammers 6, preferably of rectangular block shape, which are free to swing independently of each other on bolts 5, as an axis, and are preferably

made of wear resisting material such as cold rolled or hardened steel for example.

Shaft 3 is rotated at high speed by any suitable source of power not shown, the speed being preferably several thousand revolutions a minute so that hammers 6 tend to assume positions radial to shaft 3 as a result of the centrifugal force. The rapid rotation of rotor 3 disintegrates the paper by beating it and tearing it into relatively small fragments consisting of flakes 60 such as shown in Figs. 2 and 3, and separate fibers 61, Fig. 4. The flakes ordinarily have numerous small partially freed fibers extending therefrom, as shown in Figs. 2 and 3. The separate fibers 61, shown in Fig. 4, consist of substantially completely disintegrated paper, and are so short that they do not combine with each other with very appreciable coherency when intermingled with each other.

The separate fibers and all the flakes below a predetermined size are selected by sifting them through the screen 7 in the base of the disintegrator. The openings through screen 7 are so chosen that the flakes passing therethrough are relatively small, but have a maximum length greater than that of the fibers 61. In an actual practical case, it was found that numerous flakes of average size had a maximum length of from one-eighth to three-sixteenths of an inch, but it is to be understood that this illustration is given merely as an example of workable sizes of flakes, and that the flakes may be varied somewhat from these sizes, depending upon the character of the paper used and of the desired product. The passage through the screen is facilitated by the churning action within the disintegrator and by the suction produced by the motor driven fan 8 which blows the air together with the sifted particles floating thereon through conduit 9 in the direction shown by the arrowed line, the particles being discharged into the large storage hopper 10 which may have the glass top section 11 for inspecting the contents of the hopper.

Paddle wheel 12, located near the lower part of hopper 10, rotates to mingle the particles in the hopper, and aids their movement toward paddle wheel 13 which slowly rotates to periodically discharge definite quantities of the particles into the trough-like conduit 14 connecting with conduit 15 discharging into the rotating fan blower 16 which draws a strong current of air through conduits 14 and 15 and then blows it into conduit 17 in the direction indicated by the arrowed line.

The particles of disintegrated paper float along with the air stream into conduit 17 and are discharged into the upper part of hopper 18 which has the inner walls 19 and 20 converging toward each other. The opening between the lower ends of walls 19 and 20 is substantially closed by the feed roll 21 which slowly rotates in a counterclockwise direction and has a multiplicity of short projecting teeth 22 extending from the periphery thereof to engage the particles in the hopper and feed them as a stream down the inner wall 19. The thickness of this stream is controlled by rotation of the hand screw 23 threaded into the outer wall of hopper 18, thereby adjusting the position of wall 19 relatively to feed roll 21. Paddle wheel 24, placed closely above roller 21, rotates to churn the particles in hopper 18 and aids the movement of the particles toward roller 21.

Air entering hopper 18 from conduit 17 discharges through the coarsely woven cover 25 of burlap or other suitable material, adapted to prevent escape of the particles. When the hopper becomes completely filled, the right hand end of conduit 17 is closed by the accumulation of particles therein, and the current of air and particles is automatically shunted away from hopper 18 through the upright conduit 26 which discharges through conduit 27 into the top of hopper 10, thus preventing the production of excessive pressure within hopper 18, and tending to maintain a uniform stream of particles from roller 21. As long as the passageway into hopper 18 remains clear, the stream of particles from conduit 17 sweeps into the hopper without appreciable loss through conduits 26 and 27. A rapidly rotating toothed wheel 28 near the discharge end of hopper 18 thoroughly intermingles the particles as they leave the hopper.

A roll 29 of relatively thick flexible sheet fabric 42, such as paper, rotates on shaft 30, and a roll 31 of relatively thin flexible sheet fabric 43, such as paper, rotates on shaft 32. The two-sheet strips 42 and 43 progressively advance longitudinally over freely rotatable rollers 33 and 34. A deposit of cementitious material such as shellac, sodium silicate, glue, or other suitable material, preferably in thin liquid form to facilitate the production of minute droplets, is deposited on the inner surfaces of the sheets. The sprays 35 and 36, produced by the banks of nozzles 37 and 38, directing atomizing blasts of air past the nozzles 39 and 40 which discharge cementitious material, may be employed for producing the deposit of cementitious material on sheets 42 and 43.

The particles discharged as a stream 41 from hopper 18 fall freely through the air and are deposited as a soft cushioning layer on and between the confluent sheets 42 and 43. The particles in layer 41 adhere as a coating to the sheets 42 and 43 and the combined laminations pass between rollers 33 and 34. The beating of the dry paper, in conjunction with the selection of the particles by screen 7, produces such a quantity of separate fibers 61, Fig. 4, as to form a soft wadding between flakes 60, Figs. 2 and 3, when thoroughly mingled together, as in stream 41.

It has been found desirable in many cases to so position rollers 33 and 34 in relation to stream 41 that the particles fall more directly upon sheet 43 than upon sheet 42, or so that the particles are first carried on sheet 43 by first adhering thereto. The particles deposited upon sheet 43 then feed into cementing contact with sheet 42 between rollers 33 and 34. It will be noted in Fig. 1 that stream 41 is shifted slightly to one side of the gap between rollers 33 and 34 so that the particles fall more directly toward sheet 43 than sheet 42.

The cushioning layer 41, after passing between rollers 33 and 34 is split medially of the layer by feeding sheets 42 and 43 away from each other over freely rotatable rollers 44 and 45, the sheets 42 and 43 being then converged toward each other again. The cleavage surfaces of the fissure produced in layer 41 are then given a deposit of minute cementitious droplets by the sprays or clouds of droplets 46 produced by a bank of nozzles 47 directing blasts of air past nozzles 48, discharging cementitious material. The two sections of layer 41 are then restored into face to face contact with each other by feeding the combined laminations between freely rotatable rollers 49 and 50. Driving rolls 51 and 52 progressively advance sheets 42 and 43 with layer 41 therebetween, and temporarily

compress the cushioned laminations to facilitate the cementing of the particles and layers. The pressure of roll 52 toward roll 53 is controlled by rotation of nuts 53 threaded on screw bolts 54 fast to the frame 55. Nuts 53 vary the compression of helical spring 56, pressing on the bearings of roller 52.

The shear blade 57 rotating on shaft 58 in a counter-clockwise direction cooperates with the fixed shear blade 59 to cut the finished cushioned product into pieces of desired length, a sample of such a piece being shown in Fig. 6. It will be noted that the sheet 42 is represented in Fig. 1 as being appreciably thicker than sheet 43, but it is to be understood that the thickness of either sheet may be varied between wide limits according to the desired use of the finished product.

In Fig. 6, the flakes 60 will be seen to be interlocking or dovetailed relationship with each other. The separate fibers 61 form soft wadding between the flakes and are locked in place by flakes 60, as well as by the cementing bond with the sheets 42 and 43, and between the particles in the vicinity of the sheets and of the cleavage surfaces of the fissure in layer 41. The beating, churning, and mingling of the dry particles tend to produce curls and kinks therein, thus improving their cushioning and interlocking characteristics.

Owing to the different sizes, shapes, and positions of the particles making up cushioning layer 41, and the method by which the cementitious material is applied to the particles, portions only of the cementable parts of the particles are bonded together and as a result, the particles are free to bend and slide on one another between their cemented portions so that the desired cushioning characteristics may be obtained. The loose cellular structure between the uncemented portions of the particles, in view of the low thermal conductivity of the material of the particles, provides relatively high thermal insulation. By leaving portions of the particles uncemented, the natural springiness of the particles is preserved to a large extent, and an efficient and durable cushioning and insulating product is produced. The cushioned pad of Fig. 6 has been found to be particularly adapted for use in the paper box industry, especially in making the cushioned tops of candy boxes, and is also useful as a sheathing paper and as insulation against the transmission of sounds and heat or cold, or for packing. The method of making the cushioned product is simple and of low cost, while the materials employed are readily obtainable in large quantities at low cost in comparison with other available materials.

After splitting the cushion layer 41, the resulting laminated units consisting of sheets 42 and 43 respectively, with their adhered cushioned layers, may be separately utilized, similarly to the product shown in Fig. 6, without cementing the laminations together between rollers 49, 50, 51 and 52.

Instead of cementing the particles in stream 41 to sheets 42 and 43, they may be discharged from hopper 18 and used in bulk for cushioning and insulating purposes, the flakes 60 functioning similarly to those shown in Fig. 6.

Fig. 7 shows a modification of the machine of Fig. 1 between rollers 33 and 34, and rollers 49 and 50, the third sheet 62 of flexible fabric such as paper, being fed from roll 63, free to rotate on shaft 64. Sheet 62 feeds between the cleavage surfaces of the fissure produced in layer 41, thereby producing a bonding element between the two sections 65 and 66 of the cushioning layer.

Banks of spraying nozzles 67 and 68 respectively, deposit cementitious material on the cleavage surfaces of layer 41 and at the same time on the two surfaces of sheet 62, so that the combined laminations passing between rollers 49 and 50 are cemented together as a single unit. The resulting product possessed greater strength than that of Fig. 6, and may be used similarly thereto.

The machine of Fig. 8 has the input hopper 1, into which is placed the dry paper to be disintegrated. The disintegrator 2 has a rotor 69 constructed somewhat differently from that shown in Fig. 1. The shaft 3 has the radial disk 4 keyed fast thereto, Fig. 9. Pairs of disks 4 support the fixed shafts 70 upon which are freely swivelled the arms 71 having bifurcated outer ends. Between each pair of ends is supported the notched hammer disks 72 freely rotatable on pivots 73.

The paper is disintegrated by high speed rotation of rotor 69 and particles below a predetermined small size, driven by the churning action of rotor 69, discharge through conduit 74, into hopper 75 having the inner wall 76. Disintegrated particles, consisting of flakes and fibers, discharge through the gap between the lower end of wall 76 and the wall of hopper 75, and are deposited on the top of feed roll 77 having the small projecting teeth 78. Roll 77 rotates slowly, as shown by the arrow, and feeds a loose stream of particles 79 from the hopper, allowing the particles to fall freely through the air in more or less spaced apart relationship into the bottom of the V-shaped trough formed by the sheets 42 and 43, of flexible fabric, such as the paper in sheets 42 and 43, Fig. 1. The sheets 42 and 43 feed longitudinally into confluency between driving rollers 51 and 52. The particles in stream 27 feed through a fog-like cloud 84 of cementitious droplets formed by nozzles 85 discharging compressed air from blower 88, past nozzles 86, which discharge cementitious material from the reservoir 87.

A valve 83 for each of the nozzles 85 and 86 is adjusted so that the cementitious liquid is very finely divided into droplets which tend to float on the air as a fog-like cloud and become deposited on the particles in stream 79 passing therethrough. By making the droplets very fine, a cementitious deposit can be produced with less blowing of the particles from their proper positions in stream 79 than when the spray is deposited with force on the freely falling particles. An advantage of this method of applying the cement to the particles in stream 79 is that the cement tends to deposit in spaced-apart relationship on the particles so that portions only of their cementable parts eventually become cemented together. At the same time, sheets 42 and 43, which confine the droplets in cloud 84 to the region of stream 79, receive a deposit of cementitious material.

The particles in stream 79 are brought together between sheets 42 and 43 and form the cushioning layer 80. The pressure of roll 52 toward roll 53 aids the cementing of the particles, and of the layer 80 to sheets 42 and 43, thus producing an efficient cushioning or insulating unit.

Fig. 11 shows a form of apparatus adapted for producing and depositing minute cementitious droplets, and particularly for depositing the droplets on the particles of disintegrated paper in

stream 79, with minimum disturbance to the positions of the particles. The casing 89 is partly filled with the thin liquid cementitious material 90, forming a pool in the lower portion of the casing. A roller 91, dipping tangentially into the liquid 90, rotates in a clockwise direction and carries an adhered coat of the liquid 90 on its periphery. Any excess of the liquid on roller 91 is removed by the wiper 92 which also helps to spread the liquid so that a film of uniform thickness remains on the roller. A shaft 93 rotating at high speed in a counter-clockwise direction, has the bristles or stiff wires 94 extending radially therefrom. The outer ends of bristles 94 brush over the periphery of roller 91 and throw off a spray 95 of minute droplets of the cementitious liquid, these droplets forming a fog-like cloud 96 in the vicinity of stream 79, so that the droplets become deposited on the particles of disintegrated paper, somewhat similarly to a deposit of dew. The apparatus shown in Fig. 11 may obviously be utilized for depositing cementitious material in place of any of the spraying or atomizing apparatus shown in Figs. 1, 7 and 8.

Various modifications of the details described herein as illustrative of the invention will be apparent to those skilled in the art, without departing from the principles disclosed herein. For example, variations may be made in the thickness and character of the fabric or material employed in the backing sheets, or in the number and thickness of layers in the product. Obviously, a finished laminated sheet, such as produced by the method of Fig. 1, 7 or 8, may be fed into the machines in place of sheet 42, thus making additional cushioning layers in the final product to produce a product of greater thickness having greater cushioning and insulating characteristics than that of the product shown in Fig. 6.

No claim is herein made to the product which is claimed in our co-pending application above referred to.

Having thus described the invention, what is claimed is:

1. The method of making a cushioned product from waste paper, which consists in beating the dry paper into substantially free fibers and relatively small flakes of paper having a maximum length greater than that of said free fibers, intermingling said flakes and fibers, depositing said mingled particles as an intermediate layer between a pair of sheets of fabric having a cementitious material deposited on their inner faces, splitting the resulting laminations medially of said intermediate layer, depositing cementitious material on the resulting cleavage surfaces, and pressing said surfaces together in face to face contact with each other.

2. The method of making a cushioned product from waste paper, which consists in disintegrating the paper into relatively small particles, depositing said disintegrated paper as a loose filler between two confluent spaced apart sheets of fabric having sticky cementitious material on their inner faces, producing a medial fissure in said filler layer, depositing droplets of cementitious material on the cleavage surfaces of said fissure, restoring said cleavage surfaces into face to face contact with each other, and pressing said surfaces together.

3. The method of making a fiber product, which consists in floating a continuous stream of fibrous particles on a current of air to a hopper, discharging said particles from said hopper on a progressively longitudinally moving adhesive sheet of fabric to form a uniform cushioning layer thereon, and automatically shunting said stream of particles back to the source when said hopper tends to become overfilled with said particles.

4. A machine for making a cushion fiber product having, in combination, means for beating dry paper to form substantially free fibers and small flakes, means for continuously feeding two sheets of fabric, means for applying a cementitious material to the inner face of at least one sheet of fabric, means adjacent to one of the sheets for agitating the beaten paper to intermingle the fibers and the flakes, and means for thereafter loosely depositing the intermingled flakes and fibers between said sheets.

5. The method of making a cushion product which consists in beating paper while dry to form both partially and completely disintegrated particles in interlocking relationship, agitating the beaten paper to intermingle the particles, applying adhesive to a fabric cover sheet, applying to said sheet a loose layer of said dry beaten paper, and applying to the cushion thus formed a second enclosing sheet.

AUGUST GERARD.
MAURICE WEISMAN.